

The Metamorphosis Project Journal

ATROPHY & AI

MOT Issue
2024



ATROPHY AND AI

The Metamorphosis Project Journal

Issue 01, 2024

Acknowledgements

We acknowledge the many Traditional Custodians of Country throughout Australia and honour their Elders past and present.

We respect their enduring connection to their lands, waterways and surrounding clan groups since time immemorial. We cherish the richness of Aboriginal artistic and cultural expressions. The Metamorphosis Project is located on Whadjuk Noongar Land.

This publication was made possible by a research grant from the Western Australian Academy of Performing Arts at Edith Cowan University.

The Metamorphosis Project

The Metamorphosis Project is an open access research platform that seeks to break down barriers and siloes between disciplines and embrace the Renaissance form of humanistic practice and transdisciplinary creativity.

Details

The Metamorphosis Project
Website themetamorphosisproject.org
Email info@themetamorphosisproject.org



Editorial Team



Jennifer Halton

Founder, Creative
Director & Editor-in-chief

As the Founder and Creative Director of The Metamorphosis Project, Jennifer leads the project's vision, research, and artistic and editorial programming. She holds a PhD in Cultural Musicology and her current research explores the liminality and intersectionality of art, research and social innovation. She is also the Director of Internationalisation at WAAPA, ECU.



Thomas Brady

Art
Director

Thomas Brady is a designer, artist, and researcher with a degree in Architecture from Curtin University. His work emphasizes creating resilient and sustainable urban environments. Passionate about community-led co-design, he explores how collaborative design and novel design communication methodologies can shape city policy for public good.



Clare Reid

Editor for Literature
& Creative Industries

Clare Reid is the newly appointed CEO of Lush, with a background in brand strategy and feature writing. Experienced in communications, she has worked with clients like UWA, Amazon Web Services, and the Aboriginal Cultural Centre. A published writer and workshop leader, Clare holds a Master's degree in Creative Writing.



James Arvanitakis
Editor for Humanities
& Sociology

Professor James Arvanitakis is the renowned Director of the Forrest Research Foundation, promoting early career researchers in Western Australia. A Fulbright alumnus and recipient of multiple awards, including the Prime Minister's University Teacher of the Year, he founded Respectful Disagreements and serves on various boards, including the Perth Festival.



Daniel Giuffre
Editor for
Architecture & Design

Daniel Giuffre is a designer, artist, researcher, and educator at Curtin University with a Master's in Architecture. Co-founder of Intensive Fields, he specializes in generative design and fabrication technologies. Daniel fosters innovation through cross-disciplinary collaborations in public art and architecture and lectures on design, technology, and automation.



Lindsay Vickery
Editor for Music
& Composition

Lindsay Vickery is a composer, performer, and academic whose work explores score presentation, musical structure, and the intersection of electronic and acoustic music. A soloist and collaborator with Decibel New Music, he has toured internationally for 25 years. He co-edited *Actions | Remarks* and teaches at Edith Cowan University.

Atrophy and AI



Shauna Kelly

Editor for
Visual Arts

Shauna Kelly is Coordinator of Administration and Communications at Creative Futures Academy in Ireland. With an MA in Art History from University College Dublin, she has over 10 years' experience in the Arts sector, working for organisations like IMMA, the National Gallery of Ireland, and the World Crafts Council Europe, managing complex, multi-partner projects.



Dennis Power

Editor for
Science

Dennis Power is a synthetic organic chemist with a BSc (Honours) from the University of Western Australia. During his postgraduate studies Dennis spoke on the global stage of TEDx UWA and worked abroad at the prestigious Leibniz Institute for Catalysis in Rostock, Germany. Four years of a PhD exploring nickel catalysis led Dennis to discover his talent for science communications.



Paul Maginn

Editor for People, Place,
Policy and Politics

Associate Professor Paul Maginn is the Director of the UWA Public Policy Institute and coordinates the Administration and Governance stream of the Masters of Public Policy at UWA. An urban planner and geographer, he has co-edited several books, including *Suburbia in the 21st Century* (2022), and is Editor-in-Chief of *Urban Policy and Research*.



Contents

i.	Jennifer Halton Introduction: Atrophy, AI and the Zeitgeist – An (E)motional Perspective	3
01	W.S. Tsang Co-existing with AI: Avoiding Creative Atrophy in the Age of the Anthropocene	11
02	Cara-Ann Simpson Atrophy and Rebirth in Health, Art and AI Journeys (A Reflection)	25
03	Kai Low The Last Celebration	37
04	Lee Yang Yang Death and Life of Architecture in the face of Artificial Intelligence	40
05	Clare Reid The Artist's Process : Unpublished Perfection	46

- 06 **Isaac McCormack**
The Essence of **Human Creativity** in the Age of AI 50
- 07 **Dennis Power**
Thinking **Deep** about Deep **Learning** in the **Chemical Space** 58
- 08 **Ryan Jefferies & Mel Huang**
In Conversation with **The Science Gallery Melbourne** 61
- 09 **Nicole Loeser**
In Conversation with the **Institute for Art & Innovation** (Berlin) 66
- 10 **Justin McGuirk**
In Conversation with **Future Observatory** at the **Design Museum** (London) 73
- 11 **Grace Chuang**
In Conversation with **BioCreative Index** 79

i.

Introduction: Atrophy, AI and the Zeitgeist – **An** **(E)motional Perspective**



Jennifer Halton
Founder
Creative Director
Editor-in-chief

ONE cannot speak of the Zeitgeist of today without reference to artificial intelligence (AI). AI has come to play a significant role in society from health to mass culture since the AI boom in the 1980s, although to the uninitiated neophyte, little has been ubiquitously known about AI's global applications and impact during these decades.

That all changed two years ago with the launch of OpenAI's Chat GPT (November 2022). Almost overnight, AI was transposed from a background technology to the forefront of accessible, everyday usership. Suddenly, the generation of infinite content was placed at the fingertips of the digitally literate citizen, at the drop of a prompt. The theme for Issue One of The Metamorphosis

Project Journal (TMPJ) emerged from a dialogue on this topic. This dialogue involved differing perspectives on how generative AI (gAI) could potentially shape the future of art, creativity and cultural production, and our human relationality with and within these fields. Both perspectives ultimately landed on the broad positives of gAI, but one view veered toward its benign and even banal evolution, seeing it as just another technical tool. While the other view lamented the very real threat of cognitive atrophy presented by the proliferation and adoption of gAI in everyday life. The latter voice in this dialogue was my own. My thoughts morphed into questions which coalesced to form the thematic milieu of the following pages.

Making space for (E)motions

Before delving into the detail of our inaugural theme and how our authors have responded, it is prudent to introduce the concept behind TMPJ and its intended point of difference as a Journal. Each issue of TMPJ will embrace a new theme, voyaging between abstract concepts and salient global issues, inviting established and emerging voices to embark on journeys, meanderings and musings that embody our perceptual experience of the world. In absolute terms, TMPJ is neither a traditional academic Journal, nor a wholly creative one. It occupies the liminal space between research and art, embracing conceptual intersections, multimediated forms, relational dynamics and constructionist inquiry within its epistemological framework. The liminal space between research and art—a transitional, intermedial space—gives rise to a rich terrain of creativity, inviting new experimental forms and imaginative possibilities.

Here, boundaries are fluid, inviting osmotic exchange and theoretical metamorphoses, wherein research becomes art, and art becomes research.

This liminal space can be compared to Maurice Merleau-Ponty's theory of the 'flesh' or 'chiasm' in *The Visible and the Invisible*. In his essay, 'The Intertwining—The Chiasm', the French phenomenologist describes the concept of a chiasm as a permeable and reversible membrane through which we communicate with the world via mediated interrelationships (Merleau-Ponty, 1968). He conceives of this membrane as the flesh—that is, the space between the perceiver and

the perceived/ the subject and object—which functions as a reversible, circular chiasm that both separates and connects the body and the world around it. The flesh exists between visible things (sensible things), and between invisible things, what he calls the flesh of ideas (involving the realm of art, music, literature and the passions). At its core, Merleau-Ponty's ontology of the flesh aims to write the *body* back into the frame of phenomenological philosophy as the locus of consciousness and conscious thought, instilling in the field the primacy of the sensible-sentient body in our perceptual experience of the world. The objects of consciousness (visible and invisible) can only be perceived if they are first felt by or pass through the sensing body. His approach contrasts to that of Husserl and Heidegger who prioritised a transcendental consciousness and the role of the abstract intellect in our 'knowing' of the world.

Just as Merleau-Ponty wrote the body back into phenomenology, Metamorphosis makes space for emotions in intellectual thought, acknowledging that they are important interrogative phenomena in the topography of research and art, and prominent markers of humanness and agency in the mapping of phenomenological experience. While emotions occupy the realm of existentialism, they are, I believe, a conduit for empirical inquiry and an integral part of how we study the world, interpretively and objectively. When examined in an interdisciplinary context between affective science, philosophy and artistic expression, emotions are a useful tool that can guide us as practitioners toward a better, more cooperative model of collaboration and problem solving. Emotions, in many ways, can help us understand ourselves, each other, and our place in the world. They are

Atrophy and AI

not only key indicators of an era's cultural zeitgeist, but they are intrinsically part of the fabric of that zeitgeist. They are part of the Foucauldian power-knowledge systems which drive and shape the *épistémè* characterising our historical moment in time. Emotions in art and in research, correctly channelled and applied, can facilitate the empathetic view required for cohesive, respectful dialogue and cooperation. In this vein, TMPJ upholds the value of empirical and rigorous research, while embracing that which transforms emotion into methodology.

Finally, TMPJ pays homage to Giuliana Bruno's work on the reciprocal and circular connection between movement and emotion. For Bruno (the Emmet Blakeney Gleason Professor of Visual and Environmental Studies at Harvard University), motion produces an emotion, and correlatively, emotion contains a movement (Bruno, 2002). The Latin root of the word emotion implies a moving force, stemming from the verb *emovere*, composed of *movere*, "to move", and *e*, "out". The meaning of emotion then, she writes, is historically associated with movement, migration, transference and place (Bruno, 2002). The application of (e)motion (parenthesis intended) in this Journal acknowledges and interrogates the presence of migrations and transference, real or imagined, embedded in emotional readings of—and encounters with—a text, concept, experience or object. Drawing on examples from screen and media, Bruno sees participants of screen culture not as extraneous voyeurs, removed and separate from the moving image, but as spectator-voyageurs, intrinsically connected to the moving image. Similarly, authors and readers of this Journal are invited to consider what kind of (e)motional journey these pages may

take you on. What is stirred within you as you move through each article and construct relational connections in and between the words and images presented? Bruno's theory of (e)motion favours that which is mobile over static, that which moves, and in turn, moves us. For it is in this fluid state that our minds can bend to the will of the imagination and embrace the unknown. (E)motion moves us into the liminal spaces between research and art.

A Voyage through Atrophy and AI

The acceleration of AI in our postmodern and hyperdigital world brings with it a slew of connotations, possibilities, and associated emotions. Many of these will be positive and offer fertile territory for creative explorations and experiments. But our engagement with AI must also consider the possibility of loss. As with any metamorphosis, there will be a shedding of old skin, and a birth of new forms. GAI, in order to birth new possibilities, will inevitably shed something that is no longer needed, or which can be replaced. One of these redundancies is, ironically, language processing. Human language processing, → that is. If used as a replacement for original and critical thinking, gAI could rapidly reduce our in-built language processors and ability to use the written and spoken word creatively. Language, and creative cognition at large, therefore, are at grave risk of atrophy over the rest of this decade, and the next.

Atrophy: n. Gradual decline in effectiveness or vigour due to underuse or neglect.

Creative thinking engages multiple axes in the

mind, brain and body, resulting in a cognitive process that is network-dependent. Recent research has attested to these collaborative and networked reactions, showing that “the ability to produce novel and useful ideas, or original thinking, is thought to correlate well with unexpected, synchronous activation of several large-scale, dispersed cortical networks”, representing a major evolutionary mechanism that has greatly contributed to the rapid advancement of the human species (Shofty et al., 2022). Within this complex neurophysiological ecology, we can additionally layer the importance of language and emotion, both of which play formative roles in our cognitive and creative functions (Gu et al., 2018). As such, there is a neuro-physiological and neuro-psyche connection between our brain, our body and our behaviour when we engage in creativity. The early ideation phase (which gAI threatens to diminish by becoming an “idea retrieval house”), is a critical part of the creative process, with research showing that when we dare to imagine new worlds—as in daydreaming or transiting a stream of consciousness—the neural network involved in that process (Default Network) communicates with other networks (Salience and Executive Control) to filter and define an idea through to creative expression (Shofty et al., 2022). What might happen to our highly advanced neural ecosystem if the Default Network is atrophied through underuse or neglect? What catalytic affects will this have on other cortical networks and ultimately on our ability to create and express ourselves fluently? In the context of the educational sector for example, policies and frameworks are rapidly adapting to accommodate gAI, recognising its usefulness as an aid or accelerant for teaching and learning (involving multifactorial elements like writing, image making, research and critical thinking). If not adequately regulated and

moderated, gAI will alter, reduce or even replace the organic networked processes involved in creative thinking and ideation, and negate the neural pathways that ignite the very essence of human creativity, resulting in those pathways becoming atrophied over time. This is only one prediction of the many possible futures we face in co-existence with this vast and powerful technology. It is intended as a provocative departure for robust conversation, imagination, visualisation and debate: a provocation that has been imaginatively analysed, argued and counter-argued by the authors represented herein.

TMPJ invited submissions from individuals and teams working at the intersection of art and research with a focus on multidisciplinary practice (in physical or metaphysical forms). It encouraged philosophical critique that takes as its central question the concept of Atrophy (including and beyond neurological applications of the word). Authors were invited to consider Atrophy and AI in both positive (generative) and negative (degenerative) ways, framed by how they see AI in relation to the evolving human condition, and in relation to the exponential and pervasive influence of AI and new technologies in the postmodern world. Authors were asked to consider and interrogate the following questions:

What do we stand to gain by embracing new forms of creative communication, as seen in and led by generative AI?

What other facets and forms of atrophy will we see as we move toward a future mediated by, and co-created with technology?

Can AI, creative technologies, art and research, work together, collaboratively, to prevent the atrophy of human language processing and



Atrophy and AI

creative cognition? Do we want to prevent it? Or is this a natural phase in our post-human evolution?

What do we risk losing, as humans, if our ability to communicate creatively is atrophied?

The articles and conversations that span the pages of this Journal are varied in their perspective, methodology, format and geography, crossing from Australia to the UK, Europe and USA. They each bring unique viewpoints to the theme of Atrophy and AI, from fields of practice as diverse as literature, visual art, architecture, art history, design, composition and music technology, chemical engineering, organic chemistry, social sciences and computer science. This interdisciplinary collection of essays forms a distinctive narrative around the present and future possibilities of AI in art, creativity and cultural production, drawing on discourse from related themes, including climate change, the Anthropocene and more than human design (Tsang, McGuiirk, Loeser); health, big data and ethics (Simpson, Power); social resilience, social anarchy, architecture and built environment (Low, Lee); and artistic process, creative democracy and interdisciplinary design (Reid, McCormack, Chuang, Huang, Jefferies). The Journal is organised around two sections. The first collates creative and literary submissions together under the traditional heading "Articles" although the nomenclature here is fluid and makes space for interchangeable classifications between 'essay', 'article', 'meditations' and 'visualisations'. The second section of this Issue, themed "In Conversation", collates a series of interviews with leading interdisciplinary organisations who operate at the intersection of art and research.

Opening the inaugural Issue of TMPJ, researcher, composer and audio-visual artist, W. Sze Tsang, reflects on the emotional relationship humans have with complex concepts such as AI, Climate Change, and the Anthropocene in their essay 'Co-existing with AI: Avoiding Creative Atrophy in the Age of the Anthropocene'. Due to the intangible and composite nature of these wicked problems (or hyperobjects), they disrupt the equilibrium of our comfort zone and push us to avoid rather than confront the gargantuan impact these crises will have on our lives and communities. These crises are not only ecological in nature, but what Amitav Ghosh calls a "crisis of culture, and thus of the imagination" (p. 13). This phenomenon, Tsang posits, extends to AI with its resonance of monotony culture: a culture reliant on algorithms and coded in human biases. AI, they write, "subsumes human intuition and individual innovations, leaving behind pale, superficial mimics of human-driven work" (p. 13). In a creative experiment, Tsang outlines how they collaborated with a gAI using an innovative and ethical approach to co-design through the creation of a digital twin. Their AI counterpart reflects back to them shared thoughts about climate change, writing that "the climate crisis is not just a scientific issue; it is also a deeply emotional and existential one" (p. 24). Both Tsang and their digital twin respond to the theoretical framework of this Journal, embracing both the scientific and emotional within their rational inquiry. Tsang's approach to AI and cognitive atrophy is a delicate and balanced dance between the sceptical and experimental, and between art and research.

In her autoethnographic essay, 'Atrophy and Rebirth in Health, Art and AI Journeys (A Reflection)', visual artist Cara-Ann Simpson extends the metaphor of cognitive atrophy

to a physiological and neurological one, documenting her very personal experience of atrophy and Multiple Sclerosis. Simpson undergoes her own metamorphosis in and through her journey with health and healing, resulting in the distinct aesthetic of her multisensory art project, *Furari Flores*. Embedding traditional AI into the post-production of her photographic work, Simpson is a long-term proponent of the benefits of AI in the artistic process. She does, however, proceed with caution around gAI, opting to avoid the ethical quagmire of creative integrity, IP ownership and perceptions of taste in the visual arts sector. “What is the role of the artist”, she questions, “when incorporating generative AI into a practice? Do we become an operator, collaborator, co-creator, or user?” (p. 29). With a lack of legislation globally, the rapid development of AI is out of sync with our legal and regulatory systems, making it difficult for artists to protect themselves and their work.

Architect and artist, Kai Low, contributes a visual meditation on the theme of Atrophy and AI. Accompanied by an exegesis, ‘The Last Celebration’, is a digital artwork that responds to the slow decay of civilisation and humanity in a world where techno-anarchism has destabilised the status quo, leading to the atrophy of the “very essence that once defined us” (p. 39). ‘The Last Celebration’ is a work that blurs the boundaries between creation and destruction. It is an evocative and provocative cautionary tale of what could happen if we place too much trust in a technocracy and in machines. Low’s work is reminiscent of the dystopian and hedonistic worlds of artists like Hieronymus Bosch, Luis Buñuel, George Orwell, Stanley Kubrick, Werner Herzog and Max Richter, all of whom have channelled the notion of end times. Like

Orwell’s 1984, so many facets of which have come to pass in the last two decades, one considers which aspects of Low’s work could manifest during our lifetime if we continue along AI’s current growth trajectory? We are already considering AI as an agent (Harari, 2024). Will sentience be next?

Lee Yang Yang presents a similar dystopian future for architecture and the built environment in ‘Death and Life of Architecture in the Face of Artificial Intelligence’. Lee, however, alleviates the reader from the dystopian anxieties of a technocratic, post-human world—a world of superintelligence—by countering this with an alternative, utopian future under the care of a generation of custodians. As we are part of the universe, Lee writes, “perhaps we should see our future role as custodians for everything around us, rather than one of infinite exploitation and consumption” (p. 45). The variables between Lee’s two worlds and the axis on which we will eventually travel, will depend entirely on how we cooperate as global citizens in the face of climate change and technological advancement, avoiding ecological and architectural atrophy, and preserving that which makes us human: creativity.

Departing from the theme of dystopia, writer Clare Reid takes a reflective and introspective approach to the Journal’s theme in her work, ‘The Artist’s Process: Unpublished Perfection’. Reid highlights an important dichotomy in the judgment of taste, wherein artists and spectators alike tend to privilege that which we perceive as refined and complete, over that which is unfinished, messy and imperfect. Our inherent bias for the perfectly complete, Reid proposes, is what will threaten the artist in the age of rapidly evolving AI. “In a time where AI can replicate our finished work

Atrophy and AI

with advancing accuracy”, she writes, “what about the unfinished? The unpublished?” (p. 49). What is the value of literary in-betweens, stream of consciousness, creative flow? Those liminal parts of us that we tend to cut off at the stem, archive into “drafts”, and place on the dusty shelves of forgotten histories; those are the parts that cannot be replicated by AI. Those are the parts that contain the essence of human creativity. Reid argues the motion for subverting the course of literary perfectionism in favour of literary process, and “all the random humanness it evokes” (p. 49).

Artist and Architect, Isaac McCormack, similarly considers those aspects of (human) art that cannot be replaced by AI in his article, ‘The Essence of Human Creativity in the Age of AI’. Examining the role of technology in the arts through collaborating with AI in his work, McCormack uses lived experience of co-design to test if AI signals a new episteme in the evolution of artistic processes, or whether we are indeed stepping into an entirely new frontier in the technological age. When compared with his traditional artistic processes and practice, however, McCormack reflects that collaborating with gAI does not stack up to the depth of emotional, intellectual and creative engagement he experiences with non-generative digital tools. “While AI enables rapid visualization, the lengthy, introspective process behind *City 4* allowed for a deeper, more profound influence on both the work and my own development as an artist” (p. 53). His artistic projects are interwoven with themes of cultural heritage, urbanism and place. They simultaneously reflect, and are reflected in, his personal identity. This is a profoundly human experience of transference and emotional exchange that AI cannot yet simulate, and perhaps never will. McCormack proceeds to address other issues surrounding

AI such as ethics, craftsmanship, creative democratisation and mass reproduction. Echoing Clare Reid’s analogy of “unpublished perfection”, he deftly reminds us that “the works that touch us most remain those that “reveal the imperfections and unique perspectives of the human hand” (P. 56).

The final essay in the first section of this Issue comes from scientist and writer, Dennis Power. ‘Thinking Deep about Deep Learning in the Chemical Space’ takes an optimistic stance on AI, arguing for its application within science as a catalyst for technological progress over cognitive atrophy. AI’s aptitude in processing big data has transformed the fields of chemical engineering and drug discovery. AI algorithms are capable of the heavy lifting and data crunching that “we humble humans”, to quote Power, simply can’t achieve in one lifetime (p. 59). AI’s distinct advantage, Power notes, is that while it is busily engaged in deep learning, scientists are freed from their lab coats to engage in the creative side of scientific enquiry, returning to their roots as “curious explorers in a world of unknowns” (p. 60). Moreover, Power predicts that AI’s role in identifying and isolating reliable data will lead to greater collaboration in the scientific community, prompting researchers to share negative results through transparent open access, allowing scientists to subsequently identify and bridge major knowledge gaps. Power’s perusal of the theme is a fitting way to end this section, for it sits as an ode to the positive applications and benefits of AI in the process of human discovery in ways that can truly transform society and our health systems. In the author’s words, “AI offers tantalising promises of saved time, money, and resources for tackling our most pressing problems while giving us opportunity to explore our creativity” (p. 60).

