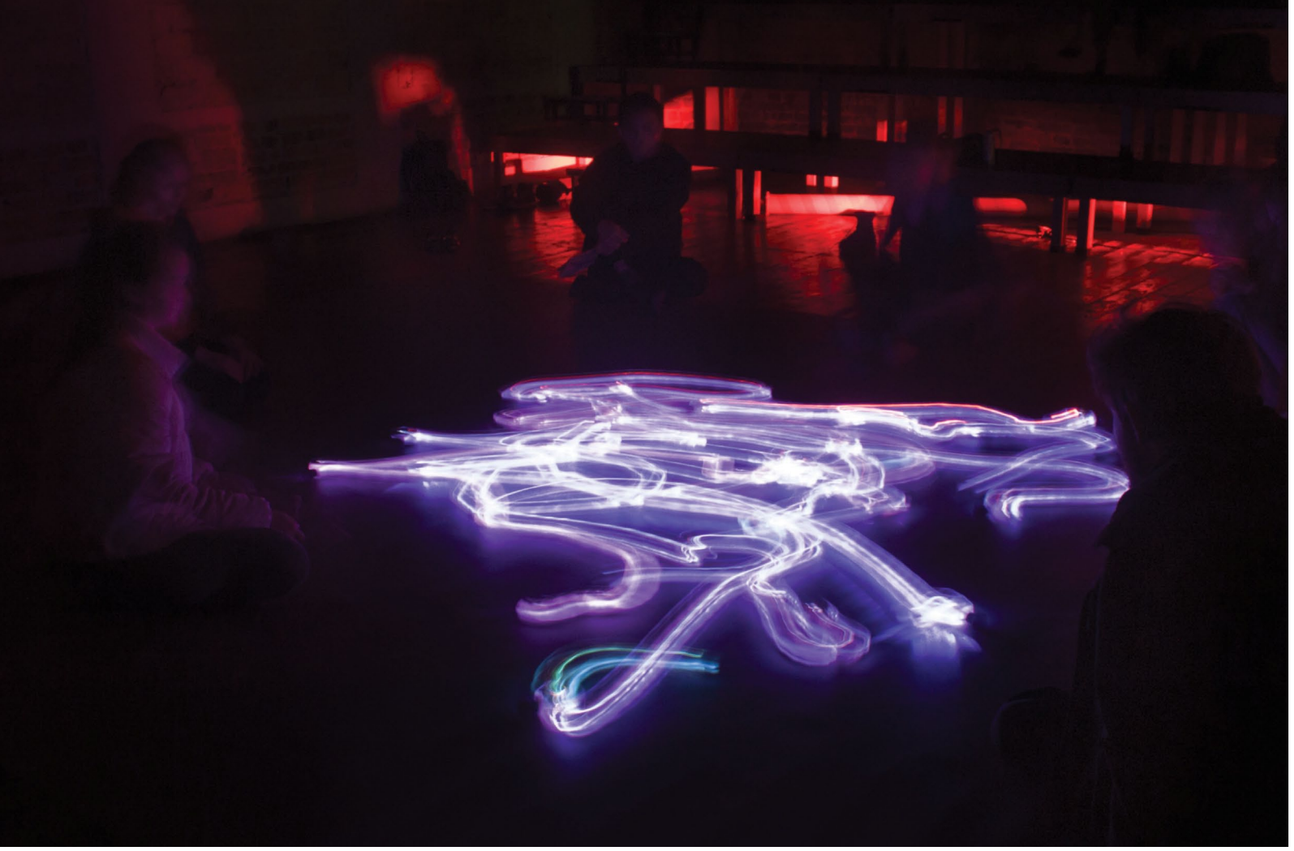
Empathy swarm

17 AUGUST–27 OCTOBER 2019



Can breeding robots solve an empathy deficit?

A jar of sourdough starter has exploded in my backpack. It was half-empty just a few hours ago. Unbeknown to me when I packed it, the creatures in the jar were alive and eager to expand beyond the capacity of the glass container. A sticky mix of flour and water is all over my copy of Valentino Braitenberg's *Vehicles: Experiments in Synthetic Psychology*, a fun little book that describes a series of insect-like machines expressing the emotions of fear, aggression and love.[1]

I received the incriminated jar from Katrin Hochschuh while visiting her and Adam Donovan at Katrin's family house in a farming area outside Hamm, Germany. She and Adam are breeding a new species of robotic beings that are swarming around the floor of what used to be a living room. When she is not developing code for the robots, Katrin bakes an excellent loaf of bread in the adjacent kitchen. I wanted to learn how to bake like that too. Now the stuff is all over the pages of my reference literature.

