

# Artificial Life and Lo-Fi Embodiment: A Conversation with Nell Tenhaaf and Melanie Baljko

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## Introduction

Feminist science and technology studies have produced a wonderfully heterogeneous sub-field of investigation populated by a myriad of vibrant and challenging intellectual voices: from Isabelle Stengers' investigations into chaos theory (1997), to Sally Hacker's sociology of engineering culture (1989), to Ursula Franklin's descriptions of the need for a holistic approach to technology (1990).

One powerful strain within this contemporary feminist landscape adopts an immanent or insider's perspective on science and technology. In these instances, the researcher often has undergone training from several disciplines or sub-disciplines to produce a distinct practice that rigorously breaches, fuses or morphs the traditional divisions between the sciences, the social sciences or the humanities: Donna Haraway crosses biology, cultural studies, communications and science fiction (1991; 1997; 2003); N. Katherine Hayles' training is in chemistry and literature (1999; 2000); Wendy Chun started in computer science before moving on to literature and media studies (2006).

This inter-disciplinarity provides the feminist critic with a rich and imaginative conceptual vocabulary, a detailed knowledge that can unravel with precision the epistemological complexities of particular areas and open up possibilities for research projects that may otherwise be left unrealized within the sub-field being scrutinized. For example, Chun's intimate knowledge of coding languages, such as PERL, gives her a purview on the rhetorical hype of some aspects of the free and open source software movement. This cross-disciplinary, anti-essentialist analysis refuses to see scientific

knowledge and training as an inherently patriarchal promotion of the domination of (female) nature. Instead the task has been to situate the sciences as a historically contingent set of enterprises, or as Haraway would say to understand it as "a lumpy and variegated discourse" and thus wrest it from certain of its hegemonic presuppositions (Gould 1981; Shiva 1993), valorize what is shunted to the margins (Fox Keller 1983), and to promote it as a potentially creative human endeavour (Stengers 1997). In the case of Stengers' work, the phrase "powers of invention" conveys the paradox of the term power as that which is not only oppressive, but a productive force.

Parallel to - and sometimes intersecting with - these dynamic movements, there exists a tradition of female practitioners in the "new media" or "electronic arts," which typically involves collaborations with scientists or technicians to build complex interactive installations. Canadian innovations include Char Davies' virtual systems and software developments, Catherine Richards' interactive sculptures and experiments with the history of electromagnetism, Ingrid Bachmann and Barbara Layne's fusion of seismology with textiles, and Joey Berzowska's forays into mathematics and wearable electronics. One artist whose work has been at the forefront of feminist explorations into the mysterious and compelling realm of science and technology is Nell Tenhaaf.

Tenhaaf has been working with computer-based media since the early 1980s when she was one of the artists selected to create interactive artworks for the Telidon field trials, sponsored by the Canadian Department of Communications. Telidon was an early model of online information delivery, much like France's Minitel system that made a variety of data bases available at public terminals. Tenhaaf's works in the 1980s were a critique and appropriation of scientific representations of genetic engineering and biotechnology. She has since become implicated in artificial life, or A-life, and created sculptures that bring human and electronic components into close contact. A-

life art borrows from evolutionary biology and computer science to examine life systems, process and evolution through its potential simulations. For example *Swell*, which Tenhaaf built in 2003, is comprised of a sensor that detects the movements of spectators towards the sculpture. These movements are programmed to trigger transformations in the blue LED lights within the object and a series of electronic sounds (created by sound artist John Kamevaar), eliciting a complex range of interactions between the human and non-human agents (the sculpture) in the gallery. A-life often studies species-life and emergent behaviours of populations and not just individual entities. Tenhaaf's interest in A-life is an extension of her early engagements with language, computer systems and evolutionary biology.

