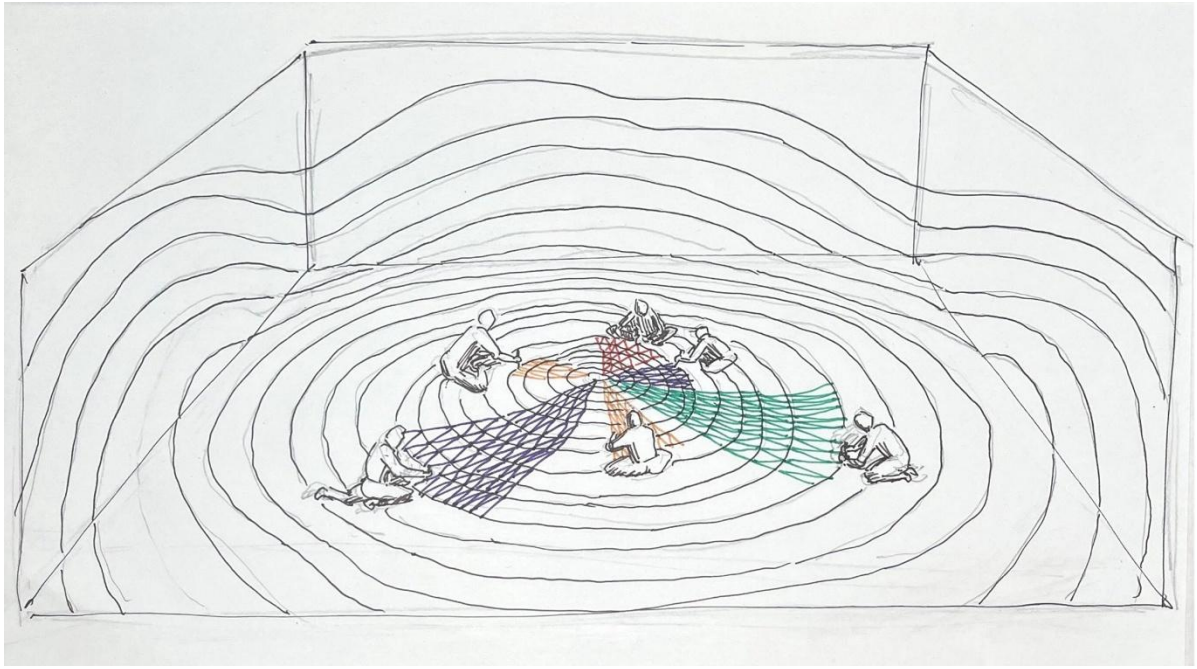
Murayama-Anderson
Fission-Fusion Evolution Artwork

JSPS-RSE Workshop
at Edinburgh Futures Institute
& the Royal Society of Edinburgh

Written by Miranda Anderson and Goro Murayama

Evolving Future Imagining Co-Creatively

This is a collaborative artwork. It has rules but participants also contribute to the expression of these rules. Two different types of drawing couple in successive stages. The artwork is a transindividual and transnational expression of our interconnectedness and distinctions, exploring our merging and diverging, through exploring how preexisting structures enable and constrain our possibilities for expression. The theme of co-creation resonated with Japanese poetic word of the year 2024, 'wa' (harmony).



Drawing of the workshop by Goro Murayama

The workshop, photograph by Goro Murayama

***The Maker Space*, *Edinburgh Futures Institute*, 3 December 2024**

PHASE 1: Creation of cellular automata in a maze designed by Murayama

The first phase of the artwork was the drawing of a circular maze by Goro Murayama.

