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Kaisu Koski, *Injection Simulator* (2015)

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IMAGINING CO-IMMUNITY IN SHADOWPOX: THE ANTIBODY POLITIC

ALISON HUMPHREY

Shadowpox: The Antibody Politic is a game-based interactive installation that renders visible the forces our immunization decisions exert not just on our personal health but on the health of others. Part fact, part science fantasy, this full-body video game combines real-world statistical data with motion-tracking, live-animated digital effects to imagine a vaccine-preventable disease composed of viral shadows. The author explains how her initial design choices were rooted in a widespread misunderstanding: that our vaccination decisions have purely individual and private consequences. Once she became aware of her own blind spot, the game's design, and the wider Shadowpox science fiction storyworld of which it was a part, came into focus, framing community immunity as a metaphor for the power we each have to make choices that will have a destructive or constructive effect on the world around us.

Shadowpox: The Antibody Politic est une installation interactive basée sur un jeu qui rend visible les forces que nos décisions de vaccination exercent non seulement sur notre santé personnelle, mais sur la santé des autres. Moitié réalité, moitié fantaisie scientifique, ce jeu vidéo sur tout le corps combine des données statistiques du monde réel avec des effets numériques animés de suivi de mouvement pour imaginer une maladie évitable par la vaccination composée d'ombres virales. L'auteur explique comment ses choix de conception initiaux étaient enracinés dans un malentendu généralisé: l'idée que nos décisions de vaccination ont des conséquences purement individuelles et privées. Une fois qu'elle a pris conscience de son propre angle mort, la conception du jeu et le monde de la science-fiction Shadowpox plus large dont il faisait partie ont été mis au point, montrant l'immunité communautaire comme une métaphore du pouvoir que nous avons chacun de faire des choix qui auront un effet destructeur ou constructif sur le monde qui nous entoure.

“... imagine the action of a vaccine not just in terms of how it affects a single body, but also in terms of how it affects the collective body of a community...”

*—Eula Biss, *On Immunity: An Inoculation**

“If the semiotic axis around which every social institution is constituted lies in the boundary between self and other—between us and them—what constitutes both its interpretive key and effective outcome better than the principle of immunity?”

*—Roberto Esposito, *Immunitas: The Protection and Negation of Life**

A virus is invisible. While Robert Koch published the first light-microscope drawings and photographs of bacteria in 1877, viruses—over 100 times smaller than bacteria—were not visualized until the 1930s advent of the electron microscope. Nor can we see immunity to a virus, except as abstract absence: I’ll never know that my October flu shot saved me a week of misery in March. I bear no sign to others that I’ve even chosen to be vaccinated, in contrast to bygone days when smallpox inoculation left a distinctive scar (Figure 1) that served as a domestic passport in times of quarantine (Bliss 20), a “government-certified ticket of immunity [...] stamped indelibly on the body [...] a well-defined sign [that] cannot be forged” (Willrich 227).

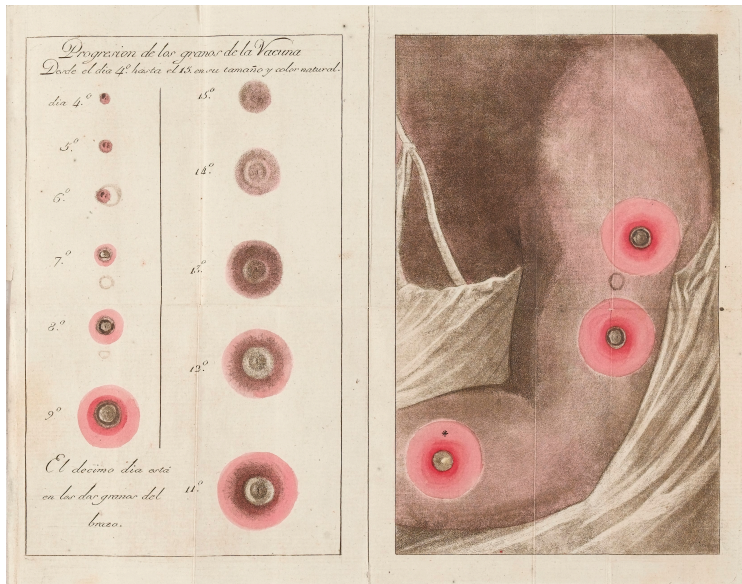


Figure 1: Foldout colour plate showing vaccination scars. Wellcome Collection., Attribution 4.0 International (CC BY 4.0). <https://wellcomecollection.org/works/hyjxgxax>

But of all these invisibilities, perhaps the most significant is the impact that our own vaccination choices have on those around us. If I forego that flu shot, there's a vanishingly small chance—but still a chance—that I might catch the virus, pass it along unawares, and become indirectly responsible for a fatal illness in a nursing home, or for the death of a toddler (Howells). I will almost never see that my decision affected anyone other than myself.

Gilles Deleuze argues that, “In art, and in painting as in music, it is not a matter of reproducing or inventing forms, but of capturing forces [...] The task of painting is defined as the attempt to render visible forces that are not themselves visible” (56). *Shadowpox: The Antibody Politic* is a game-based interactive installation that renders visible the forces that our immunization decisions exert not just on our personal health but on the health of others. Part fact, part science fantasy, this full-body video game combines real-world statistical data with mo-

tion-tracking, live-animated digital effects to imagine a vaccine-preventable disease composed of viral shadows.

The interactive “shadowpox” virus is projected not only on the digital avatar that mirrors the player’s movements on-screen, but also on the player’s own body, and on the members of the 100-strong animated population of which that avatar is a part. As the player fights the disease, moving their hands to expel the pox from their body, they discover that each handful of virus they shed has the potential to infect their 99 neighbours. The odds of infecting these animated sprites are based on real-life statistics, and the player’s score mounts with each victim. The goal of this mixed-reality immersion is to intensify emotional and physical affect, and heighten the gallery visitor’s sense of connection and consequence.

At the end of the game, a coded web link leads players online to meet their unique “Infection Collection” or “Protection Collection.” Here, the abstract statistic of their score is translated into a series of 99 individual trading cards sporting quirky pictogram and text portraits. Under this microscope, seemingly private choices are revealed to have public reverberations, while population-level health statistics are broken down into their component parts: five-score individual yet interconnected human stories. The affective arc of the game traces a connection from the personal to the political and back again.

Shadowpox: The Antibody Politic was created for <Immune Nations>, described on its website as “a speculative exhibition about the constructive role that art can play in global political discourse around life-saving vaccines.” I was a last-minute addition to the three-year interdisciplinary project at its inaugural workshop in August 2015, weeks before beginning my PhD at York University. It proved a serendipitous chance to collaborate on an incarnation of the science fiction storyworld *Shadowpox*, the core of my research-creation dissertation, co-created with youth on three continents to mark the centenary of the 1918-19 influenza pandemic.

As the first chapter in this wider *Shadowpox* storyworld, *The Antibody Politic* was created by a team including York University’s Immersive Storytelling Lab director Caitlin Fisher and Global Strategy Lab di-

rector Steven Hoffman; technical director and creative coder Lalaine Ulit-Destajo; epidemiologist Susan Rogers Van Katwyk; and website programmer Sean Sollé.

The first part of this essay describes the game as it was exhibited in Trondheim, Norway, in March 2017, and Geneva, Switzerland, in May 2017. The second part investigates the theory and development process behind it, particularly my own realization that my initial design choices reflected a common misunderstanding: that our vaccination decisions are purely individual and private. The process of designing the game led me to identify the purpose of the *Shadowpox* storyworld: to expand our civic imagination. In the game as in the wider fiction, community immunity becomes a metaphor for the power we each have to make choices that will have a destructive or constructive effect on the people and the world around us.