In 1997 Nell Tenhaaf joined the Visual Arts Department at York University, Toronto, and in early 2003 teamed up with Melanie Baljko from York's Department of Computer Science. Baljko's work in computer science began with an interest in Artificial Intelligence (AI) and computational linguistics. For her master's degree she worked on developing computational systems that could determine stylistic difference between authors who had collaborated on the same text, which led to the creation of visualization tools to graphically display how style is perceived. Her more recent work has focused on a number of inter-related areas including research into the potential application of computational models to assist those with extreme communicative disorders.

Tenhaaf and Baljko's A-life research renders and studies complex cognitive and physical interactions between human and non-human agents who must "entrain" each other. Within this new landscape of conjoining art and science in A-life, one of Baljko and Tenhaaf's goals is to create experimental prototypes and sculptures that function as both scientific research and as art works. They have co-authored papers together for journals in *Human-Computer-Interaction* (HCI), and are co-producing works for exhibition that have been presented as

prototypes in public *fora* such as their recent participation in the Fusion festival at the Ontario Science Centre (OSC) in May, 2007.

Baljko and Tenhaaf's experiments into A-life engages with how and when humans attribute agency to things, may respond as members of a system (or population) to each other, or learn to interact in concert with other non-human actants, to borrow a term from Bruno Latour (Latour and Woolgar 1986). These principles and research questions were put to the test in the OSC's Fusion festival. Baljko and Tenhaaf displayed a three-part interaction entitled "Lo-Fi Collaborative Agent Populations" that connected their system architecture (housed on a computer) to an overhead camera that sensed and could track movements whose final output was a video projector. As visitors to the OSC (mostly children with parents) moved through the designated zone of interaction a set of electronic sounds were triggered cuing participants to pay attention. If they looked up, those passing through the system would notice their overhead form projected on the wall above. Surrounding these shadowy mobile outlines were green squares of pixel-dust that participants could move around like so much virtual lint.

Within this first phase, participants danced, played games in the dust and tested what movements were possible in what physical zone. In the next transitional phase the green dust would coagulate on one person, a sign that something new was happening. In effect, the camera was focusing on one of the players with the computer program "tagging" that person. In the third phase of the interaction, the first screen and the body shadows dissolved to be replaced by a series of coloured dots in a demarcated circle. A single green dot signified the person who had been given agency in the system. In this phase, participants were given a simple instruction to push the blue dot into the red hoop. Pink dots, non-human agents, vied with the human participant for control of the blue dot. All phases of this interactive presentation were both prototypes for a future interactive sculpture, with experiments in computer-

coding and system architecture and studies in emergent human interactions and entrainment into different systems; the first more abstract and performative, the last more task-oriented.

Baljko and Tenhaaf's experiments in A-life are not about biomimickery, the creation of cute animals or fully developed artificial worlds. As they explain in the interview and in recent texts (2006; 2007) they are intrigued with communication and curious about the process of the attribution of agency to entities that convey minimal human traits or low-fidelity embodiment. Although it predates their collaborative production, Tenhaaf's 2005 work *Flo'nGlo* was influenced by her discussions with Baljko about how to model conversational turn-taking. Flo and Glo are two large-scale plastic and metal computerized entities that Tenhaaf affectionately has called "my monsters." The approximate height of an adult human subject, these two amoeba-like shapes each contain a cluster of red LED lights vaguely shaped like a mouth, that displays a video loop of what sounds like an animated conversation. As they stand side by side the two forms respond or "speak" to each other in garbled yet tantalizing electronic tones (also made by sound artist Kamevaar). A complex algorithm drives the system that produces feedback so that the same sequence of sound and image is rarely repeated. While they are one sculpture, and definitely intertwined entities, their phatic utterances, cadences and tones are different. Neither fully anthropomorphized, nor completely comprehensible, Flo and Glo (as opposed to *Flo'nGlo*) emerge as proto-characters with distinct personality traits that one cannot help but attribute to them. *Flo'nGlo* seem very much alive even though we know that they are not as their "electronic guts" are fully visible through the acrylic casing that houses them.