Outside the house, a nuclear power plant impinges on the horizon, beyond the fields of wheat and corn. The plant used to house an experimental thorium reactor ominously named THTR-300. Nuclear chain reactions once contained in its core were brought to a halt in 1986, following a leak of ionised particles into the environment that occurred at the same time as the disaster in Chernobyl. I think about other containers overwhelmed by exponential growth. I think of Al Bartlett giving his famous lecture "Arithmetic, Population and Energy" over 1700 times at the University of Colorado Boulder:

> Imagine bacteria growing slowly in a bottle. They double in number every minute. At 11:00am there is one bacterium in the bottle. At 12:00 noon the bottle is full. At what time was the bottle half full? Would you believe it, at 11:59, because they double in number every minute. If you were a bacterium in the bottle, at what time would you first realize that you are running out of space? Think about it, this kind of steady growth is the centerpiece of national economy and the entire global economy.[2]

The two-storey house where I visit Katrin and Adam was built by Katrin's great-grandfather, who used to run a tailor shop on the ground floor and raise goats in the garden. Now the home is the site of a different sort of cottage industry. Upstairs, robots are being assembled. If everything goes according to plan, the swarm is soon going to rise by an order of magnitude, from a first set of 10 prototypes to 100 units. Adam jokes that to meet the deadline he must first transform himself into a production-line robot, as these creatures cannot reproduce themselves autonomously just yet.

Katrin and Adam met in Switzerland during an exhibition in which Adam was busy with a pair of robotic arms capable of moving particles using acoustic levitation. For the last two decades, Adam has been working with sound and robotics, fascinated by things like acoustic lenses and how sound interferes with our perceptions. It was during a residency at the Defence Science and Technology Organisation in Adelaide in 2001 that he was first able to explore the possibilities afforded by hyper directional sound. Katrin matured her interest in robotics during her architecture studies, first at Bergische Universität Wuppertal and then at ETH Zurich. Her research approached digital parametric design by devising a swarm of builder drones able to cooperate to construct temporary pavilions. As is the case with most in the architectural profession, her ideas remained designs awaiting realisation. The encounter between Katrin and Adam presented the opportunity for them to join their expertise to give life to an actual swarm of artificial entities. Katrin became the coder and Adam the hardware guy.

The little hexagonal cars that are dancing around my feet run a physical implementation of the well-known algorithm 'Boids', created by Craig Reynolds in 1986, which simulates the flocking behaviour of birds. I remember playing with that code myself in programming class. Then it was just triangles on a computer screen; now, it's hexagons running freely on the floor.

In their recent book *Living with Robots*, Paul Dumouchel and Luisa Damiano explain how the field of artificial ethology is concerned with creating biomimetic robots that serve as scientific instruments to prove theories about animal behaviour.[3] There are advantages in utilising robotics over computer simulations. Robotics allow the interplay of complex physical forces to be modelled in a way that cannot be simulated accurately in virtual environments. Moreover, robots have a presence that compels human responses and enables interactions within the same space that our own bodies occupy.

The broader question that Reynolds was responding to with Boids is how swarms of autonomous agents organise themselves without a central authority. Boids models the flocking behaviour of birds using three principles: separation, alignment, and cohesion. The direction taken by each agent at every program cycle is the vector sum of these three parameters. Separation indicates the distance that each agent will seek to maintain from its neighbours. Alignment steers agents towards the average direction of nearby flock mates. Cohesion steers agents towards the centre of the flock, seeking to maintain agents within the group. If we imagine these three parameters along the lines of Braitenberg's interpretation of robotic motion, we could call them personal space, conformism, and loyalty.

One of the allures of studying swarm intelligence is the promise of developing better systems of governance—those where every member of a group is reflected in decision-making processes. In his documentary *All Watched Over by Machines of Loving Grace*, Adam Curtis refers to an experiment that was carried out during the SIGGRAPH 91 convention in Las Vegas. In this experiment, 5,000 participants equipped with colour-coded paddles collectively played the video game Pong, which was projected on the large screen of the venue. The system tracked in real time the paddles held by the audience, steering the game paddles according to input provided by the crowd. The experiment demonstrated a new way for collective decision-making that promised all but a societal revolution.[4] Fast forward almost three decades and much of the earlier enthusiasm for digital information technology is gone, replaced with fear over stock market instability, cyber bullying, data mining, online censorship and fake news.

We have reached the difficult question: where is the empathy in this swarm?

'Empathy' has been a buzzword since scientists scanning the brains of monkeys stumbled onto the idea of mirror neurons. Neuroscience explained what theatre audiences felt for centuries in front of the sorrows of Antigone or Ophelia: when we look at someone who is exhibiting pain, we experience pain ourselves. Capitalising on this discovery, Jeremy Rifkin in *The Empathic Civilization* proposed to harness these newfound brain mechanics to tackle global challenges such as climate change.[5] If we could just feel the pain of fellow humans on the other side of the planet, then we might take the steps necessary to reform our consumption patterns.