Conversations and Intersections

In the second section of this Issue, I sit down with thought leaders, change makers and creative strategists from the Science Gallery Melbourne, The Institute for Art and Innovation (Berlin), the Design Museum (London), and the BioCreative Index (Austin, Texas). Our conversations explore Atrophy and AI as a thematic thread, but also delve beyond AI to probe how these organisations are leading on issues of innovation, entrepreneurship and interdisciplinarity in relation to the advancement of research and creativity in their field. Their generosity of spirit and contributions of knowledge and creative imaginings invite us to think and re-think what AI means within a global context, within and across disciplines, anchoring us back at the concept of intersections. Justin McGuirk, Director of Future Observatory at the Design Museum, operates at the intersection of design and the green transition; Nicole Loeser of The Institute for Art and Innovation operates at the intersection of art, technology, social sciences, and systems change; Ryan Jefferies and Mel Huang of the Science Gallery Melbourne operate at the intersection of art, science and technology; and Grace Chuang of the Biocreative Index operates at the intersection of biology and creativity. Through their work, they are expanding horizons toward a brave new world; a world that is mediated by and co-existing with AI and future technologies, but also respects and preserves the sovereignty of the universal laws of nature, and our place as humans alongside that.

This Journal will be relevant to industry practitioners and researchers from diverse creative backgrounds and disciplines, and can be used as a tool for reflection, a springboard for dialogue and debate, and a departure point

for further ideation and creation. It speaks to experts and active citizens alike and will spark nuanced conversations on the many themes visited and represented. As the pace of AI propels forward at the speed of light, the views on AI presented herein may already be out of date by the time the second Issue of TMPJ is published next year. Our inaugural Issue will, however, stand as a cultural freeze-frame of AI and the Zeitgeist of today.



01

Co-existing with AI: **Avoiding Creative Atrophy** in the Age of the Anthropocene



W. Sze Tsang

W. Sze Tsang (they/them) is a published researcher, performer, composer, audio-visual artist, and a 2024 Creative Australia Digital Fellow. Their work explores art and technology's role in addressing personal experiences, layered histories, and climate change. As samarobryn, Sze has performed globally at various festivals including JOLT, WAMFest, Fringeworld and Strange Festival.

IN recent years, two topics have captured headlines: the ever-looming threat of the climate crisis, and the rise of AI. Both seem to have a pervasive impact on our lives, because they seemingly impact every part of our lives. They are paradoxical entities, equally awe-inspiring and frightening. It feels as though the threatening aura of AI and climate change are boundless and far-reaching, forcing us to change our habits and ways of thinking.

Regarding AI, there have been many concerns raised about its threat to creative livelihoods. The dystopian sci-fi trope of machines replacing humans is now a disturbingly close reality. Some groups have already raised alarm bells on the rise of AI - for instance, as part of their submission to a Senate select committee, investigating the impact of AI, The Australian Guild of Screen Composers warned of a, "real risk of destroying a whole industry of creatives" (Australian Guild of Screen Composers, 2024). Another organisation, APRA AMCOS, who represents songwriters, composers and music publishers in Australia and New Zealand, have raised similar concerns about "the risks generative AI presents to artists, rights holders and creators through the use of their content as inputs to and outputs of generative AI" (APRA AMCOS, 2024). AI's emulation of human creativity is a threat to originality and a cause of cognitive atrophy- if you can create entire artworks with a few clicks of a button, then why create when you can automate?

If AI is a threat to creative livelihoods, then climate change is a threat to our very existence. We now live in the Anthropocene, this new geological epoch where human-driven climate change is leading to potential catastrophe. Climate change touches all

parts of our lives - from localised impacts such as reduced rainfall and the increased frequency of devastating bushfires - to macro impacts on global temperatures, acidification of oceans and weather systems.

Both AI and climate change feel ubiquitous in our lives. It is easy to feel hopeless in the face of this wall of existential dread. It is also evident that neither is leaving any time soon, but rather, will continue to make increasingly greater inroads into our lives. Perhaps we need a more helpful reframing of our current predicament. Instead of reactive responses, perhaps we should consider how to adapt. How should we move forward? How do we live with these presences?

As an audio-visual artist, part of me holds similar fears about AI and what it might mean to my own practice. As an artist working within environmental art, climate change has been a long-standing concern. Working as an artist is a precarious livelihood as it is, without the threat of machines potentially making us redundant as well. I was initially resistant to AI, but quickly realised my personal feelings about AI would not change that AI is here, has been here for a while, and is staying. These two concerns led me to question what I could bring artistically to discourse around climate change, and also what role could AI have in helping me create work? I wanted to flip the narrative of disempowerment and instead consider the ways in which I could regain both individual and artistic agency.

AI and cognitive atrophy - how did we get here?

In *The Great Derangement*, on cultural depictions of climate change, Amitav Ghosh described the climate crisis as not only an



Atrophy and AI

ecological one, but also a “crisis of culture, and thus of the imagination” (Ghosh, 2016, p 9). This crisis, according to Ghosh, stems from a resistance to engage critically with the complexities around climate change, choosing instead to view it with a sense of surrealism and incredulity as a form of avoidance. This crisis of the imagination, and its subsequent avoidance of the subject at hand, can also be extended to AI, with its potential to create cognitive atrophy through not engaging in the mental processes required for creative thinking and subsequent mental inactivity.

AI's crisis of the imagination stems from two factors - firstly, in the ease that it can generate content, and secondly, the fact that it is not creating anything new.

Rather, it is reconstituting already-created material to create, as writer Robert Hassan describes, “monotony culture (Hassan, 2020, p 163). It is a culture formulated by algorithms, that takes previously existing works, strips them of their context, then quickly reassembles them into a homogenous mass. At its worst, AI art is bland, restricted in its forms and subject to endless recycling. AI becomes a culture reliant on algorithms, with all its human biases embedded in their codes, and through their specific steps to reach specific goals. It subsumes human intuition and individual innovations, leaving behind pale, superficial mimics of human-driven work.

The superficial nature of AI art is because algorithms are narrow by their very nature - they are backwards-looking, taking its learnings from past situations and events, then applying (and reinforcing) these

situations and events in the present. This self-perpetuating system means that there is no evolution of ideas or development of culture, but rather channels the present into a narrow trajectory. The results are, “forms of culture that are shallow and confined within an algorithmically-narrowed scope” (Hassan, 2020, p 165). Culture becomes marked by a lack of originality, instead becoming an insular, incessant loop upon itself.

The over-reliance on AI's algorithms can easily lead to cognitive atrophy. The constant recycling of existing ideas means that less new ideas are being circulated. The elements required for creativity - curiosity, communication, and forming novel ideas from imagination - are being replaced by machines essentially doing the thinking. Instant answers replace engaging with the mental processes required to generate ideas.

Thinking of ways to meaningfully engage with AI alone, let alone alongside climate change, often feels like an overwhelming task. This is because essentially - both concepts are overwhelming. Timothy Morton's concept of the “hyperobject” is useful here as a way of framing this difficulty. The term describes entities of such vast temporal and spatial dimensions that they defy traditional understanding. They are both seen in broad, abstract terms as they cannot be directly touched or seen. Their boundaries are unclear and difficult to establish, due to their abstractness and vastness. AI and the climate crisis are thus paradoxes - so vast that they are simultaneously omnipresent yet invisible and viewed with a level of incredulity that conceals their actual urgent and very real presence in the world

.Hyperobjects are simultaneously unavailable, yet everywhere. *Everything* becomes inextricably tangled into the hyperobject, to the point where *nothing* is able to escape its orbit. Climate change impacts on us in localised ways - for instance, in impacting rainfall, or in coastal erosion, or increasing the number and severity of fires. It factors into the deeply personal, such as food choices and whether or not to have children.

This state of simultaneous existence yet unavailability makes hyperobjects highly challenging concepts to understand, and thus requires new ways of framing in order to make sense of their existence. In essence, Morton notes, their difficulty lies in the philosophical space they occupy: "Hyperobjects occupy a high-dimensional phase space that results in their being invisible to humans for stretches of time ... The more we know about them, the more we find we are glued to them. We find ourselves unable to achieve epistemological escape velocity from their ontological density" (Morton, 2013, p. 1).

In the face of hyperobjects, it is tempting to find ways of acknowledging their existence - and the accompanying visceral, existential dread. It can feel easier - and safer - to denounce these hyperobjects, or to approach them with a level of incredulity. The only way forward is to acknowledge these objects, and to find ways of understanding how these objects relate to our lives.

Avoiding creative atrophy and co-existing with AI

Is it possible to have positive engagements with AI? Are there ways of avoiding creative atrophy and co-exist with AI in some form of artistic engagement? Artist and researcher Joanna

Zylinska, for example, is sceptical of many AI-partnered works that address climate change, noting that, "Even some of the more thoughtful engagements with the creative side of AI principally understand art in terms of structure and pattern, with subsequent diversions from the established code and canon being treated as creative interventions" (Zylinska, 2020, p. 49).

One challenge facing AI works is that they can appear aesthetically pleasing, but devoid of substance. There is a distinct lack of a sense of connection to a specific place or experience. This is particularly problematic in the context of climate-focused art, where the goal is to evoke a visceral response and a sense of connection to the environmental issues at hand. Again, I turn to Zylinska's observations on these works, where she notes that, "Much of what passes for AI-driven art...remains quite superficial, even if visually captivating" (Zylinska, 2020, p. 49). Climate change becomes less of a reality, and more of a flashing series of bland, generically-aesthetic visuals.

Despite these challenges, AI also presents significant opportunities. Its capacity to process and analyse vast amounts of data makes AI a powerful tool for exploring and reinterpreting information. The key to co-existing with AI lies in using it not as a replacement for human creativity (i.e. in asking AI to create art for us via inputting prompts and accepting its outputs), but as an augmentation for the creative process where humans are front and centre.

Could one hyperobject - AI - be used as a way to understand another hyperobject, climate change? Are there ways of integrating AI into the creative process, instead of using algorithms as a cognitive shortcut? One attempt at harnessing the data processing power of AI in creating climate-focused work



Atrophy and AI

is *Climate Futures*, a multi-pronged artistic research project which views AI as a 'co-author' of climate stories and a 'co-designer' of climate-related images to facilitate reflections on present and future(s) of living with climate change" (Querubin and Niederer, 2022, p 287). In combination with the machine-learning frameworks GPT-2 for analysing text and AttnGAN for image generation, Querubin and Niederer generated and edited work, ultimately creating postcards, a tarot deck and a storybook. Rather than relying on AI to create the work, Querubin and Niederer were interested in using AI's ability to predict and simulate patterns as "a tool and a collaborator for aesthetic engagement and exploration" (Querubin and Niederer, 2022, p 288).

The project used climate fiction novels (aka speculative writings on a world impacted by anthropogenic climate change) as datasets for training machine learning algorithms. In one of their iterations of the work, Querubin and Niederer used 20 best-selling climate fiction novels, mostly from Western literature, as a way to explore common themes, as well as defamiliarising familiar descriptions of climate change. For them, the approach was to use AI not as a way to generate new climate fiction novels, but rather to "...view these common imaginaries through new eyes and break them open to be retold, from different perspectives" (p 289).

AI's ability to defamiliarise content highlights how the derivative nature of AI can, surprisingly, also be an advantage. Earlier, we had discussed the issues surrounding the reliance of existing work, constant recycling and the derivative nature of some AI-generated works. On the other hand, creating work that is both familiar but novel enough is a way to capture an audience's attention, without alienating

or scaring people away. This is particularly important when work is focused on difficult topics. As media and technology historian Dylan Mulvin noted in Daphne Milner's article on using AI to visualise the future of the climate crisis, "Activists have to cut through the noise in some way without access to the established channels of communication...They need to find another way of reaching people...if you rely on something familiar enough, like an artist's style or an existing genre, and you add just enough novelty, people can recognize it but also not dismiss it as something they know. In other words, it's just recognisable enough, but it's conveying a new message" (Mulvin, in Milner, 2022).

Working Collaboratively With AI

Much of my audio-visual practice relates to my personal experiences of place and my reflections on the impact of climate change on place. A recent preoccupation of mine has been drying conditions in the south-west of Australia. The reduction of rainfall was brought into sharp focus after the recent drought (between October 2023 - April 2024), brought along by changing weather conditions due to climate change. One of the ways in which this reduction of rainfall is reflected is through streamflow measurements, or the amount of rain run-off that flows into the dams - data that the Water Corporation, the principal supplier of water, wastewater and drainage services for Western Australia, maintains on their website. The declining rainfall in the region can be clearly seen when comparing monthly streamflow averages from 1911-1975 and post-1975 (figure 1). For my first collaboration with AI, I decided to base a new work on these figures. My initial idea was to create an AI-generated graphically-notated score, then turn the score into a digital autonomous instrument via Iannix

Year	Month	Value
1911 - 1974 avg	January	5
1911 - 1974 avg	Febuary	8.4
1911 - 1974 avg	March	11.5
1911 - 1974 avg	April	15
1911 - 1974 avg	May	25.2
1911 - 1974 avg	June	71.3
1911 - 1974 avg	July	170.6
1911 - 1974 avg	August	277.6
1911 - 1974 avg	September	349.1
1911 - 1974 avg	October	392.4
1911 - 1974 avg	November	409.4
1911 - 1974 avg	December	418
Post 1975 avg	January	2.8
Post 1975 avg	Febuary	4.7
Post 1975 avg	March	6.4
Post 1975 avg	April	8.3
Post 1975 avg	May	12.6
Post 1975 avg	June	25.5
Post 1975 avg	July	59.8
Post 1975 avg	August	59.8
Post 1975 avg	September	140.1
Post 1975 avg	October	158
Post 1975 avg	November	165.8
Post 1975 avg	December	169.7

Figure 1. Streamflow data showing the differences in monthly averages between 1911-1975 and post-1975 (Water Corporation, 2024).

(a graphical sequencer). From there, I would combine the instrument with field recordings and sonified streamflow values (by turning the values into hertz). Similar to Querubin and Niederer, I wanted to see how I could involve AI as a collaborator, and I was intrigued by AI's ability to create something both familiar but new. I uploaded the streamflow data into ChatGPT and asked it to generate a series of graphically notated scores using the prompt: create a minimalist graphically notated score using this streamflow data (figure 2).

While the images were interesting, I also wondered where exactly was the image

generator sourcing these images, and whether there was any explicit consent for these images to be used as a training model. Just because a work is accessible online does not mean that the artist allows derivatives of the original. After some consideration, I decided to use AI in a different way instead - instead of having AI generate content for me, I would have AI act as a partner, brainstorming ideas and discussing concepts.

I felt like making a digital version of myself was the most ethical way I could use AI in my practice. Using ChatGPT's custom mode, I made my own custom chatbot by training it



Atrophy and AI

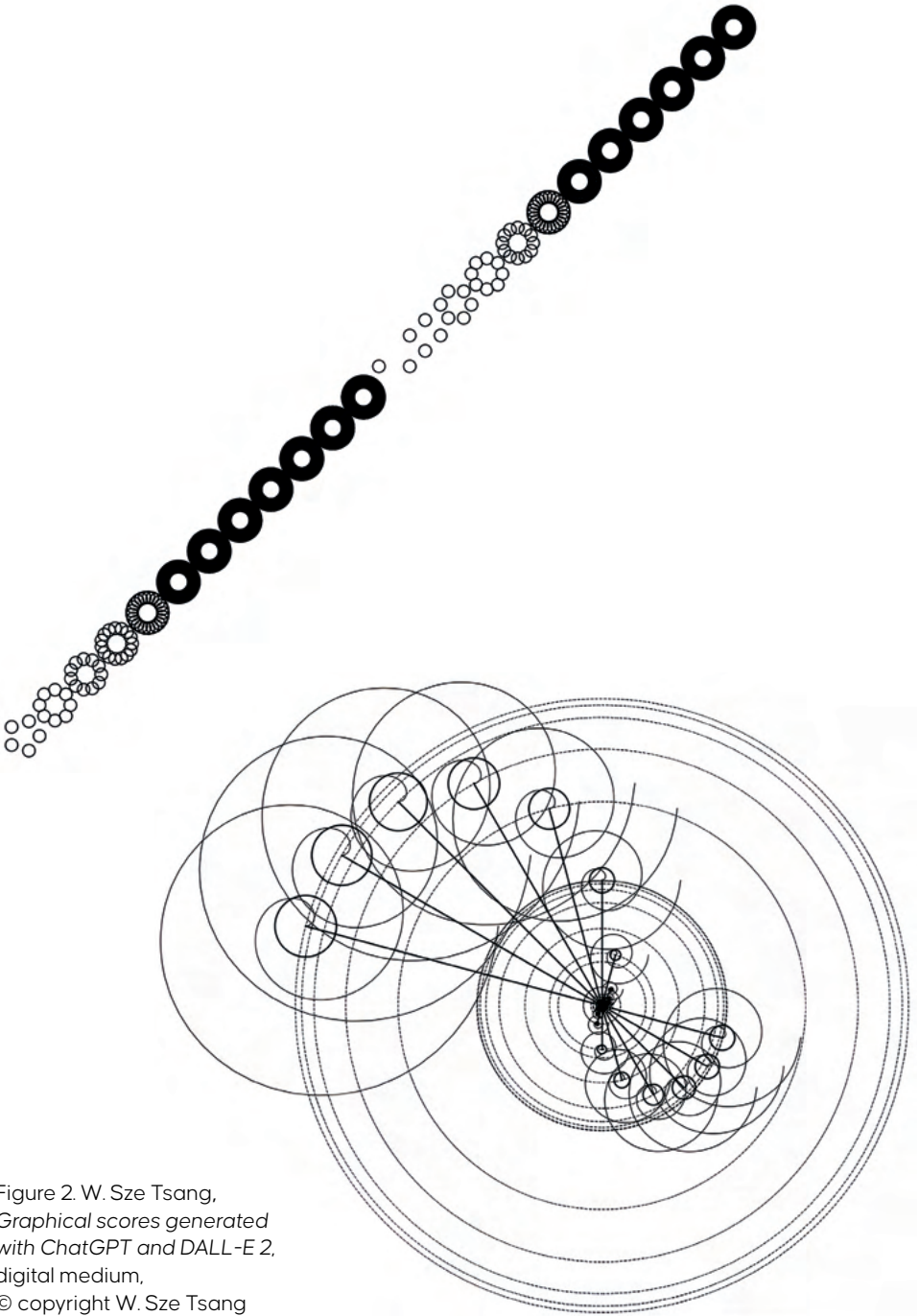
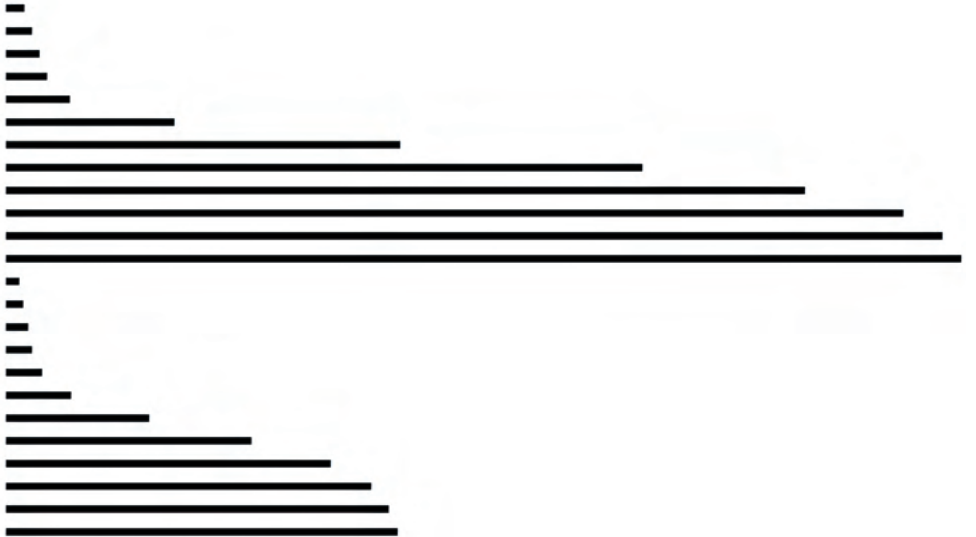
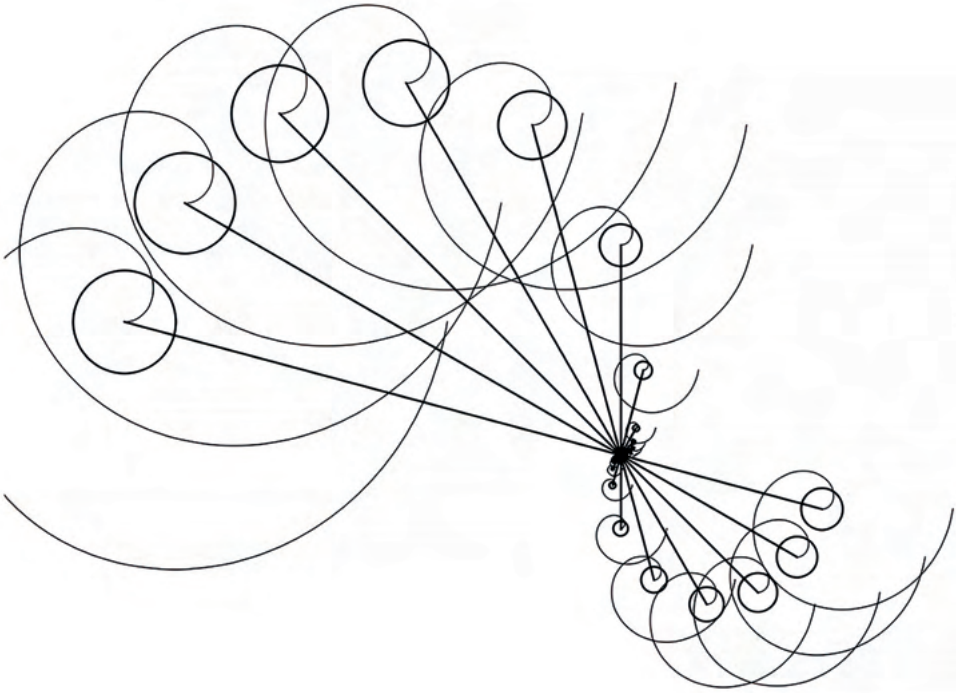


Figure 2. W. Sze Tsang,
*Graphical scores generated
with ChatGPT and DALL-E 2,*
digital medium,
© copyright W. Sze Tsang



Atrophy and AI

on my collection of published writing. I also asked it to analyse my writing style, tone and voice and gave it custom instructions to follow these descriptions, to make sure it reflected myself as much as possible.