A TRIVALENT VACCINATION GAME

Imagine you are standing in the soaring, glass-walled lobby of the UNAIDS building in Geneva. Before you is a square, light-grey tent (the sunlight streaming through those soaring glass walls is not ideal for infrared tracking). Even before you step inside, you see rear-projected on the tent walls a punning, recombinant title animation that teases the three phases of the game (Figure 2).

POX ON ME

POX ON 'EM

POXÉMON

Figure 2: Alison Humphrey, *Pox On Me, Pox On 'Em, Poxémon*, 2017. Title animation stills. Image courtesy of the artist.

This is how you play:

PHASE 1: POX ON ME—THE INDIVIDUAL'S CHOICE

In which fear and courage incarnate, as the pathogen is projected onto the player's own body.

You enter the playing area and stand facing one screen, with your back to another. A Microsoft Kinect sensor above the front screen detects your movements, giving you control over a real-time animated avatar. Two opposing projectors shine this avatar onto the front screen, and in reverse, onto your own body (Figure 3).

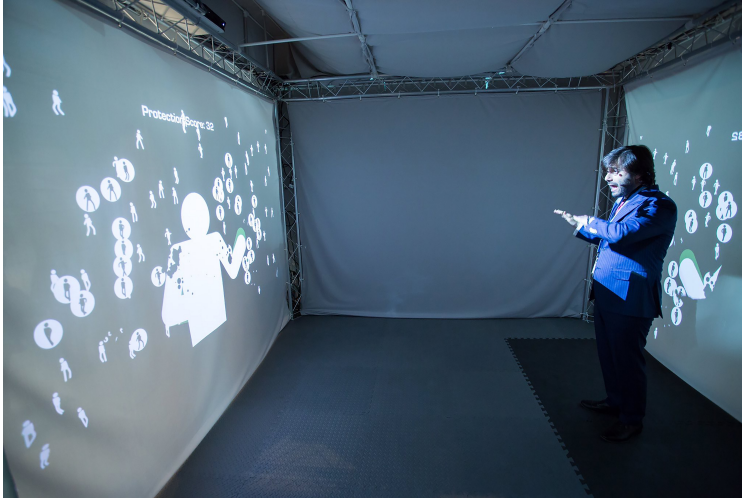


Figure 3: Shadowpox player at the <Immune Nations> exhibition opening, UNAIDS, 2017. Photo by Alison Humphrey.

The Kinect bounces infrared light off the player, tracking the position of key skeleton joints (Figure 4). Technical director Lalaine Ulit-Destajo's 2000+ lines of openFrameworks code (Figure 5) draws circles and rectangles around those points to build a simple avatar (Figure 6). The avatar's gestures are recalculated 120 times per second, so fast that the player feels like they are looking at themselves in a black-and-white pictogram mirror (Figure 7).

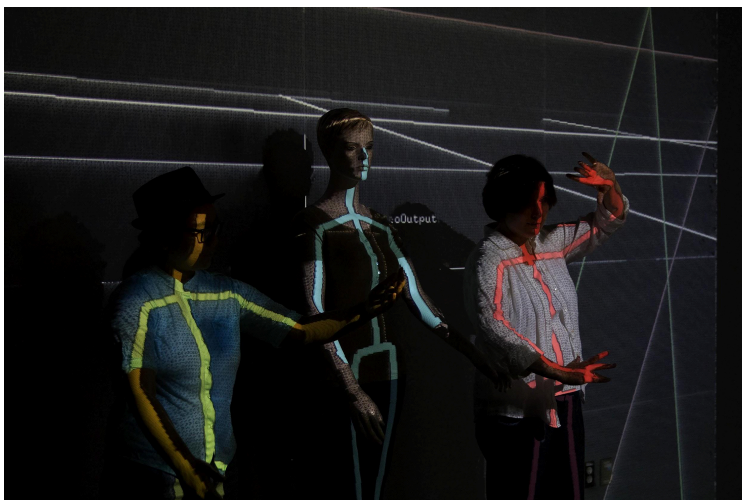


Figure 4: Lalaine Ulit-Destajo, Maggie the Mannequin, and Alison Humphrey calibrating projector with Kinect skeleton tracking, 2016. Photo by Wesley Moir.

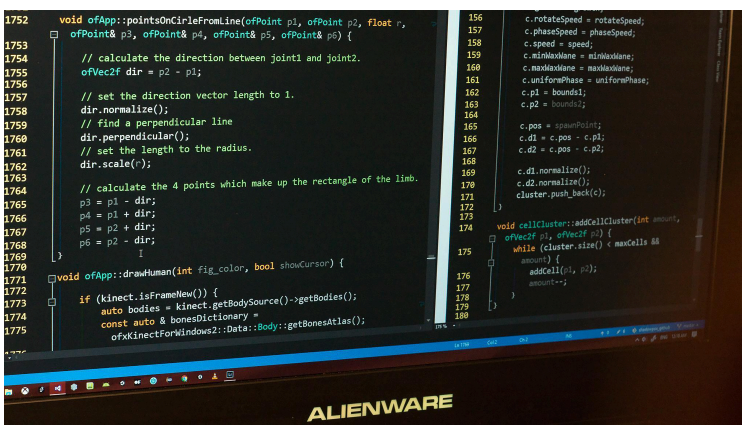


Figure 5: Coding in openFrameworks for real-time avatar animation, 2016. Photo by Lalaine Ulit-Destajo.

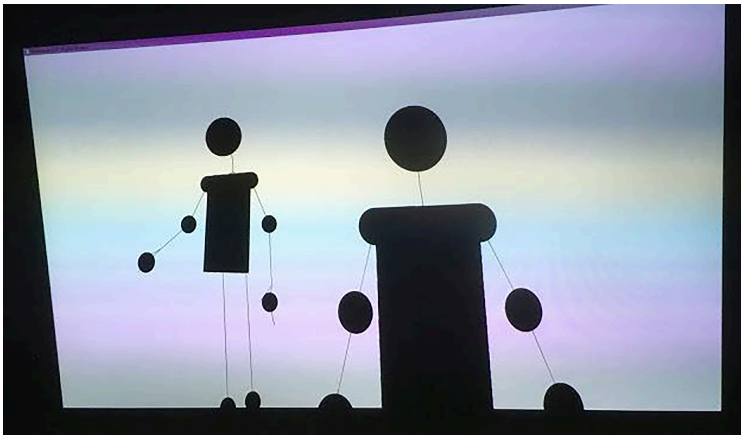


Figure 6: Half-finished pictogram avatar with torso and joints, 2016. Photo by Lalaine Ulit-Destajo.



Figure 7: Final pictogram avatar in action among 99 neighbours, 2017. Photo by Alison Humphrey.

The visual language of the game is inspired by the design and spirit of ISOTYPE, the International System of Typographic Picture Education developed by Austrian sociologist Otto Neurath between the world wars. Vossoughian explains that ISOTYPE’s elementary infographic language (Figs. 8a, 8b) was designed to “make statistical data legible and accessible to non-specialized mass audiences,” and to encourage people to “think of themselves and the world around them in terms of patterns, relationships and systems of organization” (79). Neurath’s earliest exhibit, at the 1925 Vienna Hygiene Exhibition, featured a diagram demonstrating that “the smaller the income-level of a group of people, the higher the likelihood that tuberculosis will sicken and kill” (Vossoughian 79). *Shadowpox: The Antibody Politic* is similarly designed to enable players to think of their own actions as part of a wider pattern of community relationships.