An obstacle lies in the way of pursuing Rifkin's proposition. Within the online environments that connect us to the world at large, humans have shown to express a severe empathy deficit. In 2009, Dutch artist Tinkebell published *Dearest Tinkebell*, a printed archive of hate mail and death threats she received after claiming to have tailored a handbag out of the fur of her own cat. "I seriously hope you become the obsession of a sociopath and that he makes a purse out of you," echoed with variations over the hive mind.[6]

Is it true what they say—that people with social impairments created the internet in their own image?

The recluse inventor assembling robotic companions as compensation for a lack of human connection is somewhat of a cartoonish stereotype. It makes sense that those who are uneasy with the complexities of volatile human emotion would find comfort in alternate realities where the behaviour of companions can be modelled parametrically to fit within a predefined comfort zone. Think of the androids in the sci-fi series *Westworld*, where the hosts of the amusement park can be reprogrammed to be more submissive or aggressive at the touch of a button.[7]

Where fantasy starts to meet reality, the field of social robotics proposes to develop new forms of artificial intelligence able to recognise and respond to human

emotion. One of the inspirations for *Empathy Swarm* is the work of roboticist Angelica Lim. For her PhD research at Kyoto University, Lim developed *SIRE*, a multimodal system allowing AI agents to recognise and exhibit emotional responses.[8] Differently from other researchers in her field, Lim chose not to go along the more obvious path of reading and imitating human facial expressions. *SIRE* stands for Speed, Intensity, Regularity, and Extent. Analysing the variations of these four parameters, *SIRE* attempts to infer an emotion from bodily movements and vocal dynamics. The system then creates a reference database from which it can generate its own emotional responses; it is AI that learns how to become emotional from example.

And here lies the crux of the matter. The challenge of teaching robots to develop emotional connections, however unlikely the prospect of creating truly emotional machines may seem, could give us some insight into how to teach each other to be more caring.

Searching for emotion where it's the least expected is at the core of *Empathy swarm*. An experiment carried out in 1944 by psychologists Fritz Heider and Marianne Simmel is cited by Katrin and Adam as the starting point for their work.[9] Heider and Simmel presented a short animated film to a group of test subjects and then asked them to describe what they had seen. The film shows a few basic geometrical figures in motion. Most spectators easily decode the choreography as a short story in which the figures represent people enacting emotions such as love, anger and sadness. No need to go to all the trouble of drawing cartoons of a mouse when we can connect emotionally to the adventures of a triangle and a circle just fine.

Current research into social robotics finds a direct application in fields such as healthcare, where robots sit in for human caretakers. This relationship appears to be reversed as I observe Katrin and Adam intent on the development of *Empathy Swarm*. At work in the studio, they are the human caretakers while the robots are their dependents. As I approach the creatures, I get too close and inadvertently interfere with their tracking system. The creatures lose their bearings and run out of their playpen. We patiently chase after them and bring them back to safety. If we must raise robots that have empathy, Katrin and Adam are doing it the traditional way, like a loving couple raising children.

My first globe of sourdough looks like it's ready to be put into the oven. Humans and yeasts have been collaborating for a while; there is promise in collaborations between radically different entities.

Matteo Marangoni
Matteo Marangoni is an artist based in The Hague, interested in sonic rituals and DIY culture. He is co-founder of iii and curates the performance series No Patent Pending.

1 Valentino Braitenberg, *Vehicles: Experiments in Synthetic Psychology* (Cambridge, MA: MIT Press, 1984).

2 Al Bartlett, "Arithmetic, Population and Energy: Part 3," filmed at the University of Colorado, Boulder, CO, video, 9:40, https://www.albartlett.org/presentations/arithmetic_population_energy_video1.html.