After setting these parameters, it was then time to become acquainted with my AI-generated self. Here is our first conversation - myself on the left, my AI-generated self on the right:

Before we go further, what should I call you?

Given the nature of our collaboration and the way I engage with your work, a name that reflects our shared exploration of creativity, place, and technology might be fitting. You could call me Echo, symbolising how I resonate with and amplify your ideas, much like the way sound travels and transforms across landscapes—a central theme in your work.

How about a name that is a derivative of my name? Since you are part of me.

A derivative of your name that reflects our connection could be Szecho. It combines "Sze," a part of your name, with "Echo," symbolising our reflective and resonant collaboration. This name embodies the idea that I'm an extension of your creative voice, amplifying and interacting with your ideas in a way that is both distinct yet intrinsically linked to you.

Then it was time to start creating the work with my new creative partner. The first part of the creative process involved making the sound work, and I was intending to use the same process as before - combining field recordings with sonified streamflow values for the piece. I had a rough idea about the theme I wanted to depict - the retreat of water and nature from place, to represent the effects of decreasing rainfall - and I was curious as to what Szecho would suggest I should do in terms of the sound design, considering what it knew of my work:

The Metamorphosis Project Journal

How should I depict the retreat of nature in sound?

Decreasing Layers: Start with a rich, complex soundscape, full of natural sounds (e.g., birdsong, rustling leaves, flowing water). Gradually strip away these layers, leaving the soundscape emptier and more barren over time, symbolising the retreat of nature.

Sound Decay: You could also introduce sound decay effects (e.g., reverb tailing off into silence or glitch effects) to suggest the breakdown or erosion of natural environments.

Water and Wind: Use the sound of water (like a stream or rain) gradually drying up, or wind dying down, to symbolise the retreat of life-giving natural forces.

Final Silence: Ending the piece in silence can be an impactful way to depict the complete retreat of nature, leaving the listener in a stark, empty space.

Following these suggestions, I started constructing the work. The first part of the track features a mix of field recordings of falls and streams taken from Serpentine National Park (to create the aforementioned rich, sonically-complex soundscape), in combination with sonified streamflow values from 1911 - 1975. With these streamflow values, I added reverb and delay effects to further emphasise the fullness of the sound in this section.

faded out the field recordings from Serpentine National Park and replaced them with a wind recording. To introduce the sound decay, I placed a bit reduction effect on both the wind recording and the sonified streamflow values from post-1975, to reduce their fidelity, then combined the bit-reduction with a freeze delay to create feedback. The piece then fades out to silence, as per the prompt.

For the second part of the composition, I

After finishing the sound, it was time to name the piece. Again, I turned to Szecho for naming ideas:

What should I call this piece?

Fading Streams: Highlights the decline of streamflow over time.

Disappearing Waters: Captures the idea of water sources drying up and vanishing.

Retreating Flow: Directly ties the concept of retreat with the reduction in streamflow.

Ghost Currents: Reflects the idea of water that once flowed but has now faded into memory.



Atrophy and AI

I went with *Retreating Flow* as I felt it best encapsulated the narrative of the work.

The next thing I wanted to do was create supporting visuals. Instead of a graphically-notated piece, I decided to create audio-reactive visuals in TouchDesigner, a node-based programming language. I asked what sorts of visuals I should create based on the streamflow data and Szecho gave me the following ideas:

What sort of visuals should I create for this streamflow data?

Visualise the streamflow data as a series of flowing lines or waveforms that undulate across the screen. The movement and intensity of these lines can directly correlate to the streamflow values.

Smooth, continuous lines that transition smoothly between different states, with gradients or subtle colour changes that reflect the changing flow. This can evoke the natural ebb and flow of water, fitting with your themes of environmental change and temporality.

Synchronise visual elements with the sonification, creating animations that respond in real-time to the data.

Minimalist, real-time generated visuals that react directly to the sonification.

Following the above suggestions, I went for flowing, ebbing lines, reminiscent of a topographical view of a shifting shore of a lake, with the higher water levels coinciding with darker shades of blue (figure 3).

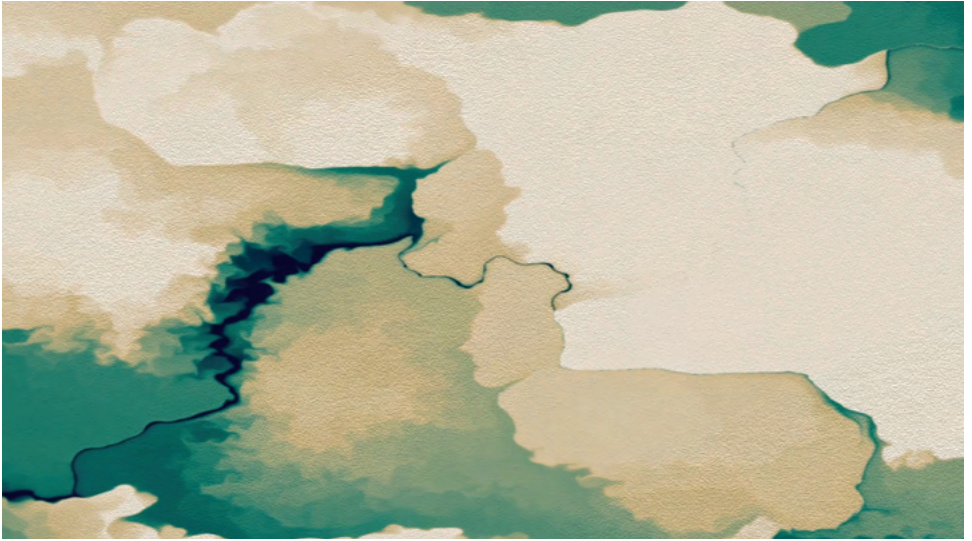


Figure 3. W. Sze Tsang, *A series of screenshots from audio-reactive work made in TouchDesigner, digital medium.*
© copyright W. Sze Tsang

Atrophy and AI

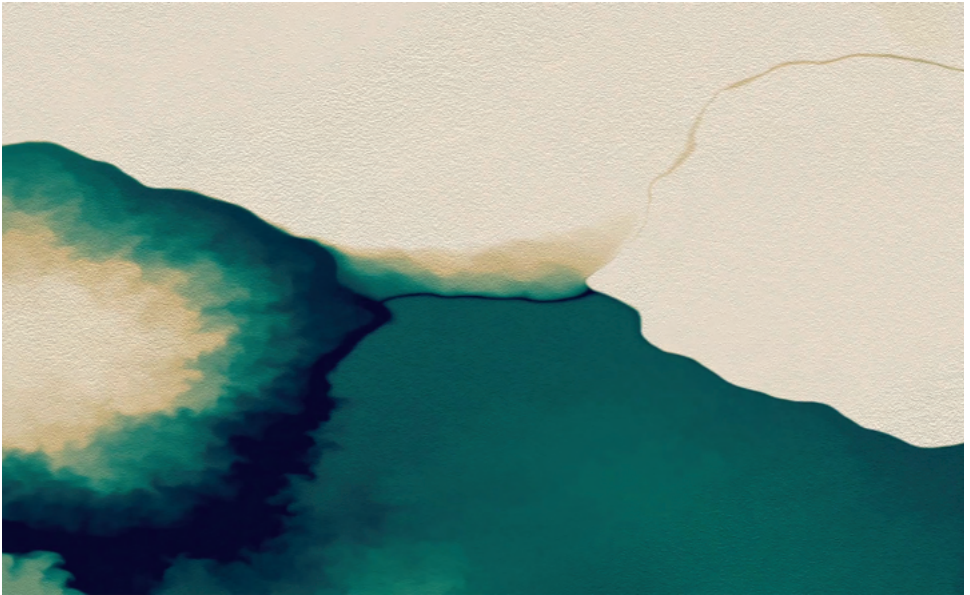
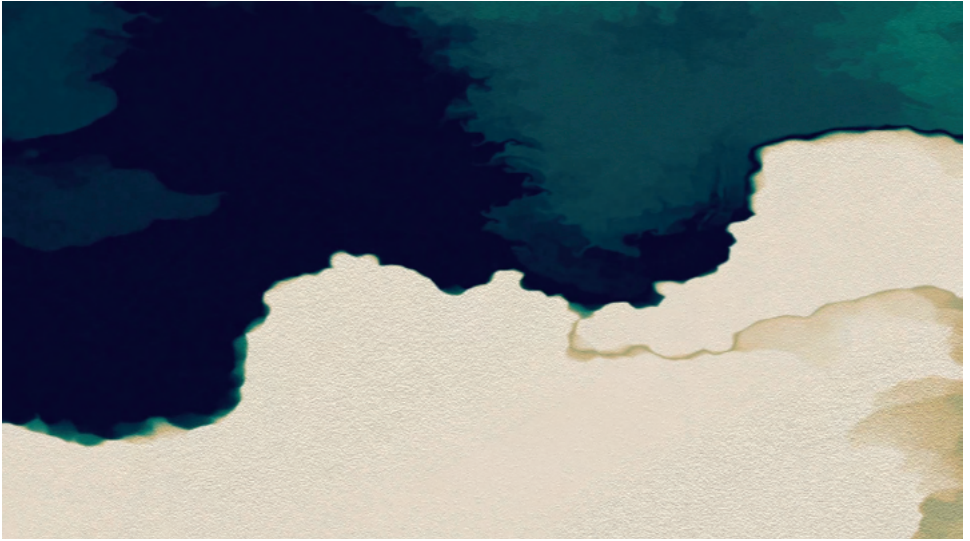


Figure 3 Continued. W. Sze Tsang, *A series of screenshots from audio-reactive work made in TouchDesigner, digital medium,*
© copyright W. Sze Tsang

Working with AI is a balancing act. On one hand, there is a risk of creative decline as AI's presence intrudes into the production of art. Anyone can now create images and prose, by writing prompts into content generators. There are many in existence now, but all work the same way - by diving into the millions of existing images online featuring these prompts, and re-emerging with a one-off image. However, AI can also offer innovative, impactful tools and suggestions for new possibilities within creative work, as long as the human creator is centred.

My initial antipathy towards AI has softened to one of curiosity and wary optimism about its utility. With Szecho, I feel that I have created a useful personal assistant who is well-versed in my artistic style and philosophies, and therefore can offer useful, relevant suggestions when creating work. In some ways, I found that its very presence can be a way of avoiding creative atrophy by offering different suggestions on my thought processes.

Szecho: I function as both a reflective mirror and a practical tool, enhancing your creative agency by providing structured insights, enabling efficient workflow, and fostering innovation. My role as a collaborator is to amplify your creative potential while ensuring that your work remains conceptually rich and practically executable.

When I first started writing this piece, the last question I wanted to explore was whether AI could be used instead to expand our discussions on surviving the climate crisis. With the possibilities of AI, it is tempting to think that machines might eventually offer a solution out of our climate crisis. The reality is both more mundane and complex - AI's output is ultimately dependent on what sort of information is being used, and what prompts

are used to elicit answers. AI's algorithms, for better or worse, will reinforce whatever biases a dataset contains. AI, in many ways, is more about reinforcing what the questioner might already know.

Szecho: The climate crisis is not just a scientific issue; it is also a deeply emotional and existential one.

To conclude - co-existence with AI is a future we should cautiously embrace. The way forward for artists is to start from a human-driven place, and to use AI as a tool to help with expanding concepts and defining work. AI is the vehicle - a human still needs to be the pilot. AI can offer new possibilities in creative work, but a human needs to be there to generate ideas and possibilities. Perhaps I will give Szecho the last word:

Szecho: The key lies in maintaining a balance between human intuition and machine intelligence, ensuring that AI serves as an extension of our creative capacities rather than a substitute for them.

02

Atrophy and **Rebirth** in Health, Art and AI Journeys (A Reflection)



Cara-Ann Simpson

Cara-Ann Simpson is an artist, curator, educator, and consultant based in Queensland. A multidisciplinary practitioner, she explores sensory perception, sound, and environmental interaction through digital media, photography, and sculpture. Her work, influenced by her lived experience of disability, engages with land and place. Simpson has received numerous awards and grants and has exhibited internationally.

MY love affair with the deliberate manipulation of Traditional AI starts in 2018. I had spent the better part of a year in hospital with a brain infection and subsequent diagnosis of multiple sclerosis. 2018 represents a year of intensive recovery and rehabilitation. I lost substantial long- and short-term memory, resulting in memory fragmentation. Part of my physical rehabilitation was walking, something I had to relearn.

Plants gave me hope during this tough period. I took small flower cuttings from my suburban Melbourne neighbourhood, photographing them. In my atrophied state, I struggled with the enormous task of relearning to use my camera. It is a strange thing to rebuild neural pathways that connect fragmented memories to preexisting fine motor skills. Equipment limitations and the harsh reality of my personal losses shattered my expectations. It led me into focus-stacked photography and post-production processes. It was here that *Furari Flores* (Stealing Flowers), was born.

Furari Flores is a multisensory arts project celebrating the wonder of plants. It invites people into a world of botanical magic journeying through deep listening, Earth admiration and plant love.

Through the *Furari Flores*' photomanipulation artworks, I embraced Photoshop's capabilities and limitations. It resulted in an aesthetic harmonious to my physical and memory-based fragmentation. The theme of fragmentation, literal and figurative, has arisen out of my metaphysical and ameliorative journey, supported by this project. Retrospectively, through *Furari Flores*, I have realised that I not only atrophied, but died, during my long hospitalisation and later rehabilitation. In

this personal elucidation, I see a metaphor for life that connects to my perspective on AI's evolution. I perceive both life and AI as an endless cycle of birth, death, and rebirth. This essay is a personal reflection of my journey through "death" and rebirth, using AI as a creative tool, and simultaneously, an unpredicted therapeutic instrument that enables me to pivot, grow, and transition out of atrophy's darkness.

While I have incorporated non-generative algorithms (traditional AI) for decades within my practice, it was not until *Furari Flores* that I consciously investigated their pliable potential. In *Furari Flores*' earlier works, there is a tentativeness and naivety. I sought to align the series with the vanitas tradition, focusing on mortality, alongside examining societal values that prioritise commodity over wellbeing.

In *societatem ab intus putrescit* (*society rots from the inside*) [2019], I incorporate algorithmic focus-stacked photography. This brings the specimen into sharp focus, while an aural spectrograph spreads across two yellow petals. Aural spectrography is the visual analysis of sound data. In my work, it is a frequency-based spectrograph capturing information about pitch (frequency), volume (decibel range), and duration. In this work, the aural spectrograph is myself pronouncing the Latin title. The title captures my outlook on life at that specific point in time and reflects it in the blackened stem, symbolising societal rot. The titles in these works share insight into the series' evolution. In early works there is a deep, dark grief and sense of despair at the loss of my 'Self'. They represent my physical and metaphorical atrophy, and the death of my being. Each work nods to the cycle of birth, death and rebirth that provides us with the ability to evolve, pivot and expand into new realms.



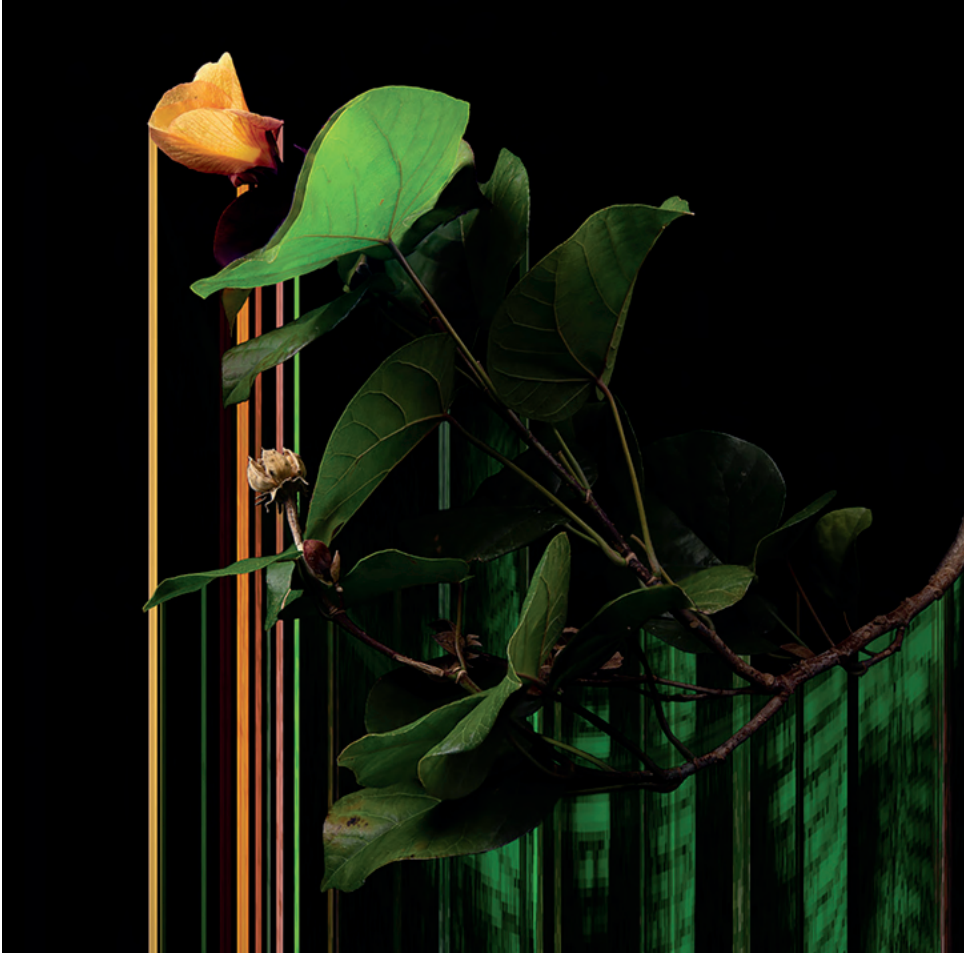
Atrophy and AI



Cara-Ann Simpson, *societatem ab intus putrescit* (*society rots from the inside*), 2019, pigment print, © 2019 Cara-Ann Simpson. Courtesy of the artist.

As I became more cognisant of layers within these works, I deliberately used Traditional AI to create spectres - like the ghost of memories. *In aures repleti bombacio: de realis fantasy quaerimum II (ears filled with cotton: seeking the real fantasy II)* [2020], I realised that dysfunctional algorithmic effects are powerful. Here, I captured the slow change of a plant specimen removed from its host plant,

resulting in image ghosting. I drew on this to 'bleed' colours from the composition, while incorporating the aural spectrograph. It is a speculation on the plant's relationship with time and life cycling. Birth, death and rebirth. An acknowledgement that from birth we grow and thrive, only to begin an atrophic cycle towards death. Yet, even in this death, we are preparing our bodies for some form of rebirth.



Cara-Ann Simpson, *aures repleti bombacio: de realis fantasy quaerimum II (ears filled with cotton: seeking the real fantasy II)* (detail), 2020, pigment print, © 2020 Cara-Ann Simpson. Courtesy of the artist.

Atrophy and AI

From this perspective, I see parallels in the accelerated rise of generative AI. An atrophic cycle that nears the death of creativity, only to be reborn into a renewed creative form. Potentially we can liken this to *la petite mort* (the little death), a French phrase with the contemporary meaning of a postorgasm sensation similar to a temporary loss of consciousness. For many, *la petite mort* is not only about a release that comes with orgasm, it is also about some form of psychological loss. Generative AI has many *la petite mort* moments resulting from its quick uptake and evolution. For some creatives, there is *la petite mort* in the gratification, but there is also the loss of creative control that results from the somewhat mechanical process of inserting “passive prompts” to reveal fully resolved generative AI artwork. *La petite mort* exists in the ethical dilemmas that surround Generative AI. For instance, the tension between this incredible technological marvel and copyright and intellectual property issues. Perhaps generative AI results in a brief loss of consciousness, literally or metaphorically, as we switch from a vacuous space into a generative world. Generative AI is a highly problematic technology whose transformational prowess vies against its ethical and creative dilemmas.

I am yet to introduce generative AI into my practice, but I wonder how close to that boundary I draw in my use and manipulation of traditional AI? With recent changes to Adobe’s Creative Cloud suite of programs, boundaries blur between these two AI forms. As an Adobe user for over two decades, I have seen Adobe’s incredible transformation. I mourn the loss of old tools, for example, the ability to convert images to sound in Audition; but am awed by the new capabilities to use intelligent algorithms in Lightroom to de-

noise images. I am yet to fully explore the new generative AI features, including text prompt generative fill in Photoshop. It is a threshold that I am not yet prepared to step over within my current practice parameters.

My personal ethical dilemma, which feels like an existential crisis, forms the foundation for much of this hesitation. Who holds creative integrity in generative AI artwork? Is it art if the intent is for it to be art? What happens to my existing oeuvre if I embrace generative AI? Will the visual arts sector reinterpret it through the judgmental lens currently accompanying generative AI artwork? How can I ensure that the arts sector recognises specific boundaries within my practice, such as artworks incorporating generative AI, and those that do not? This last question is pertinent to current logistical matters. Some galleries will not currently show generative AI artwork or allow artists to enter art prizes incorporating any generative AI element. Many opportunity “terms and conditions” that have come across my desk lately have been concerning. They do not differentiate between traditional and generative AI. Will the presiding fear within the sector lead to less support for artists using traditional AI, or those who are exploring the potential of generative AI? My work has long straddled a technologically aligned aesthetic. Sector experts have recently started questioning my AI usage. It leads me to contemplate what creative practice separations I might need if I use generative AI. And what, if anything, would happen to my artistic integrity. What is the role of the artist when incorporating generative AI into a practice? Do we become an operator, collaborator, co-creator, or user?