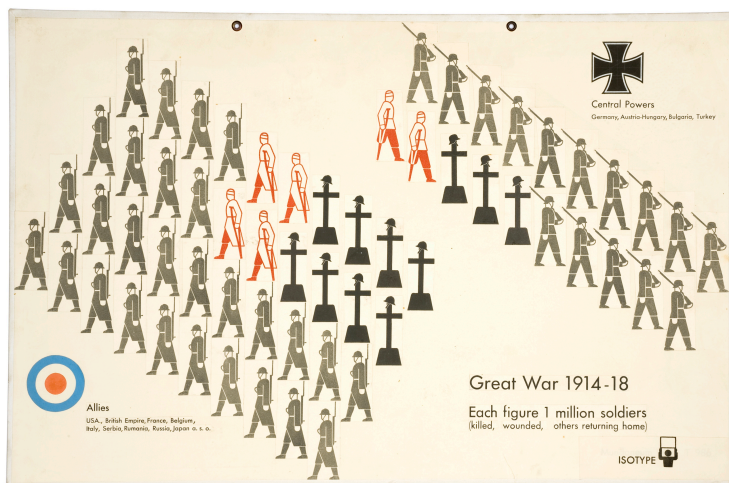


Figure 8a. Otto Neurath, Great War 1914-18, Published in a traveling, folding presentation portfolio for the Mundanaeum in London, 1930s. Image courtesy of Otto and Marie Neurath Isotype Collection, University of Reading.

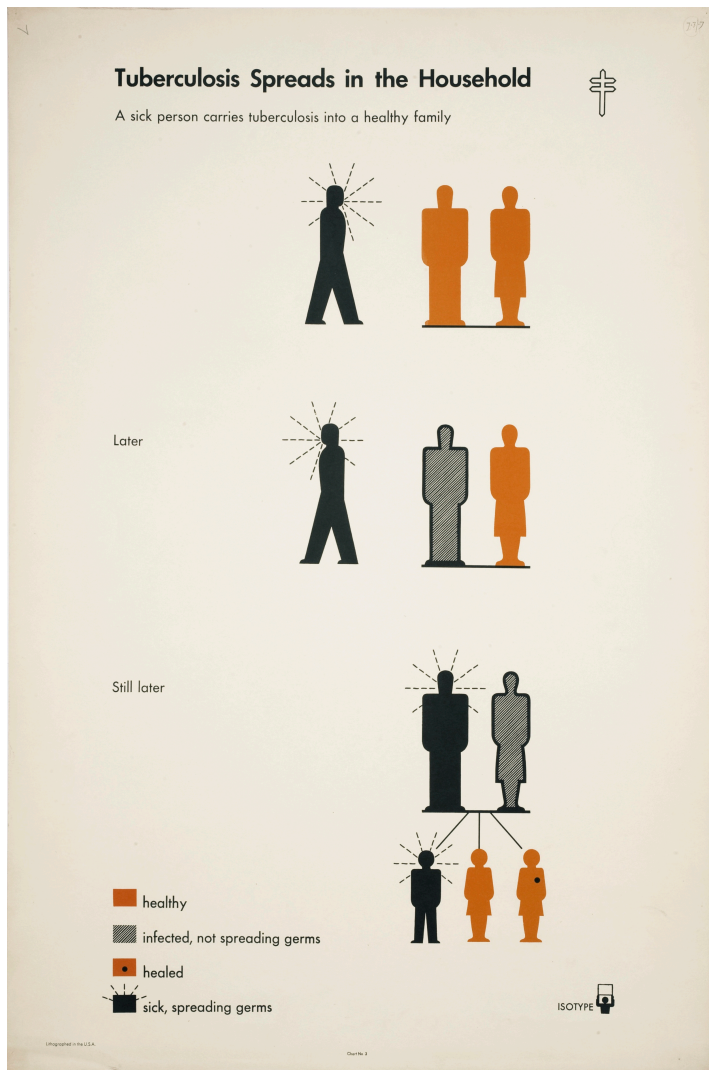


Figure 8b. Otto Neurath, Tuberculosis spreads in the household, 1938. Chart from the 'Fighting Tuberculosis' exhibition produced for The National Tuberculosis Association in the USA. Image courtesy of Otto and Marie Neurath Isotype Collection, University of Reading.

The *Shadowpox* game begins with two choices that determine how your actions will affect the world around you. An arrow-cursor appears over your avatar's right hand. You gesture at a map to choose which of 193 countries your avatar hails from. The game shows you the "shadowpox vaccination rate" in that country, derived from real-world statistics (see next section, below). Your second choice is whether to "Get the Vaccine" or "Risk the Virus" (Figure 9). Depending on your choice, your country's vaccination rate climbs or falls by 1%.



Figure 9: Alison Humphrey, Vaccine/Virus choice screen with vaccination rate, 2017.
Photo by Alison Humphrey.

If you choose to risk the virus, the game informs you that you have caught the disease, and that in the process of fighting it, you risk passing it along to others. Your "infection score" tracks the number of people who catch the virus from you. On the other hand, if you choose the vaccine, the game explains that you now have the chance to practice fighting a weakened form of the disease without the risk of infect-

ing others. Your “protection score” is the number of people you *would have* infected, had you been fighting the actual disease rather than rehearsing with the vaccine. After a brief explanation of how to fight the disease by moving your hands to push the small, round, shadowy pox off your body (Figure 10), the game begins.

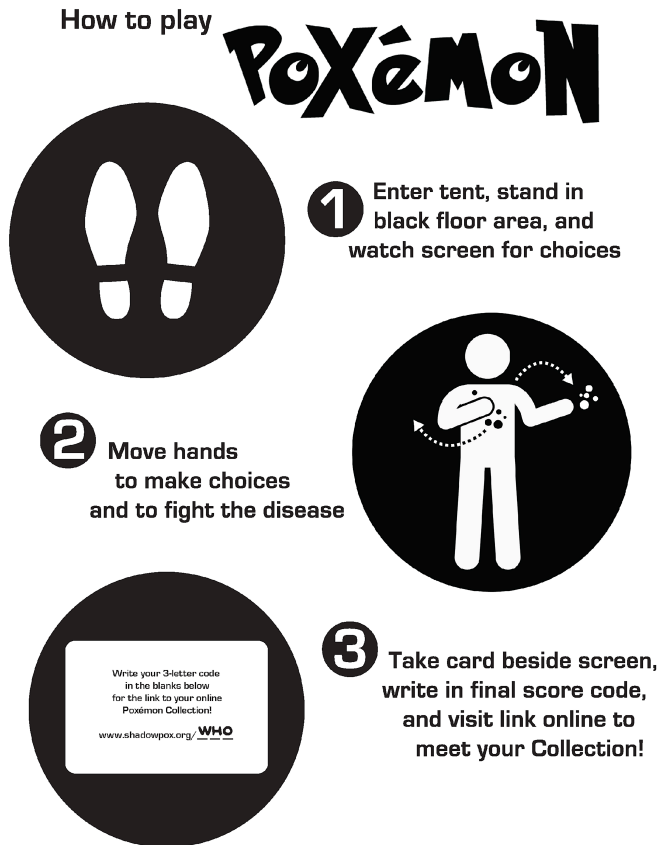


Figure 10: Alison Humphrey, *Shadowpox* game instructions signage, 2017. Image courtesy of the artist.

PHASE 2: POX ON 'EM—THE COMMUNITY IMPACT

In which risk and the individual immunization decision are cast in a wider light, as the player sees the power they have to protect or infect 99 others around them.