These systems instigate different performative interactions through cognitive or empathic identifications within heterogeneous populations with beings whom we do not resemble, but who are of our creation. While

they do not directly discuss this in the interview that follows, such a project is premised on a classic concern within feminism regarding Mary Shelley's *Frankenstein*, a text that delves into artificial life and our treatment, repudiation and betrayal of our monsters and our mutations (Kember 1998). Myths of monsters and reminders of pre-scientific tales of human-animal hybrids are a visual recurrence in Tenhaaf's past work, such as *The Solitary Begets Herself, Keeping All Eight Cells* (1993). How we recognize and interact with others in conditions of radical alterity and difference is but one key question for contemporary feminist ethics (Ahmed 2000; Zylinska 2005).

I interviewed Nell Tenhaaf and Melanie Baljko on May 8, 2007 in Toronto, one day after the OSC exhibit and two days before Melanie gave birth to her second child, Erma. We drank tea together and talked while Melanie had frequent contractions that were an insistent reminder of the very issues at hand: feminism and embodied communication. In this excerpt from our hour and a half conversation, Baljko and Tenhaaf discuss the origins of their interest in computer-based media, their collaboration and key concepts. The interview ends with a reflection on the understated presence of feminism informing their scientific research and the art practice.

**Kim Sawchuk**

Nell, could you talk about a few of your early works because you've had a long career as a computer based media artist and you've also created interactive works.

**Nell Tenhaaf**

I worked with the Telidon system in the early eighties. In fact that was my first foray into computer-based work. The Federal Government - the Department of Communications at the time - were running field trials and they invited some artists to participate. Not only was that the first interactive work that I did, it was also proto world wide web work because the pieces went

up on servers and were made accessible in terminals, with clunky graphics that you would see in public terminals. That hooked me onto a lot of things, such as the idea that computer based work can be both inside and outside the gallery system. I've always liked the idea of working outside the gallery system. I'm a bit of a rebel that way. I'm not that big on institutionalized art and I guess that shows in my career path. The artist-run community has been really important to me. I worked at Powerhouse, which was a Montreal feminist art gallery for six years in the late seventies and into the early eighties, and I very strongly identified with that place. Here in Toronto, I am quite connected with Interaccess, an electronic media resource centre as part of the workshop system that they do. I am still very keen on maintaining a community connection.

**Kim Sawchuk**

What was the early piece called that you did with the Telidon system?

**Nell Tenhaaf**

The first one was called, "Us and Or Them" and was about the Cold War. I mean, there still was a Cold War and I gathered all of this material about "them" the Russians. I was really interested in the believability factor of computer media. Not so much how you could search material, because you couldn't, but you could build databases and put all of this material up for people to access. And it occurred to me, who could ever tell whether it was true or false. There was another piece I made in this period called, "Believable if not always true" which was a gallery based work also with the Telidon system. Already there were a set of tropes that were developing around public databases, which predate the World Wide Web, like the truth or lie issue and the infinite knowledge issue. That's what I was working with at that time.

**Kim Sawchuk**

Ok. Mel, tell us who you are and what your background is.

**Melanie Baljko**

I've been at York since 2002. I started straight from graduate studies in computer science. I studied at the University of Toronto and I became very interested, before graduate school, in Artificial Intelligence. One of my profs at the University of Waterloo, where I did my undergraduate degree, suggested working with her colleague at the University of Toronto who focused on a sub-specialty of Artificial Intelligence called computational linguistics. At that time I was really interested in linguistics and had taken several courses. I thought it was great because it combined what I had been studying as an undergrad. Through that connection I found myself applying to the University of Toronto and I was accepted and started working in the field of computational linguistics.

**Kim Sawchuk**

What is computational linguistics? Was this before you started your research on artificial intelligence?