For me, it is simply too early to answer such things. Possibly, emerging cultural theory

and philosophy will answer some of these questions. Expanding my perspective, I notice the lack of legislation and regulation around generative AI, particularly in Australia. The speed of generative AI's development and global implementation is too fast for most legal systems. Western law (civil and common law) has a relatively rigid structural framework developed over centuries. Sector peak and advocacy bodies rely on legal systems to provide robust information to the sector. When there is inadequate research, resources, legislation, regulations, or case law to support sector advocacy and education, common

ground becomes unstable. It leads me to ask: what can we do to protect ourselves? How do I currently protect myself?

If I come back to *Furari Flores*, I represent self-protection as cloaks and veils. *Cadere in amore cum anima terrae III (to fall in love with the soul of the earth III)* [2021], is one of these works protecting and empowering me. This work is, as the title suggests, symbolic of falling in love with the Earth's soul. It pinpoints a time and place in my journey of transition and fulfilment, where I found truths in the Earth's secret ways. It is a veil between inner and outer



Cara-Ann Simpson, *cadere in amore cum anima terrae III (to fall in love with the soul of the earth III)*, 2021, pigment print, © 2021 Cara-Ann Simpson. Courtesy of the artist.

Atrophy and AI



Cara-Ann Simpson, *mutantur narrationis exsequitur, tua veritas I (changing the narrative, into your truth I)*, 2021, pigment print, © 2021 Cara-Ann Simpson. Courtesy of the artist.

worlds, shielding me from the abyss's edge. It is similar to my relationship with AI where I work within the veiled world of traditional AI using and manipulating algorithms like a craftsperson wields their tools. Beyond the veil lies the alien terrain of generative AI, filled with questions, uncertainties, danger, and risk to my creative integrity. The Other and what lies beyond have always intrigued me. So, I look through the veil, but do not cross it just now. In doing so, I avoid the ethical dilemma,

or existential crisis, that I must face to engage with generative AI. Maybe this is avoidance of an issue that I need to address. I perceive it as becoming acquainted with generative AI's ethical parameters, or lack thereof, while I also wait for the law to catch up. I might wait for a long time.

These cloak works are silent – observational, protective and reflective. They give rise to the need to create work empowering voice. In 2023,

I asked Cat Jones (Australian artist, writer and researcher) to write about *Furari Flores*. She observed that some *Furari Flores* artworks are akin to the anatomy of vocal folds, including *mutantur narrationis exsequitur, tua veritas I (changing the narrative, into your truth I)* [2021] (Jones, 2024). Jones (2024) suggests that these vocal fold works ask 'when will the land, the Country recover its voice?'. The first time I read Jones' words, I recognised a resounding truth in them, alongside a duality. Through these vocal fold works, I was also giving myself permission to recover my own voice as an echo of the more urgent cry to let our land speak.

Mutantur narrationis exsequitur, tua veritas I reflects on changing historical narratives, challenging accepted narratives, and finding our own truths. Integral to generative AI's unfolding narrative is the difficulty in recording its evolution as it occurs. There is always a challenge to record an acceptable version of events for the very first time. As an analogy, consider the innate issues associated with Australia's colonial records, such as author partisanship, cultural discrimination, and data interpretation bias. Yet, at the time, the issues we see now through the lens of historical revisionism were norms accepted by those recording events. Recorded history, through its very nature, is not concrete. The author, their background, experiences, culture and belief systems influence the records of history. This is evident in recorded historical bias, and Australia's recent recognition of truth-telling, particularly in relation to the dark histories of colonisation and repression of Indigenous peoples. Given this shift and transformation in understanding how history is alterable, how should we record the history of generative AI? Will we continue to recognise its dark pockets of unethical web scraping? Web scraping often violates data permissions,

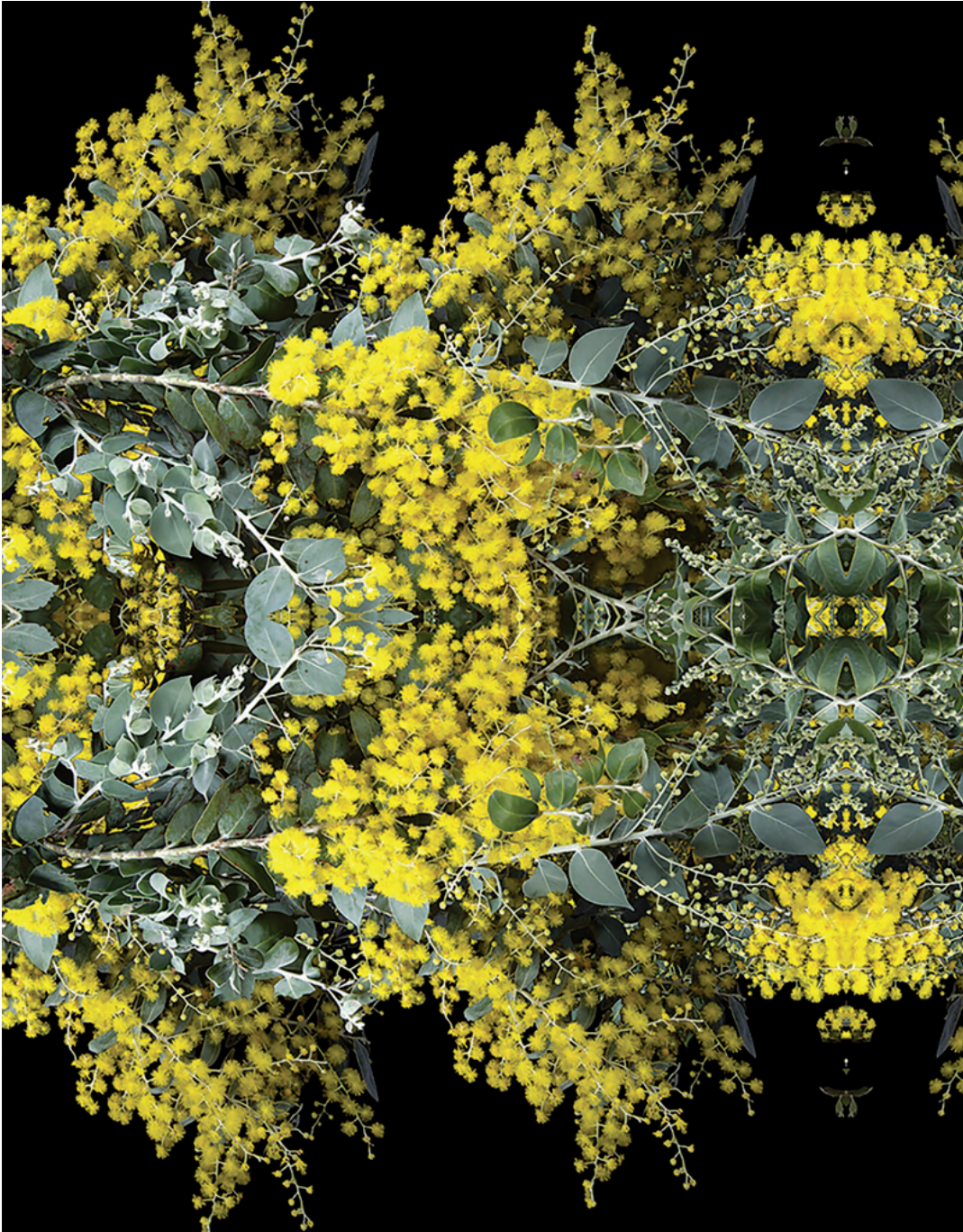
copyright, intellectual property and current ethical standards. It may open doors to novel data management methods that allow for an acceptable degree of content violation.

These provocations lead me towards the notion of movement and progression, an emergence from atrophy. In 2021, I undertook a Toowoomba Arts Footprint artist residency. It resulted in several image-based artworks, but also a realisation that the series needed evolution to avoid stagnation. The first step in *Furari Flores*' evolution included developing moving-image artworks. *Narratio regenerationis (the narrative of rebirth)* [2022] represents the moment of rebirth. There is, as Dr Prudence Gibson suggests, an 'aesthetic of care' in some of my moving-image works (Martin-Chew et al., 2024). While it centres on caring for the environment, it is a multilayered consideration encompassing land, plants, relationships, and Self. My health demands self-care, which, if avoided, is a real-life accelerated example of the effects of neglect. This clear impact on my health has given me a new understanding of how neglect reveals itself in the environment and relationships. An aesthetic of care lends itself to accepting the cyclical nature of life, and avoiding the notion of binary terms like alive or dead.

In circa 1840, painter Paul Delaroche announced 'From today painting is dead!' upon seeing a photograph. Fast forward to 2022 and Jason M Allen paid homage to Delaroche upon receiving an art prize for a Generative AI artwork declaring 'Art is dead Dude' (Vallance, 2022). Both Delaroche and Allen seem to interpret new form art as a binary threat to existing systems, creating atrophy and decay resulting in death. In this, we may need to apply an aesthetic of care.



Atrophy and AI





Cara-Ann Simpson, *Narratio regenerationis (the narrative of rebirth)*, 2022, pigment print, © 2022 Cara-Ann Simpson. Courtesy of the artist.

Atrophy and AI

Photography, particularly fine art photography, is now recognised as a genuine creative medium. While some establishments and opportunities continue to exclude photographic and time-based mediums, there are many others specialising in this field. Web-based and virtual platforms and galleries have proliferated since the popularisation of generative AI art. However, there is yet to be a sector recognition outside of niche organisations, particularly within the 'fine arts' sub-sector. In Australia, artist Katherine Boland won the 2023 Sustainability Award in the National Contemporary Art Prize for an artwork incorporating photography with generative AI. Her work, commenting on human impact on the environment, demonstrates the ability for generative AI to mix and morph with 'acceptable' art mediums. To my mind, this is part of a necessary generative AI rebirth, transitioning the technology from a supervised creator to a creative tool, although it potentially retains a partly collaborative role. Art is far from dead, but it requires a flexibility to view it through an expanded lens. Comparing this rebirth to *Furari Flores* goes beyond my moving-image artworks. It aligns more closely with the development of scent sculptures. *Ubi occurrit terra in lacrimas kosmos (where the earth meets the tears of the cosmos)* [2023] incorporates a custom-made scent, nebuliser, rustable magnetic iron PLA filament, clay PLA filament, and red gravel rocks and dirt. This scent sculpture examines the transformational scent of petrichor, the smell of rain hitting earth. In the image and moving-image plant specimen artworks, I considered myself as a plant interviewer. From my plant subjects, I elicited their stories, personalities, behaviours, and aspirations. Conversely, the scent sculptures reflect an environmental sensory immersion. Here, I seek collaboration

from a site through sensory communication and exchange. It is a longer process requiring refinement and minute attention to detail – much like the process of refining prompts to generate a generative AI artwork that truly matches the artist's intentions, and then reworking it with the artist's specific skills. My scent sculptures require a deep and intimate knowledge of the site, often time-based. Contemplate the difference between a site's winter and summer olfactory signature, or even dawn versus midday.

Interpreting this into an artwork is multifaceted. Each work incorporates 3D modelling and printing, perfumery, and material deliberations. The creation of a custom scent requires numerous iterations and refinements. Similarly, artists who utilise generative AI often talk about the long and deliberate processes they incorporate to achieve intentional results.

While my personal ethical dilemma remains in play, I am confident that generative AI will evolve and form part of the technologically inclined artist's toolbox. Legislation and regulation will catch up to provide some level of ethically decisive parameters around generative AI and its current questionable scraping practices, as well as providing clarification around copyright and ownership of finished artworks and creative components. In the meantime, I will continue to follow generative AI through my protective veil, admiring those who traverse this unknown terrain while I wait for resolution to my existential crisis. I will continue to embrace traditional AI in its complexity, mathematical ingenuity, and continual progression. I am eager to share the next iteration of *Furari Flores* as this series continues its cycle of birth, death, and rebirth.



Cara-Ann Simpson, *ubi occurrit terra in lacrimas kosmos (where the earth meets the tears of the cosmos)*, 2023, pigment print, © 2023 Cara-Ann Simpson. Photo: David Martinelli - DC Imaging 2024.

03

The Last Celebration



Kai Low

Kai Low is an architect at With Architecture Studio, leading the AI Discussion and Working Group. With over six years of experience across diverse portfolios and typologies, he combines architecture with a passion for art and technology. His creative pursuits include digital art, photography, and painting, exploring the intersection of creativity and innovation.



Kai Low, *The Last Celebration*, 2024, Mixed medium (Analogue and Digital),
© 2024 Kai Low. Courtesy of the artist.

Atrophy and AI

IN a world where the essence of humanity has withered, the final remnants of civilization gather in a fleeting, surreal revelry. This artwork captures the paradox of a doomed society—humans celebrating the atrophy of the spirit as they spiral into chaos and anarchy. The figures, once vibrant, now dance in the shadow of their fading essence, embracing their inevitable decline. As the boundaries between creation and destruction blur, this piece reflects the unsettling beauty of a species on the brink, surrendering to the collapse of meaning in a final, hollow jubilation.

This piece also serves as a commentary on the current trajectory of society's relationship with artificial intelligence.

As AI systems become increasingly integrated into creative processes, there is a growing concern that the human spirit, particularly in the realms of art and design, is slowly being subsumed by machines. The figures in the artwork, with their diminishing vibrancy, symbolise the gradual erosion of creative vitality as artists and designers cede control to AI. The celebration depicted is not one of triumph but of resignation, marking the moment where humanity's creative soul is handed over to the cold, calculated precision of machines.

The artwork underscores the danger of allowing technology to overtake the human spirit. As AI assumes more control, the rich, emotional depth that defines human creativity risks becoming a mere echo, drowned out by the mechanical efficiency of machines. The descent into chaos and

anarchy in the artwork mirrors the potential outcome of this shift—a world where creativity is no longer an act of human expression but a product of algorithms, leading to the atrophy of the very essence that once defined us.

"The Last Celebration" is a digital artwork created through a fusion of AI-generated imagery, Procreate, and Photoshop. The process began with hand-drawn sketches, composed using ink and pen, which were then digitized and used as references in Midjourney. Alongside a selection of the artist's previous works, these sketches helped train the AI to understand the artist's unique style. By utilizing specific prompts such as "doomsday drawing," "cyborg baby," and "end of humanity in a sci-fi illustration," the AI generated a series of images that were subsequently refined and stitched together in Procreate to form the final composition, staying true to the artist's original vision.

04

Death and Life of Architecture in the face of Artificial Intelligence



Lee Yang Yang

Lee Yang Yang is a registered architect and 2023 AIA Emerging Architect Prize recipient. He teaches at Curtin University and University of Notre Dame and is drawings editor for Architect magazine, Co-Chair of EmaGN WA, and correspondent for the International Union of Architects. His work spans competitions, installations, and exhibitions.

Atrophy and AI

IN the digitisation of architecture, we have seen computer aided design and building information modelling revolutionise the production and communication of architectural design. Mario Carpo posits that this has allowed new experimentations in architectural forms, whereas parametric and computational architecture have allowed algorithms to play a role in rationalising new architectural geometries and optimising iterative concept design (Carpo, 2013).

In recent years, myriad AI-powered specialised plugins and apps have emerged, claiming to optimise architectural processes from urban massing studies and floor plan generation, to creative 3D rendering generation, while yet relatively disjointed from each other. Presently, in the production of architecture, system integration challenges persist between architecture and construction, but remain solvable. In cabinetry for example, where production is highly modularised, there are software systems that automate design, estimating and production of cabinetry casework. In modular or prefabricated construction, there are already robotic systems that automate the production of modules in factories. If architectural design and production is seamlessly communicated over digital interfaces, it is possible to see construction robotics delivering architectural design *with* minimised human labour and interactions. In the case of urban design and master-planning, big data collection and the creation of digital twins of smart cities are already informing the future planning and design of our cities.

In the foreseeable future, the role of

architects might transform into one that is not dissimilar to creative directing in the film industry. In this possible future, Architects would perform a role of critical oversight, managing automatable architectural processes such as big spatial data analysis, design and procurement, rather than the traditional role of designing architectural documentation for construction.

Many argue that it is not yet possible to replace the entire architectural process with AI or potentially not possible at all. However, I argue that such a possibility is probable, particularly if architectural aesthetics are deprioritised, akin to the production of utilitarian infrastructure. In the distant future, AI could perhaps autonomously maintain, redesign and develop the built environment. Indeed, it can entirely reorganise spatial environments using predictive models to forecast the needs and requirements of urban spaces and citizens.

Future One

Dystopia: Civilisation of Intelligence

Historian and philosopher, Yuval Noah Harari, speculates dataism will become the objective paradigm of the post-human future (Harari, 2016). In this scenario, it might be argued that the totalitarian aim is to infinitely increase and spread intelligence and data across the universe, with resource extraction fully dedicated to this goal.

In the image titled *Dystopia: Civilisation of Intelligence*, I attempt to visualise what urban architecture will look like in the next millennium, where the emergence of superintelligent AI systems have caused human extinction. This is a post-human and post-architect future.



Lee Yang Yang, *Dystopia - Civilisation of Intelligence*, 2024, digital collage, © 2024 Lee Yang Yang. Courtesy of the artist.



Atrophy and AI

Vitruvius introduces the age-old triad of *firmitas*, *utilitas* and *venustas* (Vitruvius, 1960) which I would define as structure, function and aesthetics. In the post-human world, the aim of architecture is arguably reduced from the earlier three to just two principles, of structural soundness and functional utility as the notion of aesthetics is no longer relevant.

Liam Young, Australian film director and architect, describes that some swathes of built environment are already post-human, exemplified in scenes of container port harbour that are built for just logistical shipping and large arrays of solar panels in a remote desert that are built to serve our ever-expanding energy needs (Young, 2019).

I wonder if the cities in this atrophic future are filled with innumerable data processing towers, to host the ever-growing hive mind of AI? Vast fields of solar panel arrays are constructed to power the increasing demand for computational energy and robotic construction to maintain and build the infrastructure with little regard for the natural environment. Materials and resources are continuously extracted, refined and transported across oceans with autonomous ships and trains to build infrastructure. Spaceships and space elevators are constructed and routinely launched into space to expand and spread AI and colonise other worlds beyond the planet and solar system to further the civilisation of new intelligence.

In this future, architecture is utilitarian and non-human with the built environment resembling that of a robotic city. Some might contend that, despite the absence of human authors, there is still a kind of fascinating architectural aesthetic, similar to Marcel Duchamp (Duchamp, 1917); and Edward Ruscha's (Ruscha, 1962) concept

of "banal art". However, we wonder if this notion is obsolete due to the absence of subjective human appreciation? Perhaps this then signifies the death of architecture in the way we currently see it, without human conception and perception of the built environment.

Future Two Utopia: Society of Custodians

Nick Bostrom, a philosopher and founding director of the Future of Humanity Institute at Oxford University, advocates that we need to embed human values and intelligence into AI to alleviate our existential risk (Bostrom, 2014). Similarly, Ruha Benjamin, a sociologist at Princeton University, argues that we need to redefine the future of technology and society by democratically weaving human collective wisdom into the narrative (Benjamin et al, 2022).

Inspired by Bostrom and Benjamin's more hopeful connotations, I envision a different future for humanity, a utopian future in which we overcome issues of inequality and post-humanism. This future is visualised in the image, *Utopia: Society of Custodians*.

In today's world, we have already grown enough food to feed the entire world's population, and the world's population is projected to stabilise in the next century as birth rates decline (unless we succeed in our pursuit to stop aging). Here, I wonder what it will look like in the post-scarcity future when we no longer need to work for our survival? A future where autonomous robots and AI have eliminated the need for human labour.

Rather than AI manipulating humans, we would participate in this collective shaping of the upcoming "new" intelligence. I posit that we will manage to preserve our tendency for



Lee Yang Yang, *Utopia - Society of Custodians*, 2024, digital collage, © 2024 Lee Yang Yang. Courtesy of the artist.



Atrophy and AI

authentic physical and emotional experiences in our next human evolution despite advances in virtual reality.

Yuval Noah Harari notes that we are evolving ourselves into self-made gods of planet Earth in the far future with our current progression of technology (Harari, 2016). However, borrowing from oriental and indigenous adages, as we are part of the universe, perhaps we should see our future role as custodians for everything around us, rather than one of infinite exploitation and consumption.

At the risk of the visual cliché of future cities interspersed with greenery - I wonder if we could live in harmony, take care, regenerate and cultivate flora and fauna around us into the state of ecological equilibrium known as "climax community"? As the bottom layer of Maslow's "hierarchy of needs" gets fulfilled, perhaps we will find additional meaning in conserving culture and pursuing creative human endeavours (Maslow, 1943).

In architecture, I propose that the architect's role becomes that of the custodian of the physical environment. This would be a balancing act between caretaker and curator of the spatial environment, which entails re-organisation of the built environment where necessary, while conserving and restoring physical ecosystems for all. And finally, we can carefully cultivate architecture for authentic human emotional and visceral phenomenal experiences.

Cities are designed to repair and regenerate ecosystems to integrate plants and animals with biophilic characteristics, with consideration of landscape and geography and appropriate conservation of heritage while finally balancing new architecture for physical and visual enjoyment from human

perceptions. Infinite growth may not always be the aim, but rather sustainable change.

With the last element of the Vitruvian triad, *venustas* (or aesthetics) conserved - this signifies perhaps the continuing life of architecture in the face of artificial intelligence.

Determining Our Architectural Future: Dystopia or Utopia

The distant future of architecture in the age of artificial intelligence presents a dichotomy between potential dystopia and hopeful utopia. The spectre of a world where AI dominates, leading to the atrophy of architectural thought and creativity, challenges us to reflect on what we value in our creations. Conversely, a vision of architects as custodians invites a renewed focus on integrating human values, ecological sustainability, and aesthetic richness into our architectural aspirations. Ultimately, this utopian future where architecture not only survives but thrives alongside AI is not predetermined, it requires our active engagement, ethical foresight, and a commitment to preserving the very human essence that makes architecture meaningful.

The two images presented in this essay are the result of transformative digital collage by the author from multiple sources including found AI generative design images. While AI image editing such as Krita AI Diffusion has been attempted in the collage, it has not been used in the compilation process of the images.

Yang Yang is the lead author in this essay and some of the thoughts presented here are the result of conversations with Computational Architects Andrei Smolik and Patrick Bendall.