Underlying the game is a real-world population-level statistical model, a powerful reminder that countries have different levels of resilience in dealing with vaccine-preventable disease. The model was created by epidemiologist Susan Rogers Van Katwyk and Steven Hoffman, scientific director of the Canadian Institutes of Health Research Institute of Population and Public Health. As you fight the disease, throwing pox off your body, some of the virus will come in contact with one of the 99 other people around you. The odds of your neighbour becoming infected depend on your choice of country at the beginning of the game—not simply on its shadowpox vaccination rate, but a more complex calculation that reflects structural inequalities between nations.¹

Rogers Van Katwyk explains,

“Each country’s fictional maximum severity score—how severe a shadowpox outbreak could be at 0% vaccination—was calculated starting by ranking every country against each other by education, wealth and health, based on real-world statistics for:

- Average Years of Education for Women,
- Gross Domestic Product per capita (purchasing power parity), and
- Health Expenditure as a percentage of GDP.

We used a simple equation to combine these three factors into a score, and subtracted from 100% to create the maximum severity score. So, for example, the worst possible outbreak in Afghanistan is 95% while the worst possible outbreak in New Zealand is 78.6%. We also calculated a starting vaccination rate, the starting point from which people’s decisions increase

or decrease the vaccination rate. To make this a semi-realistic illustration, we borrowed the measles vaccination rates from 1997, and divided them in half. (The 1997 rates for measles vaccination reflect several decades of public health efforts, so we imagined a novel disease like shadowpox would not yet have reached such high levels of coverage.)”

| | A | B | C | D | E |
|----|-------------------|---------------------------|-------------------------|--|------------------------|
| 1 | Country | Starting Vaccination Rate | Starting Severity Score | Change in Severity for 1 Unit Decrease in Vaccination Rate | Maximum Severity Score |
| 24 | Botswana | 44.5 | 37.581 | 1.059 | 84.7 |
| 25 | Brazil | 49.5 | 32.317 | 1.06 | 84.8 |
| 26 | Brunei | 49 | 32.154 | 1.037 | 83 |
| 27 | Bulgaria | 46.5 | 34.845 | 1.04 | 83.2 |
| 28 | Burkina Faso | 20.5 | 70.965 | 1.193 | 95.4 |
| 29 | Burundi | 38.5 | 48.999 | 1.181 | 94.5 |
| 30 | Cambodia | 25 | 64.636 | 1.175 | 94 |
| 31 | Cameroon | 21.5 | 68.503 | 1.171 | 93.7 |
| 32 | Canada | 48 | 30.611 | 0.957 | 76.5 |
| 33 | Cape Verde | 41.5 | 44.771 | 1.163 | 93 |
| 34 | Central African R | 21 | 72.47 | 1.228 | 98.3 |
| 35 | Chad | 15 | 78.619 | 1.21 | 96.8 |
| 36 | Chile | 48 | 32.694 | 1.022 | 81.7 |
| 37 | China | 41.5 | 42.914 | 1.115 | 89.2 |
| 38 | Colombia | 40 | 43.174 | 1.079 | 86.3 |

Figure 11: Susan Rogers Van Katwyk, Shadowpox statistical model spreadsheet, 2017.

Each player who chooses not to vaccinate will reduce the rate by 1%. These changes mirror the real world by persisting throughout the exhibition. For example, when First Lady of Namibia Monica Geingos chose her home country (Figure 12), the shadowpox vaccination rate was 55%. Since she chose to vaccinate herself, the rate rose to 56%, and the next person to play for Namibia would start with that number. Each increase in the vaccination rate causes a decrease in the severity score. So, for example, when Canada’s Minister of Health Jane Philpott played the game, she raised her country’s shadowpox vac-

ination rate by 1%, thereby decreasing Canada's severity score by 0.957 and making her community less susceptible to infection.

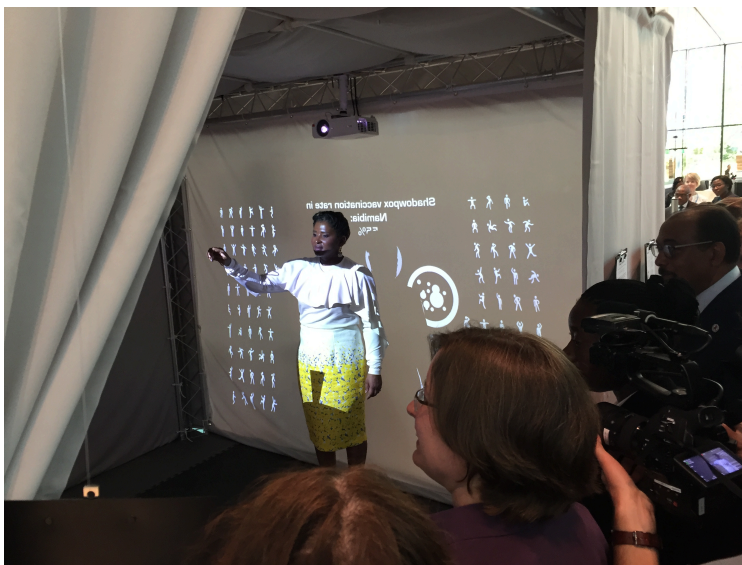


Figure 12: First Lady of Namibia Monica Geingos plays *Shadowpox* at the <Immune Nations> opening, May 23, 2017. Photo by Steven Hoffman.

Rogers Van Katwyk adds, “We decided that the vaccination threshold for shadowpox herd immunity was 80%”—for polio it’s 80 to 85%, for measles 95%—“so any increases in vaccination rate above 80% won’t make a change in disease severity.” The final ingredient in the statistical recipe was the case fatality rate. When I asked Hoffman to suggest a reasonable rate for shadowpox, he answered, “Ebola was an average of 50%. Smallpox was 30%. Depends on how dramatic you want to be!” While I was concerned not to over-dramatize, as a dramatist I know it’s possible to under-dramatize as well. Players have more fun when their actions have high stakes.

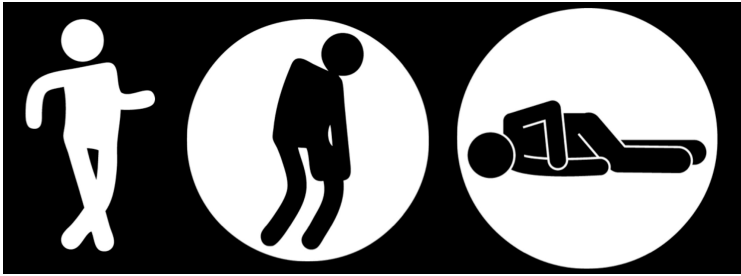


Figure 13: Alison Humphrey, *Healthy, sick and dead neighbours*, 2017. The healthy and sick figures are stills from animated loops by Geoffrey Cramm; the dead figure is a pictogram by Leremy Gan.

In the end, we settled on a fixed case fatality rate of 20%, drawing again on real-world statistics from measles, whose rate is 0.2% in the United States, but up to 25% in some developing countries. I thought perhaps we should make this a variable too, but Rogers Van Katwyk explained that there was no need to vary the case fatality rate given that the severity rate already varied by country. As a statistics neophyte, I remained confused despite her explanations (and still slightly concerned about overdramatizing), but I went with the fixed rate out of respect for her expertise. Cross-disciplinary collaboration requires a willingness to ask what feel like stupid questions, and when good answers still go over one's head, it requires respect for and trust in others' expertise. This kind of trust in experts is a crux of vaccine confidence, as well—its erosion can lead to hesitancy, denialism, and, in extreme cases, conspiracy theories.

PHASE 3: POXÉMON—FACES IN THE CROWD

In which the player's final score is unpacked into an online "Infection Collection" or "Protection Collection," a community composed of unique individuals.

At the end of the game, you are given a final score representing the number of people you infected, and the number of these who died (or the number you protected from those fates, if you chose the vaccine).

This score is translated into a three-letter code, which you write on a card to complete its web link: “shadowpox.org/___ __.”