**Melanie Baljko**

One of the areas of specialization in artificial intelligence is imbuing computational systems with human ways and one of the core human facilities is to communicate and that is often seen as tantamount to language. Now, in the meantime I've really become convinced that language and what we think of as verbal spoken language is one small component of a large repertoire of skills, which actually have to do with co-ordinating action and attributing mental states to others. But at the time I thought that a computational system that can speak or that can produce text, you can type and it can understand it - it was very exciting. That was my idea at the outset.

It often helps to distinguish the engineering approach, where you want to build systems that communicate using whichever techniques that are available, and the psycholinguistic approach, where you want to build systems that are cognitively "true," that behave or mimic cognitive mechanisms. Those systems are very complicated because they have to have

reasoning systems and memory and all of these other mental facilities. For my PhD, I shifted into computational devices that help individuals with communication disorders.

**Kim Sawchuk**

One of the overlaps between your trajectories and work is that you both were very much involved with questions of communication albeit from very different perspectives and modes of training.

**Melanie Baljko**

Yes. For my PhD, I had to produce something practical, something that could be evaluated and tested and implemented but I always wanted to counterbalance that with some sort of conceptual framework that provided the rationale for the approach. In my thesis I examined the current paradigm with helping people with communication disorders, which by and large has been to give them synthesized speech. There is the assumption that this mode of synthesized speech is going to be the solution. But that mode of synthesized speech is just a complement to a repertoire of modes that already exists. You have to have an appreciation of how the existing repertoire works, so you don't come in with a sledgehammer and wipe out everything and insert this mode of synthesized speech.

**Kim Sawchuk**

What were the questions Nell brought to you that were so interesting to you?

**Melanie Baljko**

The questions that Nell brought to me were very fundamental. She was asking about the very nature of communication, not just between humans but between humans and other entities to which humans attribute agency. Her mode of working is so different from what I had been immersed into up to that point. Instead of a quantitative engineering driven approach her questions were far more fundamental and diffuse and nebulous.

**Nell Tenhaaf**

Right away Mel saw a possible cross-disciplinary possibility in my questions about making an artificial agent. How do we have some kind of exchange with that agent? What kind of feedback do we get? How do we evaluate the exchange? Can we build an art work that gives you an instantiation of research questions? How else would you get to that? The practice we have established gives us a public to work with and it gave you a context for those questions.

**Melanie Baljko**

In creating these hybrids, the locus of the creation is not the art work, but in the minds of the interactants with the artwork. That is basically cognitive science and our research is into the processes that can elicit something in the minds of interactants: "how do you design x to get this kind of reaction?" There is a continuum between the two academic traditions and that's the point of contact I think.

**Nell Tenhaaf**

Before I met Mel I had a larger conceptual framework for what I was interested in, but I needed the steps to get there.

**Melanie Baljko**

To someone who is not in the art world, it's very intimidating because there is a special vocabulary and assumed background in the very language that is used.

**Kim Sawchuk**

Mel, you said earlier that discovered terms that Nell might use might have parallels in your own discipline, but that these ideas would not necessarily be expressed in precisely that way. This is even apparent in the different programming languages you use: artists creating interactive works tend to write their scripts in MAX while computer scientists work in Java and other non-visual programming languages. Is part of the challenge of collaboration making those different languages and skills speak to one another?

**Melanie Baljko**

There is this vast literature from cultural theory that has not been brought into human-computer interaction but it is very relevant and the reason it hasn't, I believe, is because you need an interpreter between the two because they diverge so much. It's the nature of the research literature I think.

**Kim Sawchuk**

Let's talk about how you met and how long you've been working together and what the first project was.

**Melanie Baljko**

Gillian Wu was the Dean of the Faculty of Science and Engineering at York, although the faculty at the time was named Pure and Applied Science. She organized these women and science events and she mentioned a book *Information Arts* by Stephen Wilson which Nell had given to her. I borrowed the book and then out of the blue Nell sent me an e-mail and then I put two and two together. The little note inside the book matched the name.