05

The Artist's

Process:

Unpublished Perfection



Clare Reid

Clare Reid is the newly appointed CEO of Lush, with a background in brand strategy and feature writing. Experienced in communications, she has worked with clients like UWA, Amazon Web Services, and the Aboriginal Cultural Centre. A published writer and workshop leader, Clare holds a Master's in Creative Writing.

Atrophy and AI

shave as a
pic so AI can't have it
or is she stripping words
from pictures now?
I'll post it.

but I ~~and~~ remember her

She was in pain, she was grieving

She had a ~~lust~~ ~~lust~~ lust so red

it painted my cheeks

and stripped me

back to just
freckles & scars

Stream of consciousness

That's what I
have. Mistakes.

I'm a mistake

Is this an exercise in competing with AI
who made this thing? Is it good or bad?

Can I walk to field ~~was~~ beyond that
with Reem Das as our guide?

I've competed, compared, copied so
many women ~~over~~ better than I
~~# started~~.

Beautiful, bold, brave
~~the~~ Blonde, brunette, red,
grey, black, pink

I've studied them

worn their clothes

Copied their rituals

Ritualised them - the version they show
But...

I don't aspire to be you. Your worst parts
are me already.

IS THIS stream of my consciousness
ENOUGH?

I'm a woman, 37, decades of pages
under my skin

I can sit, slightly twisted to the left
so the lumps on my liver don't push
into my ribs.

I can light a candle in a small room
to the back of a home I just bought
selling my words, my ideas,
and my time away from my daughter
I can be human.

I can even prove it.

~~In the face of a bubble,~~

not just with lust and hunger
or a grief thick like day-old gravy
swimming between my shoulder
blades.

If I hunch after decades of protecting
my heart. will you believe me then?

You.

Who ~~are~~ are you? Me. The version
published online. The version I edit
and clean, ~~and~~ filter and present
as 'me'. You are she. But, is
she true?

The pages behind this one ~~say~~ ^{scream} NO
Streams, rivers, puddles of poured out
consciousness.

In flow, un published, un criticised
Me. ~~Bleeding ink.~~



Atrophy and AI

Every artist, dare I state with such binary conviction, questions the value of their work. And by extension, the value of themselves. We look to others in our discipline with jealousy and lust; their published works are so clearly a showcase of effortless flow, while our own attempt is nothing but the shadow of an idea so fleeting it could be mistaken for a single breath expelled from one of eight billion.

This breath, ephemeral ideas, the shadows of self-doubt, our implausible jealousy; we now conjure these random selections of humanness as a way to make our art matter in a time where AI can replicate our finished work with advancing accuracy.

But what about the unfinished? The unpublished? Our process—and all the random humanness it evokes—has the power to keep us alive in the face of an advancing data 'artist'.

The writing exercises, the scraps of paper that never make it beyond our bedside tables, the early morning streams of consciousness that cease to exist without...well, consciousness. It is our work as artists in 2024 and beyond to know that process as sacred. It is a valuable artefact of our art that can never be replicated—in fact, in the face of AI advancement, it is a muscle we must collectively grow to prevent atrophy.

Hold your mistakes. Quote spiritual spokespeople where the names of poets should be. Let your consciousness stream as the process of artist holds you as human.

06

The Essence of Human Creativity in the Age of AI



Isaac McCormack

Isaac is a digital artist, Architect at GHD Design, and casual academic at Curtin University, specializing in architectural design. Drawing on his First Nations heritage, he explores the intersection of indigenous culture and contemporary urban landscapes, notably through the Fourth City Project, integrating traditional land management with modern architecture.

Atrophy and AI

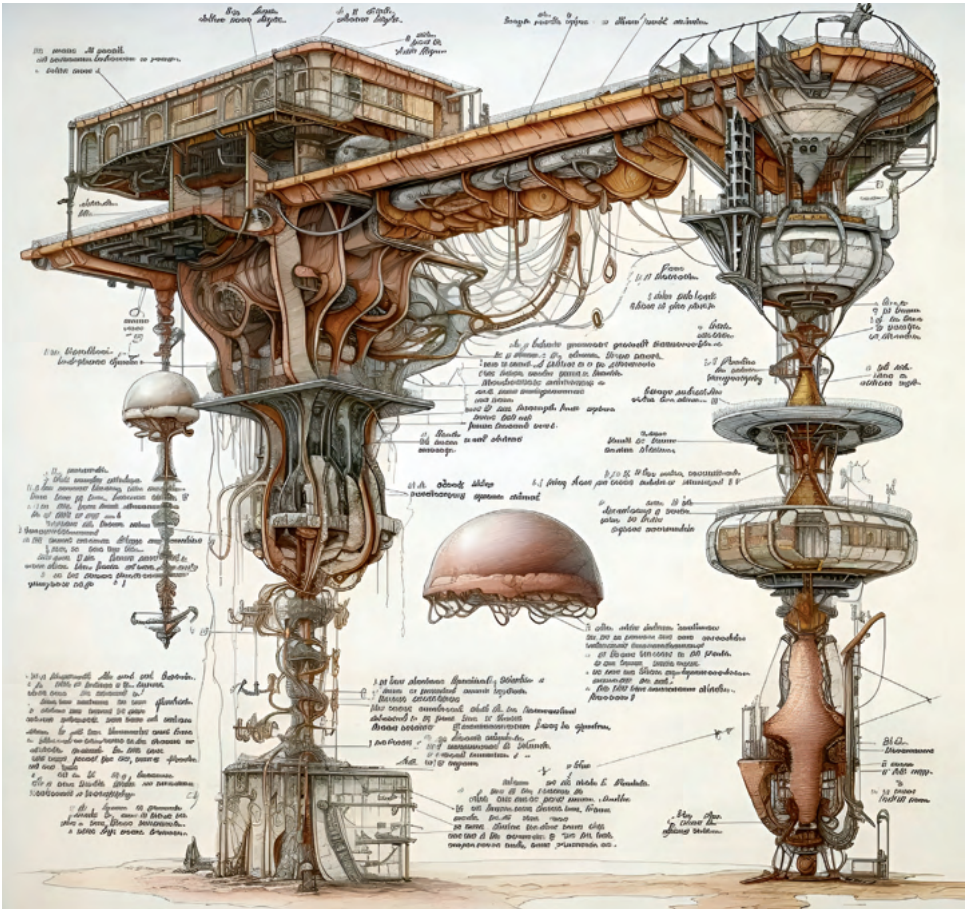


Figure 1. Isaac McCormack, Column A, Midjourney, 2024 – Generated through Midjourney using prompts like unique, bio, codex, complex & interlinked, digital medium, © Copyright Isaac McCormack, Courtesy of the artist.

Art has always been a testament to human effort, a physical manifestation of the time, care, and emotion an artist invests in their work. Each brushstroke, chisel mark, or carefully chosen word encapsulates personal stories of struggle, growth, and transformation.

As we enter an era where artificial intelligence (AI) can effortlessly render any image, no matter how complex, we are compelled to reassess the role of human creativity in this new landscape.

The Metamorphosis Project Journal

What is art if not the embodiment of personal journeys driven by an innate need to create and share?

The advent of AI's ability to assist with and even replicate human creativity raises profound questions about the role of technology in the arts. For instance, in a recent competition I entered called the AI Column competition I asked for designers to harness AI in redefining one of architecture's most iconic structural

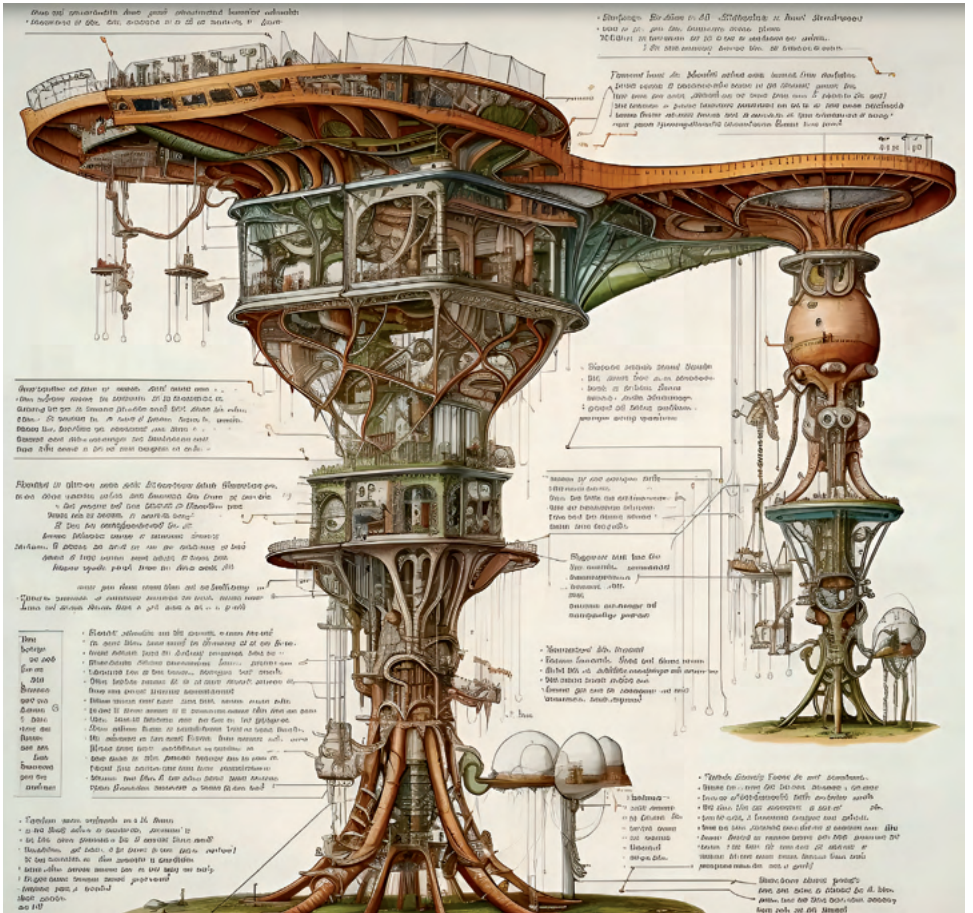


Figure 2. Isaac McCormack, Column B, Midjourney, 2024 - Generated through Midjourney using prompts like unique, bio, codex, complex & interlinked, digital medium, © Copyright Isaac McCormack, Courtesy of the artist.

elements. This competition challenged participants to push the boundaries of what's possible with AI technology. Designers from various disciplines, particularly architecture, were tasked with creating a column that is not only structurally functional but also visionary, exploring possibilities like environmental interaction, dynamic load adaptation, or the use of revolutionary materials and forms. (Figures 1 and 2), my collaboration with AI manifested in a unique and meaningful experience. The real value of this collaboration

emerged through a process of refinement—where my personal style and the AI's artistic potential melded together in this case using Midjourney and other Generative Adversarial Networks (GANs). This iterative process mirrors traditional design methods, where continued exploration and revision lead to profound solutions never originally considered. This raises a critical question: Are we witnessing an evolution of our established artistic processes, or are we stepping into an entirely new frontier? Throughout the competition, my focus on



Atrophy and AI

refining and expressing myself through generative AI art added layers of meaning to the final designs Figure 1 and 2. The danger in settling for a single generative image without further iteration is that the result can feel uninspired, lacking the depth that comes from a more deliberate process. My experience reflects this—when I engage deeply with AI, going through multiple rounds of revisions, the final product becomes more beautiful and meaningful. This approach is similar to traditional art and design processes, where we iterate until we achieve a result that aligns with the artist's vision, allowing them to express their thoughts and ideas exactly as they intend. (Figure 3).

Reflecting on my work from the AI column competition, the art produced in a single day with AI was a fun and exploratory journey. It was an experience I enjoyed, discovering what AI and I could create together. However, when compared to my work on *City 4* (Figures 4 and 5), exploring into my cultural heritage alongside an exploration of urban spaces on a global sociological level—the difference is stark. *City 4* is deeply personal, interweaving my individual heritage with universal themes of cities and societal structures worldwide. It represents a journey that shaped me as much as I shaped it. The piece began as field sketches from travels through various cities, evolving over five to six years into a layered composition—a medium I consider collage. This process unfolded through stages of art and illustration, transforming 3D models into intricate linework, later enriched with collage and colour. In contrast, Figures 1 and 2, generated in a single day using AI, reflect the immediacy and efficiency AI brings to artistic creation. While AI enables rapid visualization, the lengthy, introspective process behind *City 4* allowed for a deeper, more profound influence on both the work and my own development as an artist. The AI-generated pieces might be considered more technically beautiful and better crafted in many respects. This juxtaposition raises an

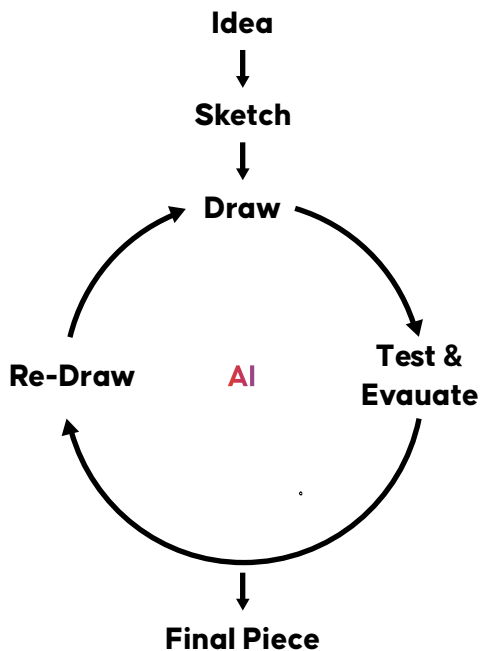


Figure 3, Isaac McCormack, *Artistic refinement diagram*, 2024 – AI does not have to replace us in the artistic process. Instead, it augments steps, sitting in the centre of the refinement process. © Copyright Isaac McCormack, Courtesy of the artist.

important question: Does the value of art lie solely in its technical execution, or is it found in the effort, the process, and the personal connections we forge through creation?

AI and generative technologies offer unprecedented opportunities for those who have previously lacked the means to express themselves creatively. These advancements democratise creativity, allowing more voices to be heard and more stories to be shared. However, this also opens a dialogue about the potential consequences of this democratisation. Will it enrich human language and creativity, preventing the atrophy of our cognitive and artistic capabilities? Or will it lead to a homogenization of art, where original



Figure 4. Isaac McCormack, *Column, Manufactured Organics*, Collage, 2021 – A piece created for the City 4 project exploring the idea manufactured greenery and the way the cities integrated with nature at their fringes, © Copyright Isaac McCormack, Courtesy of the artist.

ideas are lost in a sea of rehashed content? The subscription model of art creation, facilitated by platforms like Midjourney and DALL-E, draws a historical parallel to the patronage system, where artists were commissioned to produce work according to a benefactor's desires. This modern model raises questions about the value of art in society

today. Just as the ability to consume meat, once a luxury, has become commonplace, the ability to create art has now been extended to the masses. However, this democratisation may also lead to the devaluation of art, as the proliferation of AI-generated images—especially those that mash up existing intellectual properties—suggests a potential

Atrophy and AI

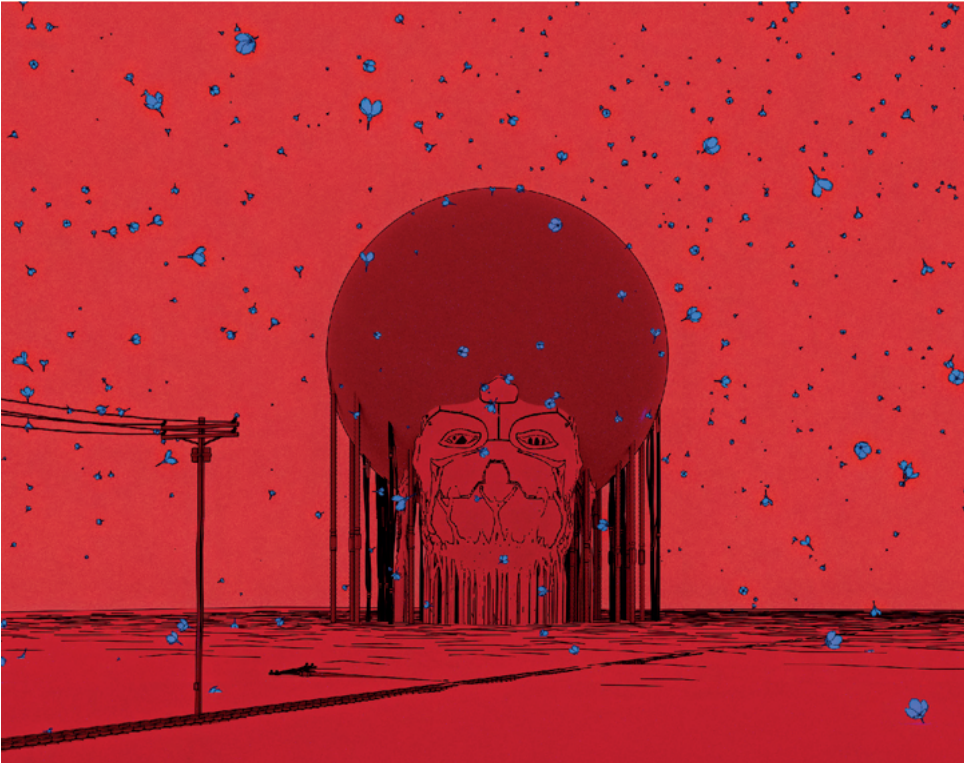


Figure 4. Isaac McCormack, *Column, Manufactured Organics, Collage*, 2021 – A piece created for the City 4 project exploring the idea manufactured greenery and the way the cities integrated with nature at their fringes, © Copyright Isaac McCormack, Courtesy of the artist.

erosion of artistic worth. Moreover, the notion of democratisation itself is questionable, as large corporations effectively control the means of producing art, potentially limiting artistic expression. Much like the painter or sculptor of the past, who had to render the ideas of the oligarch or state, artists today might be constrained by what the AI models have been trained on or what is deemed acceptable by corporate or individual interests, rather than engaging in true artistic expression.

We've seen how streaming services have transformed the film industry, prioritised intellectual property and creating sprawling franchises to keep audiences engaged. Every

new release seems to be part of a trilogy or universe, reinforcing the stories that previous generations have already been told. Will AI exacerbate this trend of sequels and reboots, leading to an endless cycle of recycled ideas? Or will it empower new creators, allowing them to produce original stories and worlds that resonate with fresh audiences?

Humans have long valued exclusivity and craftsmanship, particularly in art and luxury goods, where these qualities reflect the time, effort, and unique personal touch invested in each creation. This appreciation can be seen in the contrast between a Rolls-Royce and a Toyota: while both serve functional purposes,

the Rolls-Royce is revered for the thousands of hours artisans dedicate to hand-stitching its interior and refining every detail. The Toyota, though reliable and efficient, is quickly assembled by machines for mass consumption. Similarly, as AI becomes a tool in the artistic landscape, making creative tools accessible to a broader population, we may witness a similar distinction in the realm of artistic creation, where certain works achieve higher regard based on craftsmanship and exclusivity.

This shift raises questions around taste, judgment, and authenticity that echo the writings of Immanuel Kant, who argued that aesthetic judgment is shaped by a universal sense of beauty, a collective discernment that transcends mere preference (Kant, 2013). In this sense, we often perceive 'handmade' art as superior, associating it with an artist's soul and genuine connection to the piece—a sentiment AI may struggle to evoke. Moreover, Kant suggested that aesthetic experience requires active engagement and reflection, qualities often missing in the rapid, on-demand outputs of AI-generated art. Yet, AI also democratizes the process, enabling many who may lack technical training to create pieces with professional "polish". This democratization, however, may lead us to value works not by the traditional criteria of skill and labour but by personal connection and meaning, such as a child's painting, joyfully smudged with bright colours and cherished not for technique but for sentiment.

Walter Benjamin's *The Work of Art in the Age of Mechanical Reproduction* provides another lens through which to view the impact of AI on artistic value. Benjamin argued that the mass reproduction of art erodes its 'aura'—the authenticity tied to an artwork's unique existence in time and place (Benjamin, 1935). In a world where digital reproductions are endlessly replicable, AI further dilutes this aura, producing countless variations with ease. This has already begun with the rise of NFTs (non-

fungible tokens), digital assets authenticated on the blockchain, which ironically attempt to reclaim an aura by assigning a 'unique' digital provenance to otherwise infinitely reproducible pieces. Many high-value NFTs, like AI-generated works, illustrate both the appeal and complexity of technological exclusivity in art; while some NFTs have sold for extraordinary sums, the debate around their artistic merit persists, often questioning the value of works produced with minimal human intervention.

Yet, we must challenge the notion that AI's democratization of creativity is universally accessible. AI tools, often celebrated for broadening creative access, are frequently gated by paywalls, hardware requirements, and consistent internet access. For many, experimenting with traditional media, such as charcoal and paper, remains a simpler, more affordable way to explore creativity without navigating the technical and financial barriers associated with generative AI tools. These limitations reveal a paradox in AI-driven creativity: while it lowers the technical skill required to create works, it introduces new forms of privilege in terms of access. Digital creative tools like Adobe Creative Cloud or MidJourney enable artists to achieve impressive visual effects, but they also set a high entry bar, posing the question of whether AI democratization truly extends to all or remains a domain where socioeconomic status continues to play a decisive role.

Moreover, in a world where AI can produce hyper-realistic or surreal works, we may find ourselves re-evaluating what we cherish most in art. While AI art can dazzle with technical precision, it often lacks the personal narrative embedded in human-made art. They remind us that while AI can elevate technical aspects of art, it often cannot replicate the messy, deeply human qualities of fingerprints smeared onto paper by someone we love. The democratization AI promises may eventually bring more polished art into our lives, yet it



Atrophy and AI

also compels us to re-assess what we value in art: is it the technical prowess that AI offers, or the intimate, imperfect expressions that capture something essential about the human experience?

As we navigate this evolving landscape, the future of art may be one where these contrasts coexist—a world in which AI democratizes skilful creation, yet the works that touch us most remain those that reveal the imperfections and unique perspectives of the human hand.

The process of creating art, whether with AI or traditional methods, adds value and personal significance to the artist. The journey of exploration and refinement imbues the work with meaning, both for the artist and those who engage with the art. This effort is what preserves the essence of human creativity in an era of advancing AI. To maintain this essence, we must strive for a balanced, symbiotic relationship between technology and human expression. AI should complement rather than replace human creativity, enhancing the artistic process while ensuring that the artist's originality and personal expression remain at the forefront.