When you visit the Poxémon website, abstract statistics transform into singular humans. Whereas in the game, the people in your community are without names or any other distinguishing features, once you venture online, this identical population blooms into individuality. Slovic and Slovic attest to the difficulty of making human drama out of data: “Even the most mathematically gifted human beings are psychologically limited when it comes to attaching feeling to numerical information” (7).

Your online “Infection Collection” or “Protection Collection” riffs on the Pokémon trading card series, each virtual card depicting a single individual whose life you have touched—for better or worse—giving them a name, a “nano-story” written by Caitlin Fisher, and a unique pictogram designed by Leremy Gan. (See shadowpox.org/ZZZ for the full set of 99 cards.)

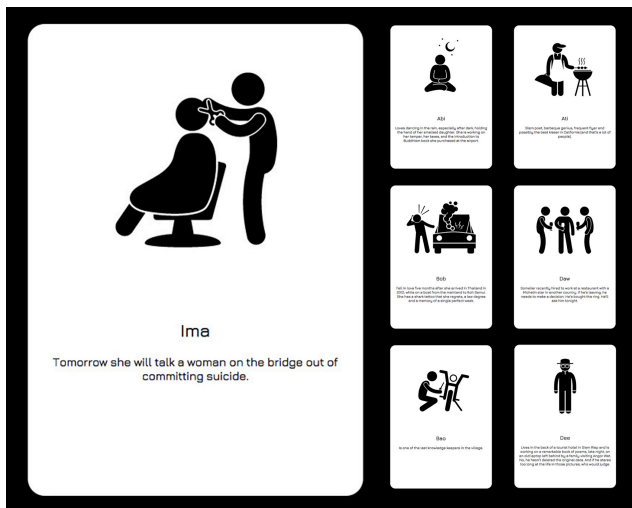


Figure 14: Caitlin Fisher (text) and Leremy Gan (pictogram), Poxémon card: Ima, 2017. Image courtesy of the artists.

Ofri points out one strength public health can borrow from the arts, while explaining the *Journal of Public Health's* decision to name a new column Chekhov's Corner, after a famous Russian playwright and doctor:

“Public health, after all, deals with populations; it eschews the individual except as it forms one of a group. The creative arts, however, deal almost exclusively with individuals. Literature, in particular, always has a protagonist, and the protagonist is never ‘Irish alcoholics with pancreatitis,’ or ‘female prisoners receiving hepatitis B vaccination’ [...] A protagonist is an individual.” (205)

Indeed, many non-scientists feel uneasy with the overtones of the term “herd immunity,” the proportion of a community that must be immunized to protect against the spread of an infectious disease. The phrase “community immunity” is beginning to replace it (I would suggest “co-immunity” as a snappier substitution), and the rhyme points to the fact that the root word of both “immunity” and “community” is the Latin *munus*, meaning a duty or service performed for the group—and also, as in the word “munificent,” a gift.

From the individual (*Pox on Me*) to the community (*Pox on 'Em*) and back to the individual (*Poxémon*), *Shadowpox: The Antibody Politic* uses game-play to make visible the public consequences of our private choices. This perspective came late in the development of the piece, however. The next section explores the *why* behind the *what*: the theory behind the game's design evolution.

As my doctoral research employs a research-creation methodology, I have a general as well as a vaccine-specific motive for thinking about the relationship between knowledge, politics, and aesthetics. Chapman and Sawchuk underline the difference between art as “creative presentation” of a predetermined message, and art as a process of inquiry (“creation-as-research”); the latter “places value on the relational qualities instigated through making and highlights how unexpected and even unknowable its outcomes can be” (50). By listening to others and reflecting on the worldviews informing my design choices as

I went, I discovered a major personal blind spot with regard to vaccination choice, which eventually enlarged the frame of the work, and prompted some useful humility and empathy as I sought ways to help players reflect on their own role in a wider game.

SCIENCE AND SENSIBILITY

The <*Immune Nations*> website (www.immunenations.com) asserts that “Art/creative research has the potential to play an important role in helping to foster a more nuanced discourse around vaccines by articulating elusive or emotionally charged issues.” That’s a carefully worded mission statement. It would be easy to assume when part of the public hesitates to accept an evidence-based scientific consensus—like climate change, or the safety and efficacy of vaccines—that the problem is simply a lack of facts. If that were true, artists would be reduced to the role of decorators on a straightforward education outreach effort. But as researchers increasingly call out the dangers of the “knowledge deficit model” (Kitta and Goldberg; Sobo et al.), it is becoming clear that artistic researchers have more to contribute than attractive infographics.

Alain Badiou outlines four frameworks that have been used to imagine the educational relationship between the arts and philosophy (for which we can read “science”). Didacticism, romanticism, and classicism are the first three schemata (5). In the didactic schema, art is seen as a “false truth,” but one that can still lend “the transitory force of semblance or of charm to a truth that is prescribed from outside” (2) (an echo of Hegel’s belief that “art is what cheers and animates the dull and withered dryness of the idea” [viii]). Badiou’s label “didactic” springs from this schema’s assertion that “the good essence of art is conveyed in its public [i.e., educational] effect, and not in the artwork itself” (2). By contrast, in the second schema, the romantic, “art alone is capable of truth [...] it is the real body of truth.” Instead of acting as an enticing vehicle for a philosophical truth, “Art delivers us from the subjective barrenness of the concept” altogether. It is not seen as the garnish—“it is incarnation” (3).

Between the didactic and romantic schemata Badiou identifies a third, the classical, in which art is seen as “innocent of all truth. In other words, it is inscribed in the imaginary” (4). Here art is ruled not by realism, but by “‘verisimilitude’ or ‘likelihood’” in contrast with the “classical definition of philosophy: ‘The unlikely truth’” (4). There is a parallel here with how our feelings and thoughts influence our beliefs about vaccination. The idea that injecting inactivated pathogens can improve health, rather than make us sick, is not just disgusting—it is counterintuitive. Some science is stranger than fiction. By contrast, with so many genuine episodes of corporate malfeasance and government cover-up in popular memory, it makes intuitive sense to believe urban legends of vaccine skullduggery. Such artful stories, though they may be unsupported by solid evidence, have “verisimilitude.” It is sometimes easier to suspend our disbelief for a “likely” story than for “unlikely” science.

Badiou concludes by positing a fourth schema in which “art itself is a truth procedure” that generates “immanent” and “singular” truths—truths “internal to the artistic effect of works of art,” and “given nowhere else than in art” (9). In this schema, “Art is pedagogical for the simple reason that it produces truths and because ‘education’ (save in its oppressive or perverted expressions) has never meant anything but this: to arrange the forms of knowledge in such a way that some truth may come to pierce a hole in them” (9). This is a breathtakingly poetic image, even without digging into Badiou’s very particular definitions of the troublesome terms “truth procedure,” “knowledge,” and “truth.” What Badiou means here by “education” is not the didactic, where art is a vehicle for a message given from outside—for example, by science. Rather, art is “the thinking of the thought that it itself is” (14).

As mentioned above, the mixed-reality game of *Shadowpox: The Antibody Politic* is part of a larger project that forms the core of my research-creation doctoral thesis.² *Shadowpox* is an online science fiction storyworld being co-created with young artists on three continents. The first laboratory took place in June 2016 in London, and the project spread to North America, Europe, and Africa for the centenary of the 1918-1919 influenza pandemic.

Lalaine Ulit-Destajo created the first generation of the shadowpox code in 2016, in preparation for a week-long workshop with nine graduating third-year actors at the Royal Academy of Dramatic Art (RADA). Drawing data from the Kinect motion sensor into the open source C++ toolkit openFrameworks, the code generated living, viral shadows that budded, grew, and spread as they were projected across the actor’s body (Figure 15). The actor could “grab” the pox and drag them off their body, fighting the disease to keep it from engulfing them in shadow.