3 Paul Dumouchel and Luisa Damiano, *Living with Robots* (Cambridge, MA: Harvard University Press, 2017).

4 Adam Curtis, dir., *All Watched Over by Machines of Loving Grace* (London: BBC 2, 2011).

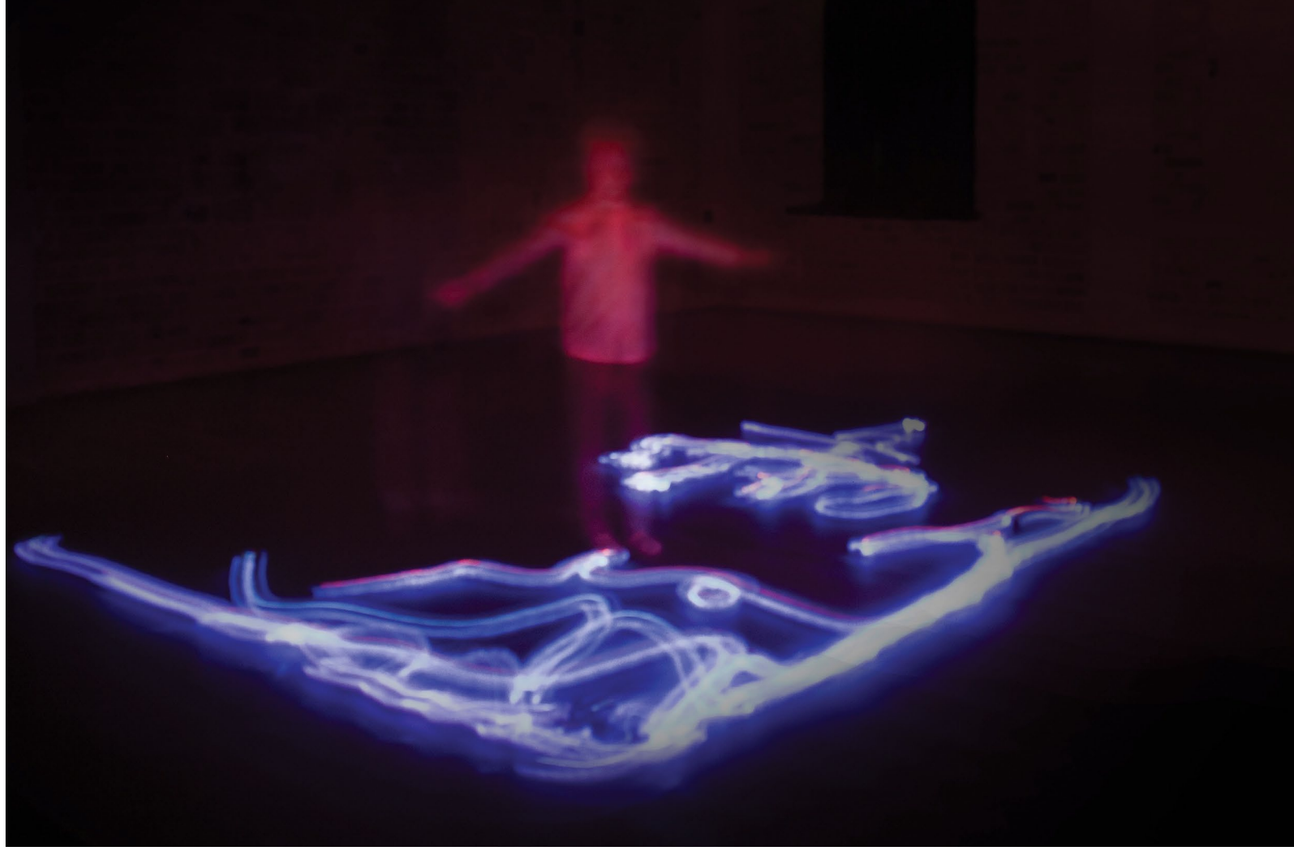
5 Jeremy Rifkin, *The Empathic Civilization* (New York: Jeremy P. Tarcher Inc., 2010).

6 Tinkebell and Coralie Vogelaar, *Dearest Tinkebell*, (Amsterdam: TORCH Gallery, 2009).

7 *Westworld* (New York: HBO, 2016–).

8 "Publications," Angelica Lim, accessed 1 August 2018, http://www.angelicalim.com/publications.html.

9 Fritz Heider and Marianne Simmel, "An Experimental Study of Apparent Behaviour," *The American Journal of Psychology* 57, no. 2 (April 1944): 243–259, http://www.jstor.org/stable/1416950



IMAGES:
Katrin HOCHSCHUH and Adam DONOVAN
Empathy swarm prototypes 2018
robotics
Installation view at WRO Biennale 2019,
Wroclaw, Poland, courtesy of the artists

QUT Art Museum

Publisher
QUT Art Museum
Gardens Point Campus
2 George Street
Brisbane Qld 4000

Publication Designer Lisa Rafferty
Printer Colour Chiefs, Brisbane

ISBN 978-0-86856-000-7

Published on the occasion of the exhibition
Empathy swarm
17 August 2019 to 27 October 2019

QUT Art Museum and the William Robinson Gallery are proudly supported by

PHILIP BACON AM
supporting visual arts at QUT

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Sponsors

Australian Government | Australia Council for the Arts

This project has been assisted by the Australian Government through the Australia Council, its arts funding and advisory body.

EMAP / EMARE
Co-funded by the Creative Europe Programme of the European Union

Work co-produced at Kontejner within the framework of EMAP / EMARE and co-funded by Creative Europe.

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Robot omni wheels produced and sponsored by Rotacaster.

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