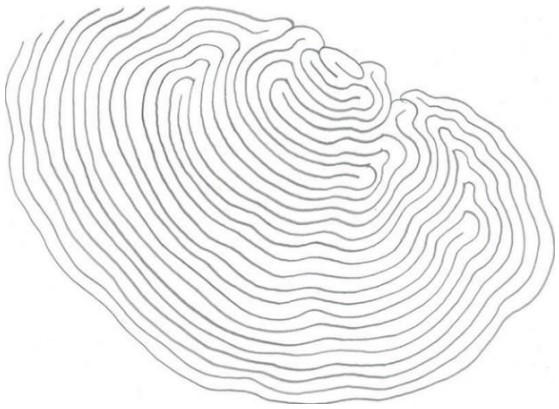
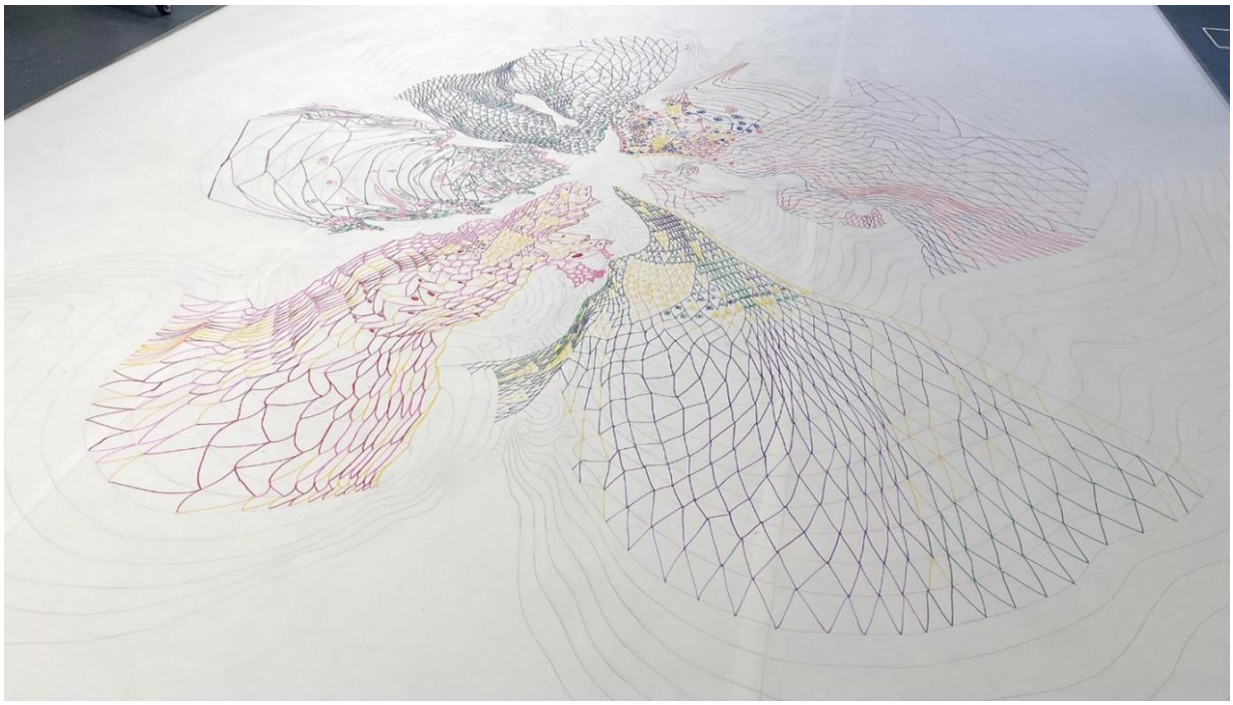


Image of a maze by Goro Murayama

In this case the shape of the maze was circular to allow the evolution out from a shared centre point all the participants cellular drawings.

The workshop participants were then introduced to the concept of cellular automata. Following discussion around the way cellular automata evolve, the participants chose three colours to work with and arranged themselves around the centre of the maze and began to draw cells into the maze. Distinctions emerged as people drew, either through a person's own style of expressing the pattern, through errors, or through complexities in the maze structure which required participants to adapt the pattern.



The evolving artwork, photograph by Goro Murayama

Cellular drawings

The drawing uses cells. The word cell comes from the living space that monks used to live in, and it was then used to talk about different areas in our minds and bodies which merge and divide with other cells, creating life and being recreated in new forms in succession. The 'cell fantastik' was a medieval term for the imagination.[1]

What would your imagination do with these cells and these spaces for free play? How would you add to the expression of this living artwork? Rules give us structures within which we can express ourselves and we also contribute to their expression and evolution.

The word cell also describes two different states, and in binary computing models is either on or off: 1 or 0. Whether the next cell is on or off is dependent on the previous time stage. The creation of patterns in nature and computer models pose the question: what can creativity be in the age of computing?

Each person was provided with a shared maze structure waiting for their cells. The cells evolve across time as well as across space. When creating the cells participants use the following pattern:

Yellow meeting yellow creates yellow on the next line. It is the same for purple and green.
Purple meeting purple creates purple on the next line.
Green meeting green creates green on the next line

But if two different colours meet, they create a third colour on the next line:
Yellow meeting green creates purple on the next line.
Yellow meeting purple creates green on the next line.
Purple meeting green creates yellow on the next line.