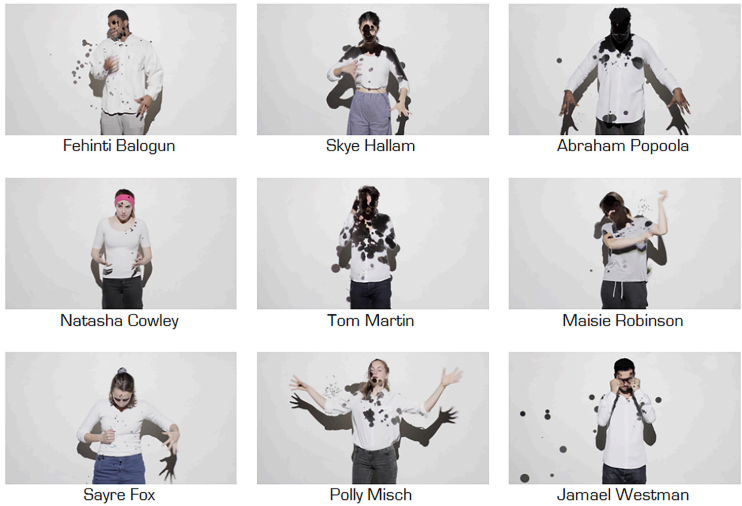


Figure 15: Video stills from RADA Shadowpox workshop, 2016. Photo by Simon Eves.

Our fictional scenario for the workshop was that the actors were volunteers in a phase I trial of a new vaccine candidate (dubbed *toropox*, in honour of cowpox, the original and eponymous vaccine), being tested at the height of a shadowpox epidemic. Our dramatic touchstone was the fact that anyone who decides to become immunized—whether with a vaccine candidate in a cutting-edge trial, or with a long-established vaccine in a local clinic—is not just protecting themselves. Through co-immunity, they are also committing an act of heroism to benefit a wider community.

The group of actors spent the beginning of the week getting up to speed on the biology and the sociology of immunization, exploring the fears that contribute to vaccine hesitancy (Figure 16), and hearing from epidemiologist Conall Watson of the neighbouring London School of Hygiene and Tropical Medicine about his participation in the recent successful Ebola vaccine trial in Guinea. For the next few days, each actor devised their own character backstory, and was interviewed on camera in-character, speaking about a loved one who had been touched by the disease, and the sequence of events that had led them to volunteer for the trial. We administered the shadowpox vaccine and recorded the results. Finally, we interviewed each actor out-of-character, exploring their thoughts on the dyads of light/shadow, individual/collective, and fear/courage in their own creative work. They mused on the metaphor of vaccination as rehearsal: the artist's advance preparation for the live performance.



Figure 16: RADA workshop. Left to right: Jamael Westman, Skye Hallam, Alison Humphrey, Polly Misch, Simon Eves, Fehinti Balogun, Natasha Cowley, Sayre Fox, Abraham Popoola (not pictured: Tom Martin, Maisie Robinson), 2016. Photo by Lalaine Ulit-Destajo.

All of this was recorded on video in London in June 2016. However, in Geneva in August 2016, during the second <Immune Nations> workshop, Caitlin Fisher, Steven Hoffman, and I spent hours discussing how *Shadowpox* could best sit within the <Immune Nations> exhibition the following spring. We sought a way to give the gallery visitor

a more participatory experience than watching actors on a screen. We wanted them to share the visceral sensation of fighting a disease made of shadows, spreading across their own skin. We hoped that an installation-based *Shadowpox* game would offer an intensity of physical and emotional affect that would heighten the gallery visitor's sense of connection not just to the piece but to the community context of their own future vaccination decisions.

As I returned to Toronto and worked on designing a *Shadowpox 2.0* in video game form, I kept returning to Bogost's concept of procedural rhetoric, "the practice of authoring arguments through processes" ("Rhetoric of Video Games" 125). Bogost quotes Murray's definition of procedural authorship: "writing the rules for the interactor's involvement, that is, the conditions under which things will happen in response to the participant's actions" (122). As an artistic creation, a game's world is the sum total of artistic choices that include "if/then" rules of in-game physics, biology, and social behaviour, just as much as colour palette and soundtrack composition. Computer programming uses rule-based "if/then" procedures that govern how actions trigger consequences. For example, in the kids' game "The Floor Is Lava," if you touch the floor, *then* you're dead. In Pac-Man, *if* the player guides Pac-Man over a power pellet, *then* he can eat a ghost to earn bonus points. These invented rules, in games or science fiction, become what I call "the local laws of gravity." Bogost believes that "videogames are particularly useful tools for visualizing the logics that make up a worldview (following Gramsci), [or] the ideological distortions in political situations (following Žižek)" (*Persuasive Games* 74–75). In designing this new *Shadowpox* game, some logics and distortions in my own thinking came into view.

My original interaction design concept had imagined the vaccine as a fight rehearsal, with characters and shadowpox sharing the performance space like a matador sharing the ring with a bull. Actors would create their own dance/fight choreography, "interacting with the deadly shadowpox as it flocks like starlings or sunfish across stage surfaces and skin," as my 2015 doctoral proposal put it. In practice, this large-scale design proved unworkable for the RADA workshop, due to the short range of the Kinect sensor. I learned from Graham Wakefield

of the Alice Lab for Computational Worldmaking that both devices should ideally be in the same location, at the same distance from the subject, using a similar throw. Since the Kinect's throw ratio is roughly 1:1 (where width of image equals distance from surface), its maximum range of four metres from the subject means the projector could create a playing space of only four metres wide.

As a result of this technical limitation, I changed the frame of the disease interaction design from room-scale to body-scale. Inspired by the image of viral budding (Figure 17), I started with the concept that shadowpox infection was transmitted by one person's shadow falling across another's, where it incubated in the shadowed side of the new host's body, then eventually "budded" out of this "dark side of the moon" to migrate into the lighted side.

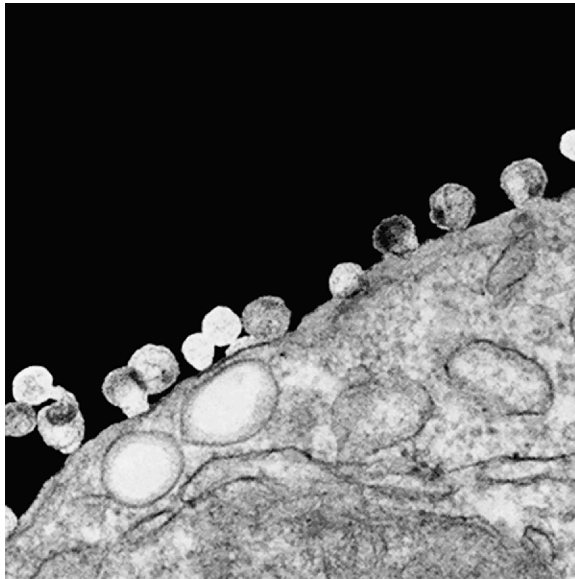


Figure 17: R. Dourmashkin (Wellcome Images), HIV particles budding from the surface of a T cell, 2004.

This concept imagined the actor's hands as the antigen-binding sites of a Y-shaped antibody (Figure 18). By grabbing the virus particles, they could neutralize them by dragging them off the body to die.