**Nell Tenhaaf**

I had been on the search ever since I had gotten to York. One was to find someone to collaborate with and the other was to promote the idea of collaboration with computer science within the whole Fine Arts Faculty.

**Melanie Baljko**

Gillian started a group called SWAY - Science Women At York and it actually accomplished its purpose, which is to increase networking amongst the female faculty members.

**Nell Tenhaaf**

It's a small percentage in your Faculty. So almost instantaneously we looked at the New Media Initiative grant.

**Kim Sawchuk**

What was the project?

**Nell Tenhaaf**

Well, the title was "A-life Sculpture: Eliciting

Complex Interactions" so it's a pretty general title. We did have the low-fidelity embodiment idea, which was Mel's term by the way. In my past work, *Swell*, I had been working with low-fidelity in the form of LED arrays.

**Kim Sawchuk**

What does low-fidelity mean for you?

**Melanie Baljko**

Low-fidelity embodiment is a term partially adapted from Justine Cassell who has had published a collection of papers on embodied communicative agents: ECAs.

**Nell Tenhaaf**

ECA is one of those terms that is very prevalent in the Artificial Intelligence or AI world. Embodied is a big term because that's where it joins up a number of disparate disciplines.

**Kim Sawchuk**

What does modifying the idea of low-fidelity with embodiment imply?

**Nell Tenhaaf**

It's tied into my early computer interests. I am someone who actually appreciated those chunky graphics of Telidon because to me it's a kind of information "truth." What I like about seeing pixels move is that it's a revelation of the actual processes as much as one can as opposed to making this really sleek shell all around that hides everything. Low-fidelity embodiment is trying to find a means to engage people as a computer based media artist who is expressing an algorithm. I can combine really low-resolution video and these algorithmic processes in one display. This grows into a more interesting research question for us because of this tendency in the AI world towards making things look more human. Apparently the more you make it look, sound, behave, smell [and] taste like a human, the better it is. A good example is the MIT's Kismet, a robot head. Behind Kismet is this room of computing. There is a real contradiction there. We're drawn to the research question about how much you can

engage people by reducing what you present to them as a representation.

**Melanie Baljko**

And instead present an entity with which to interact.

**Kim Sawchuk**

What does low-fidelity embodiment mean to you as a computer scientist, Mel?

**Melanie Baljko**

Well, the embodiment part is the starting place for me. There is this idea that the human body is the gold standard for an embodied communicative agent.

**Kim Sawchuk**

Within computer science?

**Melanie Baljko**

Within this particular vein of computational linguistics and engineering work if you're making a communicative agent, the grail is to be as human as possible. If you can't actually have a robotic figure with a skin covering and a face, then you create an animated agent and make it look human. If you take away as many of those as possible, you're left with just the core: that is the low-fidelity part for me. It has to do, again, with the mind of the interactant attributing human-like or agent-like properties to the thing they're interacting with. We know that people do that very easily, but what are those things? Do you have to have skin? Do you have to have a face? This taps into disability studies because of some of the very extreme situations where computational interventions are needed with people who have "locked-in syndrome" meaning no volitional movement whatsoever, except possibly eye movement, so that their only means of communicating is through EEG signals. These volitional capabilities aren't the important part in being human. It's something else.

**Kim Sawchuk**

How are the projects you're doing together explorations of these questions of low-fidelity,

embodiment and the attribution of agency?

**Nell Tenhaaf**

Well, we are thinking of the artifacts that we will make as very dual purpose. They are artworks but they're scientific objects, so that in itself is an interesting challenge.

**Melanie Baljko**

The interactions with the artifacts are instances of artistic processes and also things that can be studied scientifically.