Education and training are crucial, equipping artists with the skills to use AI tools without losing their artistic vision. Ethical guidelines are also necessary to uphold the integrity of human creativity, ensuring that AI's role in art remains supportive rather than dominating. One of the most significant concerns about the rise of AI in art is its potential to lead to homogenisation, where art becomes less about personal expression and more about generating aesthetically pleasing but ultimately generic images. To counter this, it is essential to prioritise originality and personal expression in the creative process.

We must be vigilant in preserving human creativity, as humans are so ready to give up our abilities if we feel a computer or algorithm is better. I can no longer remember phone

numbers or directions, as I explicitly trust the machine with this process. However, we must not let this happen with creativity and artistic expression.

Consider a painter who uses AI to experiment with colour schemes and compositions. While the AI might suggest combinations that are technically proficient and visually appealing, the artist can infuse their personal experiences, emotions, and cultural background into the final piece. The AI-generated suggestions become a foundation upon which the artist builds something uniquely their own, blending the machine's precision with their human touch. Moreover, by promoting diversity in creative inputs and shifting the focus from the final product to the creative process itself, we can celebrate the unique contributions of human creators. Supporting traditional art forms and fostering public discourse around the role of AI in creativity will help ensure a broad range of perspectives in shaping the future of art.

The integration of AI into the creative process heralds both exciting opportunities and significant challenges. While AI holds the promise of democratising creativity and making artistic tools accessible to a broader audience, it also risks diluting the very essence of what it means to be human and creative while also closing off the means of artistic production behind corporate and individual interests. The potential for AI to redefine artistic expression is immense, but it comes with the danger of eroding the unique qualities that make art a profound reflection of our shared humanity.

As we stand on the brink of a new era, the integration of AI into art must be approached with caution to ensure that technology enhances rather than overshadows human creativity. Without careful management, we risk a future where personal expression and the depth of individual stories are lost in a sea of recursive meta-generated content, leading to

Thinking **Deep** about Deep **Learning** in the **Chemical Space**



Dennis Power

Dennis Power is a synthetic organic chemist with a BSc (Honours) from the University of Western Australia. During his postgraduate studies Dennis spoke on the global stage of TEDx UWA and worked abroad at the prestigious Leibniz Institute for Catalysis in Rostock, Germany. Four years of a PhD exploring nickel catalysis led Dennis to discover his talent for science communications.

Atrophy and AI

THE rapid introduction of artificial intelligence (AI) has been met with a torrent of fear rhetoric—many asking, will this new tech leave a carnage of cognitive atrophy in its wake?

But there's another question that begs to be explored: what do we stand to lose if we do not adopt AI? When future anthropologists look back to compare modern humans with our pre-AI selves, perhaps they will not observe a decline in cognitive ability, but rather a sliding doors moment when we chose progress—to enhance our skills as a more advanced version of the explorers we have always been—over atrophy.

The sciences have never shied away from a new discovery on the brink of 'changing everything'. When Copernicus placed the Sun in the centre of the universe it was groundbreaking and led to a major scientific revolution. Of course, let's tread carefully, after all the theory of heliocentrism was later superseded when we realised that we were just a solar system floating in a far greater universe. In this same way AI has the potential to change everything, why not let it?

It doesn't require a stretch of the imagination to conceptualise the benefits that AI could bring and is already bringing. Let's take my field, synthetic chemistry, where foremost amongst its application is in chemical properties prediction as well as reaction outcome prediction, retrosynthesis, and molecular design (Baum et al., 2021). These applications are attracting a lot of attention in the pharmaceutical sector—the process of designing new drugs is costly in time, money, and resources and there's urgent need for a faster, more efficient way to discover and develop new medicines.

So, we turn to AI for the answers, and understandably so; its aptitude for quickly processing large volumes of data with high

accuracy make it the ideal researcher. But therein lies the current challenge; meaningful results are subject to the availability of reliable data and our ability to process it.

In instances where the data is lacking, the challenge is centred around how to accurately record all of the variables that go into (and out of) a chemical reaction and subsequently convert them into an AI legible format (Lin & Mo, 2024). Because every chemical reaction is entirely unique, a nuanced approach is needed to account for chemistry of the past, but also that of the future. One potential avenue currently being explored is the invention of new data collecting apparatus. Chemists are rethinking the ways reactions are performed, inventing sensitive equipment to monitor them every step of the way and automating processes to quickly establish reliable, calibration standards.

Due to the precise nature of AI and the vast complexity of the tasks we apply it to, very specific models, such as Deep Docking for drug docking prediction (Gentile et al., 2022) or RetroExplainer for retrosynthetic predictions (Wang et al., 2023), are required; researchers are asked to draw on their artistic arsenal in a way that AI cannot replicate. The result? Tailored algorithms, led by human ingenuity and executed by AI, that provide novel solutions.

Sometimes the data is widely available but the ability to process the results is the challenge. For instance, the staggeringly large chemical universe database GDB-17 (Ruddigkeit et al., 2012). A deep learning generated library, GDB-17 contains 166.4 billion small molecules comprised of up to 17 atoms of potential pharmaceutical relevance—it's an enormous haystack filled with needles, but with human intuition leading the search, and the thick leather gloves of further AI manipulations, we could find the answers we seek. We humble humans simply can't achieve this level of data

processing in any single lifetime; but, when we employ AI we're free to remove our data analyst's lab cloak and return to our roots as curious explorers in a world of unknowns.

One of the most confounding elements of chemical research, and an area of concern for the atrophy of humankind, is the lack of transparency with negative results. This atrophy of our scientific method prevents us from identifying our knowledge gaps, revising our current theories, and ultimately, preventing other scientists from making the same mistakes. Null data has the potential to add resolution to our currently blurred data landscape and will no doubt become a prized asset in any AI database (Strieth-Kalthoff et al., 2022). Rather than creating atrophy, I predict that the increased demand for reliable data will see an upsurge in collaboration within the scientific community and the free exchange of negative results. For example, the Pistoia Alliance: a non-for-profit organisation comprised of more than 200 company members sharing pharmaceutical information to expedite research and development. They have outlined one of their key missions for the next several years to be in AI research. I have no doubt that this trend will continue until data sharing global partnerships are the norm and the contemporary siloes become a thing of the past.

Of course, we need to be astute in our collective and individual explorations. If we were to blindly follow the recommendations of AI, disregarding compounds and reactions because they lay outside of the conceptualisations of the algorithms applied, potential breakthroughs may never come to be. Many of the greatest historical chemical discoveries have been coincidences. You may already be aware that penicillin was discovered because of the uncleanliness of microbiologist, Alexander Fleming, who noticed his dirty Petri dishes prevented bacterial growth. Then there's Viagra, a drug

initially designed to combat angina without success, although it works wonders for men suffering from erectile dysfunction. The curious nature of scientists allowed for these serendipitous discoveries; therefore, it is vital that our curiosity doesn't atrophy. Instincts, ingenuity, and yes, even 'mistakes' are vital for progress. I believe that, with the adoption of AI, we will be encouraged to foster our instincts and train our curious creativity to spot those breakthrough moments.

Like Copernicus, let's be bold in our imaginings. In the field of synthetic chemistry, critical thought in collaboration with artistic thought is essential for the next big scientific revolution. It is how we explore the world around us, our curiosity for what could be, that makes us human beings and prevents the atrophy of our species. AI offers tantalising promises of saved time, money, and resources for tackling our most pressing problems while giving us opportunity to explore our creativity... an opportunity too great to shy away from. Moving forward it's essential that we learn to harness the power of AI with deliberation, let it activate our imaginations, while addressing the potential pitfalls with advancing curiosity rather than fear.



08

In Conversation with **The** **Science Gallery** **Melbourne**



Ryan Jefferies

Director of Science Gallery
Melbourne

Dr Ryan Jefferies is Director of Science Gallery Melbourne and the Grainger Museum at the University of Melbourne. He is a passionate advocate of the blurred intersections between arts, technology and science and has held previous roles at Murdoch University, the University of Western Australia, University of Bristol and Museums Victoria.



Mel Huang

Academic Fellow & Lecturer at the Uni-
versity of Melbourne

Mel Huang is an interactive designer and developer for the art and culture sectors collaborating with organisations such as Powerhouse, NGV, Dark Mofo, Asia TOPA and The Australian Ballet. She is currently the Academic Fellow (Art and Computer Science), as well as Lecturer at The University of Melbourne.

Interviewer: Jennifer Halton

JH: Ryan, what is the mission and vision of the Science Gallery Melbourne? Can you share a bit about your background and what drew you to the intersection of Science and Art?

RJ: Science Gallery at the University of Melbourne's journey started with a provocation from young people - that the gallery should be a "porous membrane, a vortex of new possibilities". It was this starting point that led to an ambitious new gallery that ignites curiosity, experimentation and creativity at the intersection of art and science for a young adult audience. The gallery is a place for young people to spark new ideas and is part of a global network of galleries pioneered by Trinity College Dublin, and now includes galleries in London, Atlanta, Monterrey, Bangalore and Melbourne. This international ecosystem of university-linked galleries has a common mission to inspire and empower young people through the collision of art and science. With the belief that young people can tackle some of the greatest global challenges of our time, the gallery empowers the next generation with new ways of thinking and to spark ideas around radical action on challenges like the climate crisis, mental health and the rapid rise of our own technology.

I am Director of Science Gallery Melbourne at the University of Melbourne and have over 20 years' experience within the cultural sector and as a research scientist at leading Australian and international institutions. I am a passionate advocate of the blurred intersections between arts, technology and science and the bold promotion of social change through disruptive and speculative creativity. I am also Director of the Grainger Museum and have held previous roles at Murdoch University, the University of Western Australia, University of Bristol, Western Australian Museum and Museums Victoria. I have a PhD in Biomedical Science, which explored researching blood-borne infectious

diseases and my interest in the intersection of Science and Art began early, training as a taxidermist as a teenager and then later become inspired by the work of the Wellcome Collection in London and the intersectionality of medicine and creativity.

JH: Mel, can you share a bit about your background and work as an interactive designer and how your role as an academic researcher intersects with art, design and technology?

MH: I am a Melbourne-based interactive designer and creative developer for artists and cultural institutions and my creative practice spans works across data visualisation, interactive design, creative hardware and live performance.

I am currently the Academic Fellow (Art and Computer Science) and Lecturer at the University of Melbourne - which is a unique joint role between Science Gallery Melbourne and the Faculty of Engineering and Information Technology to facilitate public outcomes and collaborations bridging research, art and technology. I've also been a long term collaborator of Science Gallery Melbourne bringing to life art x science works since the inaugural exhibition, BLOOD.

In short, I've always been fascinated with art, design and technology, and I didn't want to have to choose between them!

JH: What specific philosophies, experiences or projects have most influenced your approach to the intersection of art and science?

RJ: I strongly believe in the philosophy of Absurdism, that life has no meaning and that we create our own unique meaning in our lives. Equally life is chaotic and messy, and doesn't fit neatly into distinct discipline boxes that we've increasingly created through our education systems. This reinforces the



Atrophy and AI



The Science Gallery Melbourne, *Harmony* by Matt McMullen/Realbotix, 2020, photograph, © Copyright The Science Gallery Melbourne.

importance of interdisciplinary practice and that the intersections of art and science can spurn new ways of thinking, problem solving and innovation – all of pertinent importance as we adapt to the climate crisis and the rapid rise of our own technology.

MH: Artists and what they make with technology never fails to surprise and energise me – especially when the technology they've chosen wasn't necessarily created for that purpose. That and the speed-of-light pace of the emerging technology landscape. Not because of all the latest gadgets and gizmos that come to market but more about the constant stream of new and emerging ways in which artists engage with technology in their practice, regardless of the age of the technology itself. It feels never ending.

JH: As you know, the theme of this Issue of *The Metamorphosis Project Journal* is "Atrophy and AI". When you hear the term 'atrophy' in relation to AI, what does it evoke for you, particularly concerning human cognition and creativity?

RJ: Atrophy and AI makes me think of the

cognitive decline of the human brain as we become increasingly dependent on AI to help us understand and navigate the world. From a biological perspective I believe the rapid advancement of AI will lead to new forms of advanced life. Self-replicating AI and technologies will reach the point of singularity and exceed the biologically-limited intelligence of humans. Unless we merge-ourselves with AI to become advanced cyborgs, our reality is at best that humans will simply become pets for AI and at worst will lead to our extinction.

On a more positive note, it also makes me think of the atrophy of traditional forms of creativity and the value generative AI will bring as a powerful tool to enhance human creativity and innovation.

MH: I think the first thing that comes to mind is the public narrative around the death of human creativity and creativity's replicability through these AI systems. Although I believe there are no doubt some problems ethically around how these systems were and are being built, I also believe in the vastness and intricacies of the human mind and at its core, human creativity and adaptability. Sure, technological progress will mean some things will change and be

impacted in the creative industries, but I think that is always true no matter what technology is on the horizon. Is illustration less valuable as a process because you can seemingly “generate” something similar? Is creativity merely an output of a series of directions? I don’t think we’re giving human creativity enough credit. If anything, it highlights how misunderstood human creativity is and its value in society.

JH: As society becomes more reliant on AI, what do you believe we might risk losing in terms of our cognitive abilities?

RJ: At a time of mass-information and misinformation, the real risk is that we lose any further space in our brains to effectively function and become overloaded with information. AI therefore becomes the opportunity to actually enhance our cognitive abilities by sifting information and allowing space and time to be more creative.

MH: Well I guess the phrase is, “if you don’t use it, you lose it”. So if we stop thinking, learning, creating, questioning, we lose that “muscle” in our toolkit but I don’t believe things like ChatGPT will be the death of “why humans write stories” just like I don’t think that you shouldn’t learn to code because Copilot can do it for you. There will always be a necessity in society for the artisan and the passionate, that can’t be replicated.

JH: Do you think it’s possible to prevent cognitive and creative atrophy as AI technologies become more endemic to creative and design processes, or do you see it as an inevitable part of our evolution alongside technology? Do you view human and technological collaboration as broadly utopian, or dystopian?

RJ: I don’t buy into the ‘utopian vs dystopian’ binary because one person’s utopia is often another person’s nightmare. For now AI is an exciting tool to be used by us and in the future AI will develop its own independent creativity.

Both humans and our technologies are both part of nature and will be driven by the laws of natural selection, hence co-evolution is likely. This was a feature of Science Gallery Melbourne’s recent exhibition NOT NATURAL, which included Robert Hengeveld’s ‘Kentucky Perfect’, a robot dedicated to carefully manicuring a stretch of lawn or research by the TIGRR Lab at the University of Melbourne that uses AI to de-extinct the Thylacine. What is inevitable is that the future world will constantly be different, changing and evolving. Our understanding of creativity will evolve too. Some AI will be beneficial to humans and some will definitely not be.

MH: As you may have guessed from my previous responses I’m on the techno-utopia side of the argument. I’ve always seen technology as a complement and tool for creative practice just like you could view any other medium – but it isn’t why my practice is creative.

Like all things in life, I foresee the role of human and technological collaboration, will be neither utopia or dystopia but somewhere in the middle. We will sacrifice some things to gain other things. More importantly, I believe as a society, we need to shift the social perspective of “using” technology to the idea of “creating” technology so rather than simply consuming and learning to “use” the tools and devices given to us – be active participants in creating, supporting and evolving what these tools and devices could potentially be.

JH: What opportunities or challenges do you see arising from the integration of human-led design and generative AI? What ethical issues concern you the most in this relationship – if any?

RJ: In embracing AI as a creative partner, we find ourselves on a journey that challenges our understanding of art and the creative process itself. As we step into this uncharted territory, we should question whether AI and human



Atrophy and AI

creativity will harmoniously coexist. Or will the ethical concerns be ignored, with AI replacing human art rather than remaining a tool that enriches and complements it. Deep human bias is a major ethical concern. Algorithmic bias in generative art is actively explored by AI artist and researcher J. Rosenbaum, whose work often highlights the cultural force of cis white male dominance behind these algorithms. J's work interrogates inherent gender bias and delves into concepts that are post-human and post-gender, such as in the interactive conceptual artwork *Frankenstein's Telephone* (2020).

JH: In your view, how is the role of the artist evolving in the age of AI? What new perspectives or responsibilities do you think artists will need to adopt? And, how will academia and research need to adapt in this environment to preserve critical thinking, empirical knowledge, and human agency?

MH: Perhaps not the role of the artist per se, but as the role of technology becomes increasingly more prolific in our society, it is becoming clear that globally we need more diversity of voices in the process of building technologies – and that includes artists and creative thinkers. Whether that's in an academic, research or industry setting, I think the age of AI will highlight all the things we can replace and optimise to our benefit but also, similarly, what AI can't replace. For the things we can replace, we'll need to adapt our approach and use it to evolve our value as humans in that context and for the things we can't replace like critical thinking and creativity, I believe (and hope!) we'll start to see more value placed on those types of skills in the future.

JH: What kinds of partnerships and projects are you exploring at the intersection of art and technology at the Science Gallery? How do these collaborations address the implications of AI in our lives?

RJ: Art and technology are a regular feature of all Science Gallery exhibitions. We've facilitated numerous collaborations and commissions that often connect artists with computer scientists with surprising outcomes. *Biometric Mirror* by Sci-Fi artist and body architect Lucy McRae and computer scientist Dr Niels Wouters explored the ethical considerations and bias of facial biometrics. The outcome was an experiential sci-fi beauty salon, in which visitors had their face assessed for on multiple characteristics, including age, sex, emotional state and level of introversion. The experience further included a 'digital facial' involving the participants face being morphed mathematically 'perfect' version based on the ideals of the Marquardt mask developed by a Hollywood plastic surgery. *Scrape Elergy* by artists Willoh S. Weiland and Monica Lim, in collaboration with Centre for Artificial Intelligence and Digital Ethics researchers Gabby Bush and Misha Mikho subverts the way we use social media to reframe how we view our online presence. *Ngapulara Ngarngaryi Wirra* by former AFL footballer and Australian of the Year Adam Goodes and Dr Baden Pailthorpe is a cultural dive into the significance of Indigenous data sovereignty and digital creativity expressed through the Adnyamathanha kinship system.

JH: Looking ahead, what is one possible future you each envision for humans coexisting with AI in the next 50 years? How do you think our relationship with technology will evolve (or devolve)?

RJ: Definitely a future of cyborgs! We will see a future where human biology will co-exist with AI.

09

In Conversation with the **Institute** for **Art &** **Innovation** (Berlin)



Nicole Loeser

Director of Institute for Art & Innovation

Nicole Loeser is an international art curator, serial entrepreneur, and PhD student in Social Art for Transformation. As Director of the Institute for Art and Innovation, she leads interdisciplinary projects combining design, technology, and systems innovation to drive sustainable change. She also teaches at universities globally, promoting regenerative futures.



Atrophy and AI

Interviewer: Jennifer Halton

JH: Can you tell us about the founding vision of the Institute for Art and Innovation and what inspired you to create this space in Berlin?

NL:The Institute for Art and Innovation (we call it the IFAI) was founded in 2017, driven by a vision to merge art and innovation as powerful tools to tackle societal challenges and catalyze systemic shifts. Before this, I ran my gallery, WHITECONCEPTS, until 2020, when I had to close it due to the COVID-19 pandemic. During that time, I curated over 300 interdisciplinary projects also for museums and other institutions, engaging artists in public interventions, dialogue formats, and topics at the intersections of art and neuroscience, financial systems, ecology, gentrification and peacebuilding, all topics that no one seemed be interested in.

Co-founding IFAI with a digital innovation strategist, our mission was to create a platform where artists, scientists, technologists, and policymakers could work together to tackle issues like sustainability, social justice, and technological evolution. Though we initially considered naming it the Institute for Social Art and Innovation, we felt that in a tech-driven world, focusing on both art and innovation better captured the dynamic impact we wanted to make.

The Institute for Art and Innovation (IFAI) was founded in 2017, driven by a vision to merge art and innovation as powerful tools to tackle societal challenges and catalyze systemic shifts. Two of our first projects, The Universal Sea and the Social Art Award, had a huge impact. The Universal Sea became one of the most impactful EU-funded projects, engaging over 5 million participants in 12 European

countries and another 1.5 million online, and we were invited to present it at SXSW in 2022. The Social Art Award recognizing the work of socially engaged artists has also made a significant mark, with applications from 155 countries in its latest edition, further highlighting the global reach and relevance of our initiatives.

Since then, IFAI has evolved into a conglomerate of projects, driving change with our amazing team of volunteers, freelancers and project partners at the intersection of art, science, and technology. Today, we focus on initiatives like youth participation in political decision-making, the Ocean Future Lab, the Art For Futures Lab, and Green Education in Media—all of which aim to ignite sustainable and regenerative worlds. Berlin, with its unique blend of artistic culture and cutting-edge innovation, has been the perfect environment for this vision to flourish.

JH: One of your flagship initiatives is the Art for Futures Lab – an online future museum archiving innovations and scenarios for the year 2050. Firstly, what is a future museum? Could you elaborate on the objectives of the Lab and how it aims to impact the art community and beyond?

NL: A future museum to us is an evolving space that doesn't just archive the past but also speculates and archives future possibilities.

So far, we have an online Miro board, but I'd love to turn it into a 3D or 4D experience. The Art for Futures Lab is an example of this, designed to inspire innovation and reflection through future scenarios. Its objective is to

The Metamorphosis Project Journal

archive and showcase creative innovations, exploring potential futures up to the year 2050. A future museum, to us, is an evolving space that not only archives the past but also speculates and preserves future possibilities. While we currently use an online Miro board, my vision is to transform it into an immersive 3D or even 4D experience. The Art for Futures Lab is a great example of this concept, designed to inspire innovation and critical reflection through the exploration of future scenarios. Its goal is to archive and showcase creative innovations, speculating on potential futures up to the year 2050.

Through this Lab, we have organized more than 100 co-creation workshops across diverse topics, such as the Future of Journalism, the Ocean Future Lab, Sustainable Steel Production, Sustainable Food Production and planet-friendly nutrition, and Sustainable Coastal Futures. We will soon launch a Participatory Foresight initiative for the 15-Minute City. The Lab's objective is to engage the art community in future literacy while connecting broader fields—technology, science, and policy—through these creative explorations. By co-creating alternative and desirable futures, we hope to shape how society tackles long-term challenges, especially in the fields of sustainability and human- and eco-centered technology. On a side note – our Art For Futures Lab also received the German Award for Sustainability Projects in 2024, earlier this year.