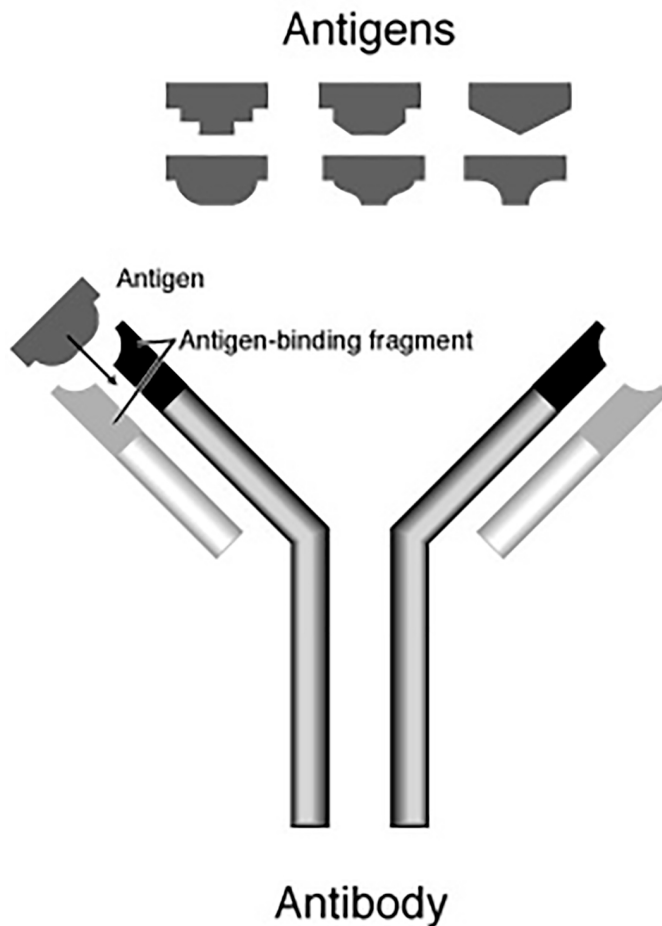


Figure 18: National Human Genome Research Institute, Antibody and antigens, n.d.Public domain.

Ulit-Destajo coded a procedure whereby, when the Kinect sensed the actor's hand closing over a group of pox, the pox could be moved. If the actor moved them off the body, the pox would begin a visible death sequence: breaking, curling, shrivelling, and falling to the ground. We worked hard to make this effect compelling—me by sourcing vector art of curling animal horns (Figure 19) in a nod to the name *toropox*, and her by putting a sine wave on their y-position and a cosine wave on their x-position to give them a nice arc as they spun, shrank, and fell to the bottom of the frame.



Figure 19: KatarinaF and Andrijamil, Horn vector art, n.d. Shutterstock.

Ulit-Destajo also wrestled with the best way to trigger that change. We initially discussed drawing an outline around the avatar, so that when the pox crossed this frontier, its death would begin. However, that proved easier said than coded. As described above, the live-animated avatar was a collection of circles, rectangles, and Bézier curves calculated on the fly, and drawing an outline around it was so computationally taxing that it slowed gameplay. She eventually crafted a workaround based on proximity-to-centre of the avatar's spine (Figure 20). When any pox moved away from that midpoint by a distance of

more than 0.75 times the spine's length, it was considered to have left the body, and its demise began (Figs. 21, 22).

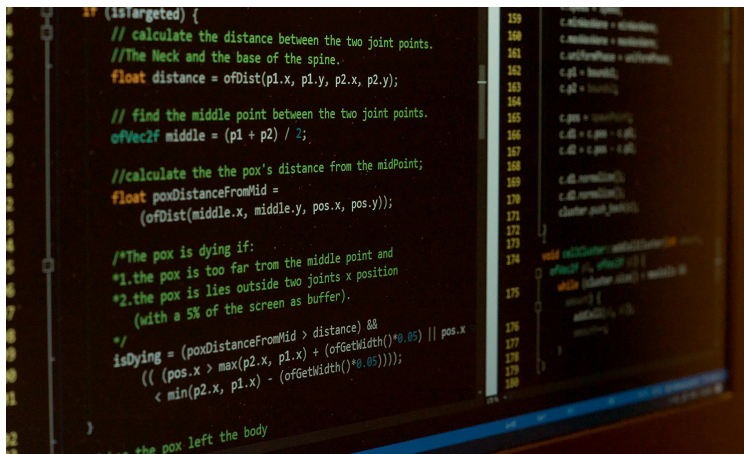
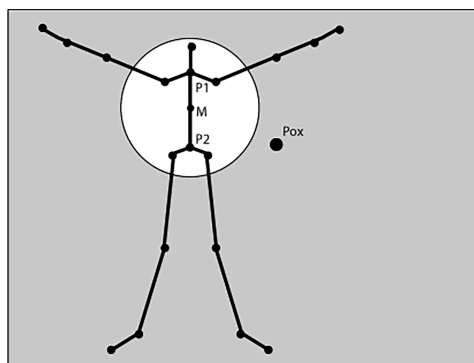


Figure 20: openFrameworks code calculating when a pox's death is triggered, 2016.
Photo by Lalaine Ulit-Destajo.



If the pox is too far from the middle point then it is considered as dying.

Figure 21: Lalaine Ulit-Destajo, Kinect skeleton-tracking: radius beyond which a pox's death is triggered, 2017. Image courtesy of the artist.



Figure 22: Actor Maisie Robison in RADA workshop, 2016. Photo by Simon Eves.

When I proudly described this procedural representation of “fighting a virus” to Natasha Crowcroft, a sci-fi aficionado, then chief of applied immunization research at Public Health Ontario, and one of the project’s first scientific advisors, her response put the first tilt on my perspective. After first admiring the visual concept, she said simply, “But I would be concerned about infection control.” That comment struck deep and stayed with me for months. In all my focus on the figure, I had ignored the ground. This is what makes a communicable disease different from, say, diabetes or cancer: the affected individual, as they fight a virus, can inadvertently infect others.

The second opportunity to look at my design from a new angle came in October 2016 when I visited Debajehmujig Storytellers, a theatre company based on Wiikwemkoong Unceded Territory in northern Ontario, to discuss a possible *Shadowpox* workshop. Bruce Naokwegijig, then artistic director of outreach and education, encouraged me to revisit the original room-scale design idea, in order to accommodate multiple actors in the scene and explore the fundamentally relational nature of contagion.

Naokwegijig’s and Crowcroft’s comments led to a realization that my first interaction design had incarnated the economic concept of exter-

nalities, defined as a cost or consequence of some economic activity which affects a third party, without this cost being acknowledged or factored into the equation. I was paralleling what Reich terms the ideology of individualist parenting, which she argues “prioritizes individual choice for one’s own children over community obligation, [and] ignores how some families with fewer resources have fewer options, but face increased risk of illness” (12). Our society’s focus on the individual is equally reflected in policy efforts to increase vaccination uptake, which Kitta and Goldberg argue “suffer from methodological individualism, which emphasizes the individual as the agent for behavioral change,” ignoring the upstream structural factors, “belief formation, risk and risk communication, fear, legend, and folklore” that determine those behaviours (1–2).

The *Shadowpox* effects quite literally embodied the idea that anything outside the outline of the actor’s own individual body did not matter. When a pox got far enough from the actor’s centre, it died. The game seemed to presume that no one else was affected, or if they were, they were so far from the centre of attention as to be out of sight and mind. Turning a blind eye to externalities in this way was, in Bogost’s terms, an “ideological distortion” *coded into our game’s procedural rhetoric*.

Esposito keys the principle of immunity to the “boundary between self and other—between us and them” (151). In stopping my imagination at that border, I had re-enacted the process that most of us use when we make immunization decisions: we think only about how a vaccine might protect or, in extremely rare cases, harm us as individuals. I had left the community who surround me—family, friends, colleagues, and strangers—completely out of the picture. I had forgotten that when I choose to “get the vaccine” or “risk the virus,” I take all of them along with me in that choice.