Participants choose their own three colours to work with, one representing the past, the second the present and the third future imagining.

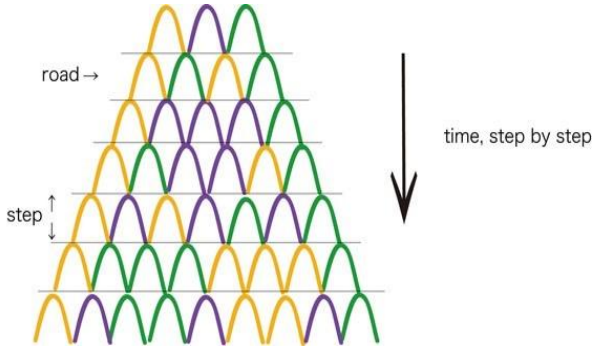


Image of the steps in creation of cellular automata by Goro Murayama

Cellular automata

Cellular automata, mathematical models developed by thinkers such as John von Neumann and Stanislaw Ulam, are useful for examining the emergence of complex systems in nature, computing, culture and society. Cellular automata are mathematical idealizations of physical systems, involving rows of cells with a value of 1 or 0, that synchronously evolve in discrete time steps, according to the values of neighbouring variables in the previous timestep and a set of local rules (Wolfram 1983; see also von Neuman 1963).

[1] For example, Chaucer, *The Knight's Tale*: 'Biforen, in his celle fantastik.' (l.1376, 'In the front lobe, in his imagination.) See: https://chaucer.fas.harvard.edu/pages/knights-tale-0.

Each next cell's state is a function of the cells' topical arrangement in the prior step.

for example 

'rule 30' generates a chaotic pattern

Images of the steps in creation of cellular automata by Goro Murayama

Typical examples of cellular automata are Francisco Varela's *Substrate Catalyst Link* (SCL), Wolfram's *Classes*, and Conway's *Life Game*.

Varela's *SCL* is a bottom-up synthesis approach to autopoiesis, which describes the process of self-making by living organisms and the way organisms and environments shape each other's emergence reciprocally.

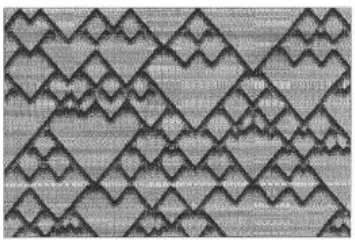
Wolfram's classes of cellular automata describe the rules that produce different states: Class 1 resolves to a uniform state; Class 2 a repetitive oscillating or stable still-life state; Class 3 chaos; and Class 4 involves a mixture of order and randomness. Especially with class 4 emergence occurs when 'the whole is greater than the sum of the parts', meaning the whole has properties its parts do not have. An example of Class 4 is Rule 110 which is capable of universal computation.

John Horton Conway's *Game of Life* (1970) involves cells in one of two possible states, live or dead (1 or 0). Every cell interacts with the adjacent neighbouring cells: live cell with less than 2 live neighbours > dies (underpopulation); live cell with 2-3 neighbours > lives; more than 3 > dies (overpopulation); 'dead' cell with 3 neighbours (reproduction).

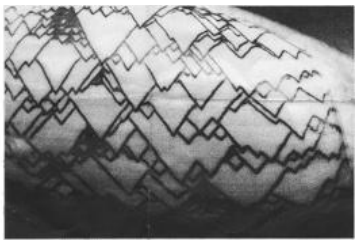
The initial pattern is the seed which generates the system without further top-down engagement needed. Recent work has also developed more life-like algorithms, such as Bert Chan's *Lenia*. Daniel Dennett used it to exemplify the ways in which consciousness and life can emerge from relatively simple deterministic physical laws.

These same principles are evident in natural structures, such as Porphyria seashells, which reveal the natural expression of a Turing pattern, which can also be computationally modelled with cellular automata.

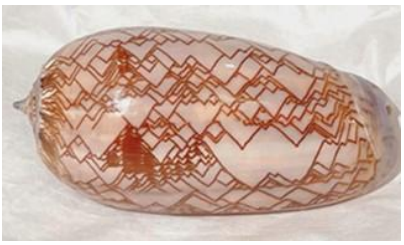
Patterns created by cellular automata in computing and nature



computational



Conus seashell



Porphyria seashell

The surface pattern is created by a distributed neural network as is the shell structure, which is formed through the coupling of two materials, which strengthen its resistance capacities while enabling it to remain relatively flexible;[2] the possibilities for Turing materials remain underexplored and the possibilities of quantum materials exciting.[3] You can see these dynamics in nature in relation to phenomena such as susurrations and swarming too.