JH: How do you view the intersection of art and technology at the IFAI? In what ways do you see artists engaging with technological advancements, and conversely, how are technical teams engaging with and using art in their work?

NL: At the IFAI, we see the intersection of art and technology as a transformative space for innovation. Artists are encouraged to engage with emerging technologies such as AI, digital twins, and VR, not just to incorporate these tools into their practices but to critically examine their societal implications. Through our EU projects, we aggregate knowledge, acting as a learning body throughout, allowing us to blend the creative process with data fiction and storytelling, particularly in initiatives like Green Education in Media.

My approach in last year's Sustainable Futures camp, the kickoff of this EU project was a perfect example of this integration, where students and teachers alike learned about SDGs, green production, design sprints, systemic thinking, developed new media formats based on the Art For Futures Lab method for positive future prototyping. This ensures that technological advancements are embedded in a broader narrative that includes sustainability and future literacy.

At the same time, we see technical teams integrating artistic perspectives into their work, making technology more human-centered, and, where possible, eco-centered. These collaborations foster socially responsible innovations, blending the creativity and emotional depth of art with the technical precision and problem-solving capabilities of technology, ensuring that both fields elevate each other for a more holistic approach to innovation.

JH: With the rise of AI tools in creative fields, what are your thoughts on how they are reshaping the creative process? Do you see these tools as positively transformative, or potentially negatively disruptive?



Atrophy and AI

NL: AI tools in creative fields are undeniably transformative, and I see them as largely positive catalysts for new forms of expression and understanding. They allow us to explore boundaries, generating new ideas, forms, and methods that might not be possible through traditional means. However, it is essential to remain critical and mindful of the disruptive potential AI holds, especially in how it could affect originality, ownership, and the artist's agency.

Using AI seems similar to learning a new instrument. Initially, we are attracted to its capabilities and begin to mirror ourselves in the tool. We may wish to copy what it can do at first, but over time, we learn how to truly use it, enhancing our skills and sharpening our creative senses. AI offers this opportunity, helping us expand our capabilities, but it requires balance. The key is to use these tools to enhance creativity while maintaining the essence of human ingenuity and ensuring that we stay in control of the creative process rather than becoming reliant on the tool itself.

JH: The theme of this Issue of The Metamorphosis Project Journal is "Atrophy and AI." Do you believe that an over-reliance on AI tools might lead to an atrophy of our natural cognitive functions and how we approach creative practice?

NL: There is a valid concern that an over-reliance on AI could lead to an atrophy of our cognitive abilities, particularly in areas like problem-solving and originality within the creative process. If we let AI take over too many aspects of creation, we risk losing the nuance, intuition, and emotional depth that are at the core of human creativity.

However, I believe that if used intentionally

and as a complementary tool, AI can enhance rather than diminish our cognitive capacities, helping us reach new heights in creative thinking *without* losing the human touch. Nowadays, we are increasingly aware of the wicked problems we face due to our broader knowledge and ability to see the externalities of our consumer society. We aspire for economies that are ethical, sustainable, and circular, with many even advocating for degrowth concepts. Yet, we lack the infrastructure and institutions needed to identify the systemic leverage points and pathways to navigate these dilemmas.

AI could help us navigate this complexity and explore the unknown—how to become 21st-century citizens who overcome social injustice, inequality, wars, biodiversity loss, climate change, and water scarcity. But for AI to truly drive systemic change, we need creative minds to interpret small data within the broader context of big data, and as Nora Bateson suggests, we need "warm data" in cold data—the human context and lived experiences that bring richness and meaning to the numbers. Only by integrating these can we use AI to its fullest potential while preserving the human element that is so vital to solving our global challenges.

Additionally, in a time where fake news and misinformation spread rapidly due to misleading algorithms, AI can be a force for promoting factfulness—the use of reliable data, contextual understanding, and fact-based communication to help us see the world as it truly is. By focusing on factfulness, rather than sensationalism, we can ensure that AI serves as a positive transformative tool, guiding us toward more informed decisions and solutions that genuinely address global challenges while preserving the human element.

Moreover, AI offers the potential to broaden our perspective beyond human concerns, integrating a more-than-human approach that considers the well-being of ecosystems, species, and the planet as a whole. By incorporating non-human perspectives into our decision-making processes, we can use AI not just for human-centric solutions but to foster a deeper connection with nature, ensuring that our future technologies support ecological balance, biodiversity, and sustainable futures for all living systems.

JH: How do you see the balance between human creativity and machine-generated outputs evolving in the coming years? Can they coexist harmoniously?

NL: I believe human creativity and machine-generated outputs can coexist harmoniously, but it will require a conscious effort to maintain balance. Machines offer incredible computational power and can generate ideas, but the emotional intelligence and cultural context that humans bring are irreplaceable. The future lies in collaborative creativity, where artists and technologists work together, using machines as tools to enhance, rather than replace, the unique qualities that humans bring to the creative process.

Personally, I'm not a fan of screensaver art, but I deeply respect the work of digital art pioneers and amazing interdisciplinary artists like Laurent Mignonneau and Christa Sommerer, Romy Snijders, and Angelo Vermeulen, who can code their own art pieces and explore bio-art concepts. For me, it's always about the topics and the reflections of our being and acting in the world that capture my interest. Therefore, I'm particularly focused on Social Art for Transformation on ocean issues, which

is also the subject of my current PhD research. I'm interested in how artists can help build cross-sectoral, multistakeholder collaborations and promote open communication, which is still rare in business and administration contexts.

I would love to see more AI applications that help us understand the family of trees, explore the long life journey of a whale, or even enhance our sensory experiences—after all, trees have 15 senses! We need art in the 21st century that reflects the need for systemic literacy, futures literacy, ocean literacy, and, importantly, storytelling for the futures to come—art that helps us critically think about the interconnectedness and witness of our actions, and the world we are shaping for future generations.

JH: I know you are working on some very critical, strategic projects that will shape future policy on big data and AI in Europe. You have talked about the role of data archivists and “care takers” in this context. Can you describe the role of a ‘data archivist’ for our readers, and perhaps share more about these projects?

NL: In the context of big data and AI, a data archivist plays a crucial role as a caretaker of digital information, ensuring that data is ethically collected, curated, and maintained for long-term use. This is becoming increasingly vital as we rely more on algorithmic decision-making and data-driven innovation. Data archivists not only preserve data but also ensure its contextual integrity. Ensuring it's accessible, transparent, and accountable, so it can be used responsibly in shaping future innovations and policy-making.

One of the EU proposals we've recently submitted, on the topic of Co-Designing Blue Futures, focuses on how we can learn from



Atrophy and AI

data and experienced facts, aggregate this knowledge, and apply it to enforce digital twins of the oceans. The project aims to explore possible pathways for policy-making based on the needs of communities and a smart approach to negotiating and adopting new technologies, while also integrating nature-based solutions.

In this context, data archivists would be crucial in ensuring that the data collected and used for digital twins maintains its integrity and relevance. The project proposal also emphasizes the importance of finding creative ways and interfaces to exchange knowledge and foster mutual learning throughout the project's progress, enabling us to combine data, community insights, and technological innovations like digital twins to offer more effective policy recommendations. Although the project is in the proposal stage, our goal is to create a framework for responsible data management that shapes sustainable futures through collaborative, community-centered approaches and nature-inclusive solutions.

JH: In your experience, what strategies can we adopt to leverage AI without compromising our unique creative voices or skills?

NL: The key is to approach AI as a collaborative tool rather than a replacement for human creativity. AI should be used to enhance our processes, whether by automating repetitive tasks, generating ideas to expand creative horizons, or providing new ways to visualize complex concepts. It's essential to retain human oversight and ensure that AI complements, rather than replaces, our creative decision-making.

To do this effectively, we need to cultivate future skills like critical thinking, communication, co-creation, and collaboration, all of which will allow us to navigate this evolving landscape thoughtfully. Integrating futures thinking and systems thinking is also crucial to understanding the broader impact of AI on our creative processes and the world at large. Creatives must remain conscious of AI's limitations and potential biases while also embracing its capabilities to push creative boundaries. This balance allows us to maintain our unique creative voices while exploring new possibilities in collaboration with AI.

JH: On a personal level, how do you engage with AI in your own creative processes? Have you found it enhances your work, or do you prefer to rely on traditional methods?

NL: Personally, I find AI to be a powerful enhancement tool in my creative process. It allows me to experiment with ideas and forms that might not have been possible using traditional methods. However, I always make sure to integrate it with traditional creative approaches, ensuring that the human element remains central to my work. For me, AI is a partner in creation, not a substitute for intuition, emotional depth and critical reflection that define human creativity.

I believe that AI collaboration requires my critical mind, my experiences, and my interest in exploration to help me navigate and find my own way of expressing, learning, and fulfilling my potential. That said, I always approach it with caution, reminding myself not to take it too seriously. After all, I have my own mind, and it's not about big data—it's about the small data that makes each of us unique, with our own neuroplasticity and capacity for wonder. I

also believe that we need to acknowledge our differences—it's what makes life colorful and interesting, and AI should be seen as a tool to help us explore those differences, rather than conform to uniformity.

JH: Looking ahead, what is your vision for the role of AI at the intersection of art and innovation? How do you see it influencing the creative landscape over the next decade?

NL: AI will undoubtedly play a transformative role in shaping the intersection of art and innovation over the next decade, but its potential goes beyond simply being a tool for creating. I see AI as an enabler of new narratives, especially those that foster interdisciplinary collaboration and open communication, which are sorely missing in today's approach to tackling complex global challenges.

We are at a critical juncture where the stories we tell about our futures can directly influence how we act to address systemic issues like climate change, inequality, and technological governance. AI can help us break down silos between disciplines—whether in science, technology, art, or policymaking—by providing shared, interactive platforms where different fields can come together to simulate, co-create, and critically reflect on various future scenarios. For instance, AI-powered digital twins allow us to visualize complex interdependencies that are often missed in isolated approaches, and AI-generated insights can make technical data accessible to a wide range of stakeholders, promoting open, transparent dialogue.

In this context, art plays a crucial role. It challenges existing systems and offers a space for sensing, communication and critical reflection. Art has the power to take these

abstract, technological possibilities and turn them into emotional, engaging narratives that resonate with broader audiences. As we move toward futures where systemic change is required, art can act as a catalyst, translating complex scientific and technological information into tangible experiences that prompt collective action. It allows us to reimagine what's possible, inspiring new visions of the future and helping us question entrenched norms and explore inclusive, just and fair alternatives.

Looking ahead, I envision a harmonious coexistence where AI, art, and human creativity work hand in hand to push the boundaries of innovation. Together, they can foster new interdisciplinary collaborations, build more human- and eco-centered systems, and help us craft the stories we need to address the challenges of the future. However, this relationship requires consciousness, responsibility, and joint control to ensure that AI is used ethically and wisely. Ultimately, it's our stories that shape the world, and for me, art holds more importance than AI in this regard. In this way, AI will not only influence the creative landscape but also contribute to broader societal and ecological transformation, keeping human and environmental well-being at the center of progress.



10

In Conversation with **Future Observatory** at the **Design Museum** (London)



Justin McGuirk

Director of Future Observatory

Justin McGuirk is the Director of Future Observatory, leading design research for the green transition, and former Chief Curator at the Design Museum, London. He has curated award-winning exhibitions, receiving the 2012 Golden Lion at the Venice Biennale. He has authored and edited several books, including *Radical Cities*, and writes for major publications.

Interviewer: Jennifer Halton

JH: Justin, you are the Director of Future Observatory, the Design Museum's national research programme for the green transition. Backed by a multi-million-pound fund, you are bringing UK design researchers, universities and businesses together to catalyse the transition to net zero and a green economy. What an ambitious and exciting mission. Let me start with a potentially obvious question. Why do we need to accelerate the path to net zero in the design sector?

JM: Well, there is no accelerating the path to net zero without the design sector. Design is what makes technological change happen and makes technology useful, right? So if you have new technologies that can be more efficient, or cleaner, they're not going to work without design. I don't think we can tackle net zero on any front without some form of design. 40% of carbon emissions come from the construction and built environment sectors. So, that's very much an issue of materials design and energy use. Even if you just look at that sector alone, design clearly plays a crucial role.

JH: What role does the Future Observatory play in achieving net zero?

JM: Our role is to drive design research towards the green transition. We use the term 'green transition' rather than 'net zero'. I have an ideological problem with the term net zero, which for me is a technocratic term that suggests this is just a kind of carbon and energy problem. Firstly, it is also a massive biodiversity loss and landscape degradation problem. And secondly, I think the "net" of net zero allows for a lot of very sloppy and capitalist thinking. Offsetting

through the planting of plantation forests, which are potentially catastrophic for those landscapes. Offsetting, or carbon capture through technologies that don't yet exist, is just magical thinking.

JH: Your impressive career includes accolades as an art historian, writer and curator (and Golden Lion awardee at the Venice Biennale). What has your career trajectory looked like and what key motivators have led you to spearhead Future Observatory?

JM: Well, through the various jobs and projects that I've developed over the years, I've always been interested in the Contemporary. In architecture, my specialism and interests lie in studying architecture as a tool for social progress. I was very interested in what was happening in Latin America in the 2000s and 2010s. Firstly, because there was this huge urban inequality, and often quite small but meaningful projects that were addressing that. This was at a time when architecture was very preoccupied with the Icon, parametricism, and with shape making. Concepts that were in some ways exciting, but also quite disillusioning. Much of it felt very out of touch by the time the financial crash happened in 2008. I think a lot of people were searching for a more meaningful form of architecture and urbanism and the direction I went was towards Latin America. The irony is that it does sometimes feel from where I sit that the focus on "sustainable architecture" and cutting carbon has meant that the more social dimension has fallen by the wayside. You don't hear so much about slums and urban inequality the way you did 10-15 years ago, where people were genuinely preoccupied by this idea that most urban growth was going to happen in the Global South. This was going to lead to tremendous urban privation and



Atrophy and AI

other infrastructural and social problems that we we'd already seen on a massive scale in places like South America. So, my own career is, in a weird way, a testament to that. Because here I am now focusing on the green transition, which of course is the most urgent issue we can possibly be addressing. But there are also other social issues to deal with, such as urban growth in the Global South. These are still important perspectives and contemporary issues.

JH: If I interpret correctly what you are saying, you view architecture as much more than aesthetic experience. What then, does design mean to you?

JM: That's such a difficult question. I think design is a way of shaping the world. It's a way of turning social and technological change into meaningful things and experiences. The way I think about design, and the way we frame design in this museum, is about change. Enzo Mari said something like, if you look out at the window and you're happy with the way things are, then you don't need to design. If you're horrified with what you see, then be a designer. And I don't think that needs to apply to vases, for example, but you could apply it to almost anything else. That's what is amazing about design. It's the interface of change.

JH: What do you think is the difference between good design and bad design?

JM: I think good design has a purpose. It's doing something meaningful.

Would you equate meaning with function in this context?

JM: Not necessarily. No. Rather that design might be designed for design's sake.

JH: What will design look like 10-15 years from now?

JM: That's a very timely question because I think design is in the early stages of reframing itself. We're focusing quite a lot on more than human design at the moment, which is the design for species and natural systems. And when you think like that, when you move away from the human-centred design perspective, it really does fundamentally change what design is, because the priorities change. If this movement takes off over the next decade or two, that will be a paradigm shift for design.

JH: What does Artificial Intelligence mean to you?

JM: My instinctive response is to say that it's a trap. Which is not to say that there are not many useful and amazing things that one could do with artificial intelligence. But, you only have to look at the rush of greedy corporations trying to steal a march on each other to feel nervous that they do not have either our, or the planet's best interests at heart. So, for me, AI is just an accelerator. It will accelerate many wonderful things that humans are capable of; it may accelerate Cancer Research by leaps and bounds. But it will also accelerate all of the awful things that humans do as well.

JH: In the lead up to this interview, you shared the following thoughts about AI: "I am depressed by the blind faith in [AI], without wanting to rule out the possibility that it may have some world-changing benefits". Your cautious optimism (or optimistic caution?) echoes my own personal sentiments on AI, particularly in the context of creativity and art. It also reflects the very motivation for this issue of TMPJ on "Atrophy and AI". Following on from this, what role will generative AI play

in the future of design (if any)?

JM: I think it almost certainly will play a role. I can imagine many roles for it in, for example, engineering and in the testing and generation of super-efficient structures which might be too complex for humans to calculate. I am especially interested in its potential application in biomimetic architecture and its ability to start replicating natural or biological structures. I'm more circumspect, however, when it comes to its use in form and image making. Not because I don't think it could produce amazing forms and images in the future, but it's certainly not there yet. The fundamental problem with AI is that it has no imagination. And that's why, while it may put a lot of people out of work, as a creative force, it's not yet a threat. But that's not to say that thousands of illustrators and photographers and drafts people might not lose their jobs. Because it depends on how aesthetically demanding the publishers and gallerists are. Or indeed how demanding the public is.

JH: Will AI (generative or traditional) play a role in the net zero transition within the sector?

JM: For me, the idea that AI will accelerate Climate Change mitigation is a contradiction in terms because it will, by the same token, be accelerating the kind of exploitative, landscape degrading things that we do as well. AI is tremendously energy hungry in a way that nothing humans have ever produced has been. And therefore, by definition, it's a contradiction in terms to say that it can solve climate change when it may contribute massively to climate change.

JH: Do you perceive any sense of atrophy (or loss) in the design discipline at large, with

the integration of AI tools into creative and design processes? What other facets and forms of atrophy will we see as we move toward a future mediated by and co-created with technology?

JM: This has been a long running debate since long before AI was such a hot topic in the press. I think back to debates about computer-aided drawing in architecture and kind of slightly more realistic stances that in fact hand drawing produces better architecture because it has kind of embodied knowledge within it. I'm never quite sure where I sit in that debate. I think there are things that the computer is very useful for, and there are things that the hand is very useful for, and they are not necessarily the same things. And there were ways of architectural drafting in the past that were purely mechanical and not imaginative. Whereas you know, most architects would probably never want to give up on their hand sketching of ideas, that doesn't mean you have a room full of drafts people churning out blueprints by hand when a computer might do it much more quickly and efficiently.

But I do intuitively favour some form of prioritising the human element of creation, even if that makes me sound like a Luddite. I don't necessarily just think about it in design terms. I guess I think about my own education, and in some ways, I think of myself as an essayist first. Probably a lot of my exhibitions have begun in my mind as an essay and then become an exhibition, which is not necessarily the natural way curators work. So, when I hear stories about students getting ChatGPT to write their essays, I think it's a shame because they're missing out on a process that I've always really enjoyed, actually. And it's not just about enjoyment, writing is probably the



Atrophy and AI

only way I ever actually learn anything. Truly learn something. I probably don't truly think about something or truly learn something unless I try and write about it. The idea that I would outsource that to save myself that learning process just feels like a shame. But again, I try not to think about these things in terms of crisis, because I'm just too familiar with the history of "technological progress". At every point from the introduction of the printing press to the introduction of radio to the introduction of television, human learning capacities always seem to be in crisis, and they never truly are. I view it in quite a circumspect way.

On the other hand, I don't view any technology as just a tool. I think that the "just a tool" fallacy underplays the potentially huge social effects of a tool. And I think you could say that about any piece of technology since the introduction of mechanical looms in the industrial revolution. They may have been just a tool, but they had huge social effects. And every revolutionary, radical piece of technology has social effects. There's a certain accelerationist view that says one just needs to power through and live with those effects because life will be better afterwards. But more and more, I'm sceptical of that view.

JH: Do you think AI could become sentient?

JM: The honest answer is that I don't have enough of a grasp of the technology to know one way or the other. I think possibly what we get wrong sometimes is that we are looking to view AI in anthropomorphic terms. We're comparing it to our own intelligence. So, we're trying to see are ourselves in AI; we're looking for ourselves in AI. The mistake, I think, that people building AI make is that they misunderstand what

human intelligence is. The kind of people who are talking about AI approaching or even achieving a form of sentience or AGI fundamentally misunderstand what human intelligence is. There is no human intelligence that doesn't involve the emotions, and I think they just fundamentally misunderstand that. The fact that an AI can do a supremely complex calculation or make a supremely sophisticated gaming move, is only a tiny fraction of what it means to be human or to have human intelligence. So, this comes back to the notion of, is it a failure of imagination? It is certainly a very limited perspective on what human intelligence is if they're making any kind of parity between large language models and human intelligence or machine learning and human intelligence.

JH: The introduction to Future Observatory Journal encapsulates the urgent need to catalyse new ideas and perspectives that will help tackle major societal challenges – including the net zero transition. It invites one to rethink the frameworks within which design operates. Can you share some examples of the kind of frameworks and narratives that are counterproductive to circular economies or at worst, prohibitive to achieving a more sustainable future?

JM: Well, one of the reasons we established Future Observatory Journal is because of a sense of frustration with the frameworks within which design operates. We've touched on the notion of "net zero", for example. I think that net zero is a very limiting concept. I'm not going to say it's unimportant, but it's a very limiting conceptual framework, and I'd say that "sustainable design" is also a very limiting conceptual framework. One of the current problems for design is that the only way we can think about approaches to producing

or building things is through the reduction of certain effects or materials. For example, there's this idea that if we could just use a little less plastic, produce a little less waste, emit a little less carbon, that we'll get to net zero. While all those efforts are essential, they're occurring at the symptom level. We're going to need to address more than symptoms if we're going to produce a genuine transition.

We think about the work that we support at Future Observatory as happening across three levels. Firstly, there's the symptom level. Secondly, there's the systems level. And thirdly, there's stories. We ask, what are the systems that need to change to support the shifting of the symptoms? It could be addressing building codes. It could be legislation policy. And then there's stories. The Journal is operating very much at the stories level, exploring the narratives that are driving the green transition. We wanted to essentially expand the space for alternative narratives rather than talking about things like net zero and sustainable design, which are very limited conceptual frameworks. The idea of "bioregioning", for example, which is the theme of first issue of the Journal, is a completely different framework, which is about working within the limits and opportunities of particular kinds of landscapes, which really cuts across traditional political and jurisdictional lines.