Figure 23: Alison Humphrey, "My 99 and I..." sticker designs for #ArtSciImmunize symposium at Jackman Humanities Institute, University of Toronto, April 13, 2017.

Image courtesy of the artist.

Shadowpox: The Antibody Politic found its focus the instant those 99 other figures were added into the frame. At that moment, fighting the disease was no longer a solo activity conducted in a vacuum, but the amassing of an "Infection Collection" of one's fellow humans. Even the vaccine choice sparks a communal what-if: your "Protection Collection" is all the people you *would have* infected in the alternate universe where your fight rehearsal was showtime with the actual virus, though this concept was harder to visualize. How do you show things *not happening*?

The team found a solution to that conundrum three years later with *Shadowpox: #StayHome Edition* (shadowpox.org/game). In this online reinvention of *The Antibody Politic*, coded in JavaScript and submitted to the United Nations COVID-19 Response Creative Content Hub in April 2020, the player's avatar is infected but asymptomatic, and inclined to wander. If you don't actively work to stay home, there is a 50% chance you will infect any of the 99 neighbours who encounter you or cross the viral trail of shadowpox you leave as you walk. Each infected neighbour has a 20% chance, not of death, but of needing hospital care, bringing to mind the pandemic-era concept of "flattening the curve" so as not to overwhelm the healthcare system. The team was also keen to add exponential growth into the visualization this time around: if you go out and infect even one of your 99 neighbours, they can pass the virus along to others, who can pass it along in turn, and all those infections are added to your total score.

Hoffman suggested that if the player's initial choice is between going out and staying home, the winning score should be zero: "No one else gets infected. It's boring—like staying at home—but that's the point." On the flip side, Sollé proposed that if the initial choice were between two worlds—one where everybody but you is physically distancing, and one where nobody is—the latter world could give players a vivid model of how multiple individual choices can add up to collective chaos.

CITIZEN SCIENCE FICTION

The Shadowpox project (shadowpox.org) has continued to evolve, its mixed-reality technology now powering both a participatory storytelling method I'm calling "action refraction," and a pedagogical framework called a "courseplay" developed in collaborative workshops with Debajehmujig Storytellers and the Desmond Tutu HIV Foundation Youth Centre in Cape Town.

In his eulogy for Nelson Mandela, Barack Obama said, "There is a word in South Africa—*ubuntu*, a word that captures Mandela's greatest gift: His recognition that we are all bound together in ways that

are invisible to the eye; that there is a oneness to humanity; that we achieve ourselves by sharing ourselves with others, and caring for those around us.” *Shadowpox* is intended to be one example of the “constructive role that art can play in global political discourse around life-saving vaccines” (<*Immune Nations*>): the use of visual, narrative and procedural rhetoric to make visible the ways we are all connected, and the impact we have on one another.

Community immunity can only be achieved, not by a single hero, but by the dragon-slaying courage of hundreds of thousands. Perhaps this “citizen science fiction” can offer young people more ways to imagine the unseen, to inspire reflection and debate in the audience of their peers, and to generate new insights into one of the thorniest political dilemmas of public health: voluntary participation in the collective good.

ACKNOWLEDGMENTS

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IMAGE NOTES

Figure 1. Fold-out colour plate showing vaccination scars. Wellcome Collection, Attribution 4.0 International (CC BY 4.0). <https://wellcomecollection.org/works/hyjxgxax>.

Figure 2. Alison Humphrey, *PoxOnMe, PoxOn'Em, Poxémon*, 2017. Title animation stills. Image courtesy of the artist.

Figure 3. *Shadowpox* player at the <Immune Nations> exhibition opening, UNAIDS, 2017. Photo by Alison Humphrey.

Figure 4. Lalaine Ulit-Destajo, Maggie the Mannequin and Alison Humphrey calibrating projector with Kinect skeleton tracking, 2016. Photo by Wesley Moir.

Figure 5. Coding in openFrameworks for real-time avatar animation, 2016. Photo by Lalaine Ulit-Destajo.

Figure 6. Half-finished pictogram avatar with torso and joints, 2016. Photo by Lalaine Ulit-Destajo.

Figure 7. Final pictogram avatar in action among 99 neighbours, 2017. Photo by Alison Humphrey.

Figure 8a. Otto Neurath, Great War 1914-18, Published in a traveling, folding presentation portfolio for the Mundanaeum in London, 1930s. Image courtesy of Otto and Marie Neurath Isotype Collection, University of Reading.

Figure 8b. Otto Neurath, Tuberculosis spreads in the household, 1938. Chart from the 'Fighting Tuberculosis' exhibition produced for The National Tuberculosis Association in the USA. Image courtesy of Otto and Marie Neurath Isotype Collection, University of Reading.

Figure 9. Alison Humphrey, Vaccine/Virus choice screen with vaccination rate, 2017. Photo by Alison Humphrey.

Figure 10. Alison Humphrey, *Shadowpox* game instructions signage, 2017. Image courtesy of the artist.

Figure 11. Susan Rogers Van Katwyk, *Shadowpox* statistical model spreadsheet, 2017.

Figure 12. First Lady of Namibia Monica Geingos plays *Shadowpox* at the <Immune Nations> opening, May 23, 2017. Photo by Steven Hoffman.

Figure 13. Alison Humphrey, *Healthy, sick and dead neighbours*, 2017. The healthy and sick figures are stills from animated loops by Shutterstock/GCramm; the dead figure is a pictogram by Leremy Gan.

Figure 14. Caitlin Fisher (text) and Leremy Gan (pictogram), *Poxémon card: Ima*, 2017. Image courtesy of the artists.

Figure 15. Video stills from RADA *Shadowpox* workshop, 2016. Photo by Simon Eves.

Figure 16. RADA workshop. Left to right: Jamael Westman, Skye Hallam, Alison Humphrey, Polly Misch, Simon Eves, Fehinti Balogun, Natasha Cowley, Sayre Fox, Abraham Popoola (not pictured: Tom Martin, Maisie Robinson), 2016. Photo by Lalaine Ulit-Destajo.

Figure 17. R. Dourmashkin (Wellcome Images), HIV particles budding from the surface of a T cell, 2004. Wellcome Images available under the following creative commons usage <http://creativecommons.org/licenses/by-nc-nd/2.0/uk/>; <http://www.cellimagelibrary.org/images/39465>.

Figure 18. National Human Genome Research Institute, Antibody and antigens, n.d. Public domain, originally a work of the United States Government, <https://commons.wikimedia.org/wiki/File:Antibody.png>.

Figure 19. KatarinaF and Andrijamil, *Horn vector art*, n.d., purchased by the author at Shutterstock.

Figure 20. openFrameworks code calculating when a pox's death is triggered, 2016. Photo by Lalaine Ulit-Destajo.

Figure 21. Lalaine Ulit-Destajo, Kinect skeleton-tracking: radius beyond which a pox's death is triggered, 2017. Image courtesy of the artist.

Figure 22. Actor Maisie Robinson in 2016 RADA workshop, 2016. Photo by Simon Eves.

Figure 23. Alison Humphrey, "My 99 and I..." sticker designs for #ArtSciImmunize symposium at Jackman Humanities Institute, University of Toronto, April 13, 2017. Image courtesy of the artist.

NOTES

1. Editor's note: For more on how structural inequalities between developing and developed countries are reflected in vaccine availability, distribution, and uptake, see Sahar et al., "Overview of Key Legal, Political, and Social Challenges Facing Global Vaccination Efforts," this volume.¹
2. Working title: "The *Shadowpox* Storyworld as Citizen Science Fiction: Building Co-Immunity through Participatory Mixed-Reality Storytelling" (Cinema and Media Arts, York University).²