These biological and computational expressions of complexity through emergence from the dynamics of variations in simple patterns also relates to new understandings of the multiple possible worlds entailed by quantum physics, as instead expressing the co-existence and correlation of plural perspectives on reality. As Michael Brooks describes it: 'Instead of myriad alternative realities continually branching away from our own, these relational interpretations build a singular universe up from within by stitching together many subjective perspectives.'[4] This conceptualisation resonates with Anderson's use of the term 'fission-fusion' to express epistemological and ontological mergings and divergings across perspectives, entities and processes. Fission-fusion further argues that the flickering potentials of living forms, are expressed in the workings of artworks.[5]

PHASE 3: Origin Status and Cultural Drift

Anderson suggested an additional phase to the cellular automaton activity created by Murayama, which he has previously produced as an individual and with groups. This new iteration of the cellular artworks invited the six co-creators to each design three symbols, representative of past, present, and future or imaginary realms by drawing on diverse cultural traditions, from adinkra to emojis. Participants were invited to:

> Draw a symbol that represents for you the past in one colour of cell
> Draw a symbol that represent to you the present in a second colour of cell
> Draw a symbol that represents the future or dream realm in the third colour of cell

After completing around four rows, everyone moved one place round the circle, taking the position of the neighbouring participant and drawing their chosen symbols into that lineage of cells. After around another four rows everyone moved a further place around until we had all completed a circuit. As well as it expressing their own style, participants commented on oscillating between observing the particular expression of the symbols of the previous person, and scanning back to the original creator's representations of the symbols. The nature of the expression of the symbols was also modified in relation to the diverse cell structures that had been created previously.

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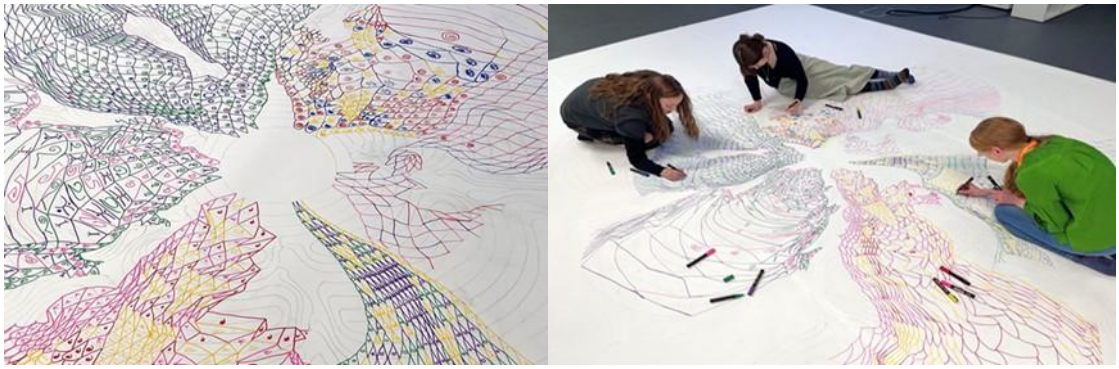
[2] Stefan Szyniszewski et al (2020) 'Non-cuttable material created through local resonance and strain rate effects'.
[3] Tanaka et al (2023) 'Turing pattern–based design and fabrication of inflatable shape-morphing structures'
[4] Brooks (Jan 2025) 'How a quantum innovation may quash the idea of a multiverse'.
[5] Anderson 2015, 2023, (forthcoming) 2025 e.g. https://www.skape.ed.ac.uk/developing-the-fission-fusion-concept-a-journey-through-the-arts-humanities-social-sciences-and-natural-sciences-part-1/.