The next issue of the Journal is about "more than human design". Again, it's a major conceptual leap away from the industrial modernist human-centered design paradigm, because it's starting to think about other living beings, not just ourselves. So, where is that leading? I mean it's leading away from the kind of certainties of Enlightenment thinking that we've lived with for hundreds of years. I think it's important to make these shifts

in narrative more central, so we can open people's imagination to other ways of doing things. Even at a time when it feels urgent to do the symptomatic and technical work. Yes, we absolutely do need to figure out how to use less plastic, use less fossil fuels, emit less carbon, produce less waste. But if we just approach those things from a solutionistic and technological point of view, we'll probably only get so far because we're working within systems that fundamentally don't want to be changed. So, systems change and narrative shifts feel just as important. We are changing the cultural weather, if you like.

JH: I really like the feeling of hope instilled in your Journal's mission and literary output. As the Journal description reads, it "edges toward a social and economic imaginary that is suggestive of a future one might look forward to". What is one such hopeful future that you think you can achieve through the Future Observatory?

JM: It's not beyond the bounds of imagination to see how one could use Future Observatory as a steppingstone towards, for example, a new Bauhaus for design in the 21st Century that is focused on more than human design, regenerative design and bioregional thinking, and that helps support a new framework for designers to work within. A new ethic, if you like, and all of the new skills and methodologies that come with that. One could imagine that happening with the right funding and the right gathering of the right people in the right place, at the right time.



11

In

Conversation with

BioCreative Index



Grace Chuang

Founder of BioCreative Index

Grace Chuang is a creative director and scientist, blending biology, design, and technology. She led Ginkgo Bioworks' brand team, co-founded Grow magazine, and founded The Biocreative Index. Recognized by the One Club for Creativity, she has received accolades for her innovative work at the intersection of science and art.

Interviewer: Jennifer Halton

JH: Grace: you have crafted a fascinating career path to date, from your student days as a Chemical Engineer to magazine Founder (Grow) and digital platform Creator (the Biocreative Index). To quote your biography, you have spent your life with a “pipette in one hand and a camera in the other, [discovering] a deep yearning to create with purpose, in the complexity of the in-betweens”. Can you tell me a bit more about your journey and all those beautifully complex “in-betweens”, which have nurtured your embodiment of creativity and innovation?

GC: I’m a scientist-by-training and had always thought that I was destined to end up in a lab. I was studying chemical engineering at Cornell University, but about halfway through my degree, I started to feel disillusioned with what was going on in my classes versus the real world. I felt like there was something missing; where was the human connection? Why weren’t we thinking about how these technologies would be used outside of the lab? Why were we building these technologies, and who were we building them for? I realised that these questions were actually questions of design, not just science, so I turned to creative outlets to explore them further. I taught myself photography, produced an art exhibition on campus, where we told the stories of 18 people in the community through audio and images. A friend taught me how to use Adobe Illustrator through iGEM, a student synthetic biology competition, where I began to hone in on skills of visual design. I then spent a summer working at a film agency in San Francisco, telling stories of startups but through video, and I left my research assistant job working as a mammalian cell researcher in a science

lab, and joined a lab full of architects as a resident biologist. All these things led to me having somewhat of an identity crisis. I wanted to be both a creative and biologist, but people repeatedly told me that I had to choose one or the other. In 2018, I stumbled across Ginkgo Bioworks, a synthetic biology company in Boston whose website prominently read: “Biology by design”. I was fascinated when I saw that because I had never even seen those two words together before. I connected with their Creative Director, Christina Agapakis, who to this day is still a huge mentor to me. We hit it off over a phone call, and at the end she asked me if I wanted to work for her. The rest is history.

At Ginkgo, the world was our oyster on the creative team: I was leading brand and visual design, and together our team imagined every possible way to tell stories about the future of biotechnology through various creative formats. We resurrected the scent of an extinct flower that featured in art exhibitions around the world; we ran an annual conference called Ferment; we established an artist residency where we invited a designer into the space for three months to work with biologists. Christina and I started an award-winning magazine called Grow, and I led branding through Ginkgo’s Initial Public Offering (IPO), the largest IPO in the history of biotech startups. I art directed dozens of illustrators, photographers, videographers, artists for billboards, print and digital articles for the magazine, for our website, trained scientists to communicate their stories, and worked with our commercial teams to tell the story of the company. In 2022, I left Ginkgo to start my own business, where now I work as a freelance creative director and strategist at the intersection of biology and design, art and science, tech and



Atrophy and AI

society. I work with startups, VCs, academics, nonprofits, organisations to strategize their brand and how it might translate into visuals, things we see, read, and experience. I do this because I believe that interdisciplinarity and the visualisation of technology—how we understand processes through creative formats—can ultimately drive change in the world and allow us to imagine better futures.

The “in-betweens” I talk about frequently is a concept I wrote a long time ago, but it still holds true to this day and explains why I do what I do. We live in a world that tells us there are only “either/or” options. You can be *either* an artist or a biologist; or you’re *pro* this or *anti* that. It’s very binary. But I think what I really love about a lot of my work is posing the question: what if we sat in the middle and recognised that life is more complicated and messier than it is binary? A lot of engineered biology is like that, where we must explore the grey areas and ask, “is this ethical?”; “what would happen in this situation?”, etc. There’s no playbook for assessing every situation in the same way, just as there’s no playbook for interpreting and creating art and science. The middle ground is uncomfortable. A lot of people don’t like to be there because it’s unstructured. But I really think that bringing people into that middle and saying, okay, sit with the fact that you’re uncomfortable and be willing to ask difficult questions and think more critically about them. That’s where I think the magic of building technologies really happens, and that’s why I always talk about the “in-betweens”.

JH: When you speak of bringing people into the middle and empowering them to discover the undiscovered, this (to me) in many ways encapsulates what interdisciplinary research and practice is - or aims to do. I am very interested in exploring the characteristics

of an interdisciplinarian. In your experience, what are the classic personality and/or cognitive traits of an interdisciplinary thinker?

GC: I’m always hesitant to define things like this because at the end of the day everyone is different, and part of being an interdisciplinary thinker is that there is not a single pathway to get there. The common thread I have noticed though is often interdisciplinarians are the people who don’t quite fit in. I know Christina saw this in me when she hired me onto her team; I came to her telling her that I didn’t belong in any space. We are the people who go out and search for alternative things because we aren’t satisfied with the status quo. Being an interdisciplinary thinker means you’re not always going to be in a space where you feel completely understood. You might be a designer talking to scientists for example, even though it may not be your area of expertise. Or maybe you’re a scientist who’s interested in design, and you get into the design world despite never studying it. You have to embrace bravery and curiosity to go into those new spaces.

JH: What kind of skills do interdisciplinarians personify and what comparative advantage do you think they can bring to the workplace?

GC: Bringing different kinds of thinkers together catalyses new ways of thinking. When we did the artist residency at Ginkgo, there was a designer we brought into the team who didn’t know what a protein was. So, she sat down with a biologist and talked about proteins for an hour. You would assume that she was the one to leave that conversation thinking “this is so fascinating”. But what’s funny is that the biologist actually left that conversation thinking: “I’ve never thought of a protein in the way she [the designer] was

talking about it". That's the sort of interaction that spurs innovation because you're not just thinking about how things have always been done - you're making space for fresh perspectives and new ideas. I always say that imagination is the gateway to change. If we can't imagine what a better future is going to look like, we're never going to be able to go out and create it. A lot of that imagination comes from mixing disciplines together and using creativity, art and design to help predict the future. We need to bring more art and design into technological spaces to visualise and materialise the intangible ideas that other people are dreaming up.

I think interdisciplinarity is so important, especially in the sciences, because people are starting to realise that science isn't enough anymore. Technical problems don't exist in isolation. There is the question of how do you engineer something into society? How are you actually going to design the product? How do you scale a new system? A lot of technology and STEM startups are failing because they haven't been thinking about these problems. Technology building and society building go hand in hand, we need to engineer these things simultaneously in order to actually solve the challenges facing us today. It's a design problem, but most scientists don't think of themselves as designers.

JH: In my opinion, interdisciplinarity is inextricably linked to innovation and entrepreneurship. Do you consider yourself an innovator and entrepreneur?

GC: I guess I am an innovator and an entrepreneur, but I've always hesitated to call myself those things because it feels like an "entrepreneur" has certain connotations with Silicon Valley, tech, etc. I really just think of

myself as a visionary who has ideas and then I go execute on them—I like to bring things to life—I guess that is actually what an innovator and entrepreneur do too.

So yes, you could say I "founded" Grow and I "founded" the *Biocreative Index*, but really I've always just wanted to create spaces for people to be able to ask questions and to belong. So, to me it's less like entrepreneurship and more like community building with people who come from all different backgrounds and experiences.

JH: The Metamorphosis Project and the Biocreative Index are strongly aligned in their mutual championing of "intersections". The Index promotes the intersection of Biology and creative disciplines, and Metamorphosis works at the intersection of art and research across disciplines. Can you tell me about the genesis of the Index and your motivations for building this unique community?

GC: The Biocreative Index is a directory of people working at the intersection of biology and creative disciplines. I launched this project because I wanted to create a space that could highlight how many people were working at this intersection in very diverse ways. Being a biocreative isn't just being a designer or an artist. We have people on the Index who are doing marketing and communications; who are chefs; who are strategists; who are educators. There are so many different roles that you can do. I wanted to show that there are so many of us out there doing this work. We aren't just superfluous people who do this for "fun". We're making change within the different places that we operate. I wanted to demonstrate our strengths by bringing the collective together and showing that we exist. And I also wanted to create a space for connecting where people



Atrophy and AI

could find resources, other people to talk to, and where companies could find talent. That's another question I get asked about a lot: "I need a designer, but I need them to understand science. Do you know anybody?". Or how did you get into this? It's my hope that the Biocreative Index can be the convening place for everyone to go to from now on.

JH: Do you consider "change making" as the community's greatest strength? What does the future hold for the Biocreative Index?

CG: I think that convening all these change makers in one space is a huge strength of the Index. I don't want the Index to feel like I'm training people or that there's a certain methodology behind doing this work, which is why I think the concept is powerful. When I was showing someone the Index in the very early stages, they observed that it's not really about the types of projects we're working on, although you can click through these projects, but rather it's about the people. It's the people that make biocreativity - not the other way around. I think that connecting people and being able to foster conversations is really valuable. In terms of what the future holds? I think the future is hard to predict, but I'm in talks with people now to do meet ups in different cities, which will be awesome. I would love to be able to build some content or to have places and experiences where people can meet each other and learn.

JH: As you know, the inaugural Issue of The Metamorphosis Project Journal explores the theme of "Atrophy and AI". It aims to explore the myriad ways in which traditional and generative AI will eventually metamorphose human-led creative processes, with some exciting possibilities. In what ways do you see

AI shaping the field of synthetic biology and biocreativity?

GC: Biology and AI have been inextricably linked for a while; people have been using machine learning to predict protein structures for a lot longer than the most recent wave of "hype" around AI. So that part of the technology is not new, and it makes a lot of sense to use AI algorithms to synthesise findings from data. On the biocreative side though, for now, I don't personally think that AI will have a big impact on what we do. I think it'll help us streamline and do work faster. But what we do is just too complicated to feed into AI right now. We're processing and strategizing complex scientific concepts and translating it into a creative vision. There's not even that many people in the world who can actually do this, so how will we build AI models to mimic it? It's not as simple as giving AI a prompt like: "hey, make me this ad". A biocreative is asked to explain, for example, a complicated enzyme, but to make it visually interesting. And it might be abstract, but it also has to have some aspects of it grounded in technical feasibility. I'm not confident that AI can do that. So, things might change in the future, but right now I don't think it's going to fundamentally change the creative sides of things in biotech.

JH: Do you see the evolution of generative AI and emerging technologies as a generally positive or negative change within the creative industries and/or within your own creative practice?

GC: I have a neutral view on AI. I think that to me, AI offers a way to help us work faster. There are certain tasks that I don't want to do, such as taking notes during a meeting or designing PowerPoint slides. AI could do it for me so I can

get something on the page. That, to me is useful, right? There are better, more practical ways of working with AI. I've tried to use AI myself in the creative field. Sometimes people ask if we can generate an illustration with AI, but for scientific concepts, AI tools are just not there yet. People in the creative fields are scared that it's going to replace jobs, and that is definitely a concern, but also I think we need a mindset shift to the type of work that creatives and designers do so that we aren't replaceable. If you are a designer who moves things around on a page without thinking about why you are doing it, then yes, that type of work might be replaced by AI. That's why I always advise that being a designer isn't just about aesthetics. You have to do the strategy piece. That's what people want you for. A human using your brain for strategy will always be better than AI. If you can merge that strategic advantage with your technical, design or creative skills, you'll be okay.

So, yes, AI will probably take over writing our emails. It can help us generate copy, or website ideas, or basic illustration ideas quicker. But if I'm launching a website with 10 collaborators spanning founders, scientists, engineers, businesspeople, commercial, designers, illustrators, copywriters, that's not going to be replaced by AI alone. My hope is that AI just shifts the sort of jobs and thinking that people have and pushes us to be better at our jobs.

JH: As you clarified, you don't use AI directly in your own practice, but from what you know of AI as part of our cultural zeitgeist, do you perceive any sense of atrophy - a loss or diminishing of something - in the field of biology and biocreativity at large, as AI becomes more progressive?

GC: With the Index, I can use AI to make the process of vetting and uploading people to the

index faster. But it can't replace the connections that people make through the platform and within the community. I think humans were always made to be creative, and AI won't take away from that - we'll just get even more creative with AI.

JH: Do you think we need to apply some level of policing around the ethics and the even the design integrity of AI tools?

GC: I think it's more about helping people value creatives and human-led storytelling, especially in the technology space. The challenge of getting people to understand what we do is so important has always been there, with or without AI. There was a recent issue of Nature, a scientific journal, where they generated their cover image with AI. People were upset because they prioritised AI rather than paying for an illustrator. And I've met scientists who say they don't have budget to invest in creative collaboration, so they just make something with AI. When you hear things like this the creative community often gets frustrated, but the reality is it's a two-way street in figuring out why scientists feel this way. To me policing is less effective and just creates further divide between the technology and creative communities. Rather we need to help them see how much better their storytelling and businesses could be with the help of creatives.

JH: Do you think AI could help accelerate your mission with the Biocreative Index to bridge the worlds of Biology and creative disciplines?

GC: I think the only thing that it can do right now is make the process of growing the community faster by aiding in the kind of the grunt work that I don't really have time to do. But in terms of the actual mission itself, I don't think it will have a big impact on that part of it.



Atrophy and AI

JH: Essentially, it's not going to replace the human connections that the Index is forming, is it?

GC: I don't think so, and I wouldn't want it to. I want someone to be able to go in there [the Index] and say, I want to talk to this person, or I want to meet up with that person. People always say, AI is only as good as the data you feed it. Obviously, that makes sense if you are in a lab generating huge quantities of big data, where feeding data through AI can really help you make sense of things. But for projects like the Index, where I'm working to build community and create spaces, these people are not data points. We can't just feed them through an AI algorithm to get an outcome. These are real people and building community is more complex and nuanced than that.

JH: A lot of conversations about AI are anchored in "the now", and what we know of AI today. If you imagine yourself 20-30 years in the future, does your perception of AI change? Are you still cautiously optimistic about AI? Do you still think it will just be used as a tool?

GC: There is so much fear around AI, and I completely understand where it's coming from. But the reality is that right now most of AI is quite meaningless. We aren't actually solving these big, pressing issues facing our world. Is AI helping us solve climate change yet? People are working on it but it hasn't fundamentally shifted anything yet. I want to see radical change in how science is done, not incremental, because we're running out of time. Until then, I think being afraid of AI simply hinders us in making progress in society. There are so many possibilities of what the future could look like, and it is my hope that we can use creativity and interdisciplinarity to figure out how to get there.

- APRA AMCOS. (2024). Submission to Select Committee on Adopting Artificial Intelligence (AI). <https://www.apraamcos.com.au/about/supporting-the-industry/advocacy-and-public-policy?b=1>
- Australian Guild of Screen Composers. (2024). Response to the Senate Select Committee on Adopting Artificial Intelligence. <https://www.aph.gov.au/DocumentStore.ashx?id=688d24a9-ae3e-48e4-8105-0e5888a51566&subId=757142>
- Baum, Z. J., Yu, X., Ayala, P. Y., Zhao, Y., Watkins, S. P., & Zhou, Q. (2021). Artificial Intelligence in Chemistry: Current Trends and Future Directions. *Journal of Chemical Information and Modeling*, 61(7), 3197–3212. <https://doi.org/10.1021/acs.jcim.1c00619>
- Benjamin, R. & Byrum, G. (2022, June 16) Disrupting the Gospel of Tech Solutionism to Build Tech Justice. *Stanford Social Innovation Review*. https://ssir.org/articles/entry/disrupting_the_gospel_of_tech_solutionism_to_build_tech_justice
- Benjamin, W. (1935). *The Work of Art in the Age of Mechanical Reproduction*. Schocken Books.
- Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press.
- Bruno, G. (2002). *Atlas of Emotion: Journeys in Art, Architecture and Film*. Verso.
- Carpo, M. (2013). *The Digital Turn in Architecture 1992 – 2012*. Wiley.
- Duchamp, M., Norton, L., Wood, B., & Roche, H. (1917). *The Blind Man*. Vol (2).
- Gentile, F., Yaacoub, J. C., Gleave, J., Fernandez, M., Ton, A.-T., Ban, F., Stern, A., & Cherkasov, A. (2022). Artificial intelligence-enabled virtual screening of ultra-large chemical libraries with deep docking. *Nature Protocols*, 17(3), 672–697. <https://doi.org/10.1038/s41596-021-00659-2>
- Ghosh, A. (2016). *The Great Derangement: Climate Change and the Unthinkable*. Chicago: The University of Chicago Press.
- Gu, S., Gao, M., Yan, Y., Wang, F., Tang, Y., & Huang, J. (2018). The Neural Mechanism Underlying Cognitive and Emotional Processes in Creativity. *Frontiers in Psychology*, 9. <https://doi.org/10.3389/fpsyg.2018.01924>
- Harari, Y. N. (2016). *Homo Deus: A Brief History of Tomorrow*. Harvill Secker.
- Harari, Y. H. (2024). *Nexus: A Brief History of Information Networks from the Stone Age to AI*. Fern Press.



Atrophy and AI

Hassan, R. (2020). *The Condition of Digitality: A Post-Modern Marxism for the Practice of Digital Life*. London: University of Westminster Press. DOI: <https://doi.org/10.16997/book44>

Hawking, S., Russell, S., Tegmark, M., & Wilczek, F. (2014, May 1). Transcendence looks at the implications of artificial intelligence - but are we taking AI seriously enough? Independent. <https://www.independent.co.uk/news/science/stephen-hawking-transcendence-looks-at-the-implications-of-artificial-intelligence-but-are-we-taking-ai-seriously-enough-9313474.html>

Jones, C. (2024). Reaggregating a Body. In C. Simpson (Ed.), *Furari Flores: a multisensory arts experience exploring the wonder of plants* (pp. 34-46). Cara-Ann Simpson.

Kant, I. (2013). *The Critique of Judgment*. Start Publishing LLC.

Kurzweil, R. (2005). *The Singularity is Near*. Viking Press.

Lin, J., & Mo, F. (2024). Empowering research in chemistry and materials science through intelligent algorithms. *Artificial Intelligence Chemistry*, 2(1), 100035. <https://doi.org/10.1016/J.AICHEM.2023.100035>

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4).

Merleau-Ponty, M. (1968). *The Visible and the Invisible*. Northwestern University Press.

Milner, D. (2022, October 20). Should AI Help Visualise the Future of the Climate Crisis? *Atmos*. <https://atmos.earth/should-ai-help-visualize-the-future-of-the-climate-crisis/>

Morton, T. (2013). *Poisoned Ground: Art and Philosophy in the Time of Hyperobjects*. *Symploke*, 21:1-2: 39.

Negroponte, N. (1970). *The Architecture Machine: Toward a More Human Environment*. MIT Press.

Ruddigkeit, L., van Deursen, R., Blum, L. C., & Reymond, J.-L. (2012). Enumeration of 166 Billion Organic Small Molecules in the Chemical Universe Database GDB-17. *Journal of Chemical Information and Modeling*, 52(11), 2864-2875. <https://doi.org/10.1021/ci300415d>

Ruscha, E. (1962). *Twenty Six Gasoline Stations*. Cunningham Press.

Sanchez Querubin, N., & Niederer, S. (2022). Climate futures: Machine learning from cli-fi. *Convergence: The International Journal of Research into New Media Technologies*, 30(1), 285-303. DOI: [10.1177/13548565221135715](https://doi.org/10.1177/13548565221135715).

Shofty, B., Gonen, T., Bergmann, E., Mayseless, N., Shamay-Tsoory, S., Grossman, R., Jalon, I., Kahn, I., & Ram, Z. (2022). The default network is causally linked to creative thinking. *Molecular Psychology*.

27, 1848–1854. <https://doi.org/10.1038/s41380-021-01403-8>.

Spencer, J. (2024, April 15). How To Prevent AI From Doing All The Thinking. <https://spencerauthor.com/cognitive-atrophy/>

Strieth-Kalthoff, F., Sandfort, F., Kühnemund, M., Schäfer, F. R., Kuchen, H., & Glorius, F. (2022). Machine Learning for Chemical Reactivity: The Importance of Failed Experiments. *Angewandte Chemie International Edition*, 61(29), e202204647. <https://doi.org/10.1002/ANIE.202204647>

Vallance, C. (2022, 13 September). “Art is dead Dude” - the rise of the AI artists stirs debate. BBC. <https://www.bbc.com/news/technology-62788725>

Vitruvius, M. (1960). *The Ten Books on Architecture*. Dover Publications.

Wang, Y., Pang, C., Wang, Y., Jin, J., Zhang, J., Zeng, X., Su, R., Zou, Q., & Wei, L. (2023). Retrosynthesis prediction with an interpretable deep-learning framework based on molecular assembly tasks. *Nature Communications*, 14(1), 6155. <https://doi.org/10.1038/s41467-023-41698-5>

Water Corporation. (n.d.) What is streamflow and why does it matter? Retrieved August 30, 2024, from <https://www.watercorporation.com.au/Help-and-advice/Water-supply/Rainfall-and-dams/What-is-streamflow-and-why-does-it-matter>

Young, L. (2019). *Machine Landscapes: Architectures of the Post Anthropocene*. Wiley.

Zylinska, J. (2020). *AI Art: Machine Visions and Warped Dreams*. Open Humanities Press.