The evolving artwork and the workshop, photographs by Goro Murayama

All the participants enjoyed the activity, discussions and activities and felt their perception of the other participants had also changed. Half the participants felt it had changed the way they think about the mind or self and all the participants felt their ideas about creativity and art had changed. EFI student, Aisha Zealey commented that it 'challenged my understanding of "good" versus "bad" artists' such that 'I began to see my self as creative in my own right, rather than comparing to others. It was very insightful. The practice was new to me and therapeutic.' Her fellow student, Mara Strang, commented that it led to her 'thinking about art' in a more fluid and patterned way', adding that it 'brought a real stillness to my mind through rhythm' as 'just working together on art created a sense of connection'. Eeva Holt, EFI staff member also found it created 'a nice feeling of togetherness and connection' and that it was 'a very accessible form of art making, in fact the only way for me to feel creative after injuring my dominant hand', concluding that it was a 'simple yet beautifully diverse technique.' Artist Jimmy Turner commented on it having changed the way he thought about creativity through 'the effect of offering constraint in a workshop', adding that 'repetition can do surprisingly interesting things.'

After the workshop, Murayama and Anderson cut around the drawing's outer edges making it a flower-like shape with a sun or flower-ovary at its centre point. We produced a time lapse film of the whole event, filmed for us by Ezra Course. We will edit this film to create another mode of experiencing the evolution of the drawing across time.

***Royal Soceity of Edinburgh*, 4 December 2024**
PHASE 4: EXPANDING FISSION-FUSION DYNAMICS

The artwork was then continued at a Symposium at the Royal Soceity of Edinburgh which was organised with the Japan Soceity for the Promotion of Science and which brought together leading thinkers from across Scottish and Japanese Soceity. The Symposium on *Fission-Fusion Perspectives and Complex Issues* brought together thinkers from across academia, culture and society to inspire more holistic understandings of mind, selves and world for the critical and creative development of our technologies, cultures and societies. As well as responses to provocations, the symposium involved imaginative exercises led by Anderson, poetry and movement activities let by Jennifer Williams, and dance led by Natasha Gilmore. Co-creation of the artwork was another means of exploring ways of working and imagining the evolution of possibilities together beyond conventional modes. The work was accidentally separated in two, at which point Murayama and Anderson cut it into two segments, enabling participants to contribute to either of the two segments. Participants were invited to continue the patterns in the artwork through their own expressions of the symbols created by partipants on the previous day.

PHASE 5: ENGRAFTING ANEW

In the next phase of the artwork Anderson and Murayama plan to continue the evolution of the artwork by dividing the different segments of the artwork and grafting them on to a new background composition. The Japanese poetic word for 2025 is 'yume' (dream). This iteration shall explore further how dream realms range across and create our past-present-futures, and our individual-shared worlds, traversing our imaginations and realities.[6] Artworks reveal the ways in which we are organised by patterns in our lives and in the world. We are both enabled by and constrained by preexisting patterns. Awareness of this enables us to evolve new ways of thinking and being in relation to ourselves, each other and the world around us.

Miranda Anderson: https://www.research.ed.ac.uk/en/persons/miranda-anderson
Goro Murayma: http://goromurayama.com/

Published in 2026 to celebrate the creation of a *Fission-Fusion Evolution* artwork at Edinburgh Futures Institute, University of Edinburgh, in concert with the JSPS-RSE *Fission-Fusion Perspectives on Complex Issues* Symposium at the Royal Society of Edinburgh. Supported by Japan Soceity for the Promotion of Science, the Royal Soceity of Edinburgh and Edinburgh Futures Institute.

In 2024 JSPS London celebrated the 30th Anniversary of its establishment. During this special year, JSPS London organised regional events with valued partner organizations. On 5th December, JSPS London held a celebratory event with RSE, which included talks, presentations and performances that showcased successful collaborations between Japan and Scotland. This event included the signing of a Cooperation Agreement between RSE and JSPS London to reaffirm our working partnership and commitment to strengthening research partnerships between Japan and Scotland for the future.

EFI Workshop Particpants: Eeva Holt (EFI Postgraduate Experience Advisor), Mara Strang (EFI Interdisciplinary MA), Jimmy Turner (the Binks Hub) and Aisha Zealey (EFI Interdisciplinary MA). Supported by Peter Bentley (Maker Space), Jennifer Williams (Utopia Lab), and attended by Masahiko Hara (Institute of Science Tokyo). Filmed for Anderson and Murayama by Ezra Course (Napier University). Special thanks to Peter Bentley and EFI's Makerspace for hosting the endeavour.

The workshop, photograph by Masahiko Hara

[6] In the Japanese New Year Poems there is a sense of dream's range accumulated across the fission-fusion of poems created on this theme: https://www.kunaicho.go.jp/e-culture/odai.html.