**Nell Tenhaaf**

Including HCI - Human Computer Interaction. Because it is dual purpose it is important that we call the piece, like the one we did at the Science Centre, a prototype rather than an artwork, as there's something different there even though it's not un-artistic. There are a lot of interesting boundary questions coming up about when it's called a work of art. What makes it that? That's the thing when you are doing both scientific research and making art work. Is it one object that does both of those things? Does it just depend on how you see the object?

**Kim Sawchuk**

So in what ways does this act as a piece of scientific research for you, Mel?

**Melanie Baljko**

Well, it's a very ecologically valid test-bed. You have an artwork in the world, like in the Science Centre but it's not a laboratory set-up, so the interactions that are elicited are natural to that environment. Much HCI work is done in a lab under very controlled conditions and that is good for certain questions, but not so good for others. It also comes with a host of problems and issues that need to be resolved, like how to collect the data, how to analyze it, how to pose the questions in the first place.

**Kim Sawchuk**

What is the difference between a prototype and an artwork for you?

**Nell Tenhaaf**

I would prefer for an artwork not to be quite that goal oriented. I think these are really interesting questions that are unanswered for me at this point. I think this is what we're seeing and finding out.

**Melanie Baljko**

The prototype is not yet an artwork. The prototype plus some improvement or augmentation could gradually become an artwork.

**Nell Tenhaaf**

There is probably a little more mystery in an artwork, but not too much mystery because then people won't get it. It should also connect to social issues. That's a real complication in our work because our artwork connects to A-life issues, such as agency, but people don't necessarily know about those. So you need to give the meta-level story at the same time you are presenting the actual experience.

**Melanie Baljko**

In science, when do you get to call something a scientific contribution? In art, when is something an artwork? Each area has its gatekeepers to keep the interlopers out and to let the authentic ones in. It's not clear-cut which community is more welcoming.

**Kim Sawchuk**

To the outsider or to the interloper?

**Melanie Baljko**

By interloper, I mean someone who hasn't followed the same path that everyone else seems to have followed. In HCI there's a certain way you do it and the lay practitioner has to be around for a long time and has to earn respect in a certain way so their contribution is appreciated. I think there's an analogy in the art world, folk artists now get acknowledgment: but it wasn't always that way.

**Nell Tenhaaf**

That's for sure. Think of the feminist movement. In those days, if guys didn't say



that work is interesting then it wasn't - there's a whole gamut of stuff that was left out of what was considered real art...

**Melanie Baljko**

...like textiles.

**Nell Tenhaaf**

Yes. Anything related to women's work or women's issues it just wasn't *seen* let alone validated.

**Kim Sawchuk**

I was going to go back to even "Flo'nGlo" which becomes part of an exhibition, so seems to become an artwork so it's supposedly not a prototype, but what if there are different versions of something?

**Nell Tenhaaf**

I keep wondering if I have to shoot documentation of that work every time there is a new version. Maybe I should just leave it at the first one and make public that there are different versions.

**Melanie Baljko**

If we use the term prototype we unwittingly buy into something that we don't even really agree with: the notion that you can be done, that you're finished. If you hold onto this idea that you can be finished at some point, then anything short of that is still the prototype. We should just call it versions. We have a versioning system.

**Kim Sawchuk**

Let's return to the question of agency? What does agency mean for you?

**Nell Tenhaaf**

Well, agency is a key term in A-life. A-life is computing plus evolution and adaptation plus the artificial. It asks what is the artificial and the natural and addresses the conundrum of the dividing line and how they relate to each other. I read about theories of evolution and biology, genetics really - genetics and evolution before arriving at A-life.

**Kim Sawchuk**

That was a present in the previous works that you did that were not necessarily interactive, like your digital photo pieces on DNA and ideas of human destiny.

**Nell Tenhaaf**

That had more to do with biotechnology, which was my zone before I arrived at A-life. Then, I was a science critic in my practice because that's what we did in art theory. Artists suddenly discovered a role to play in the critique of representation.

**Melanie Baljko**

Representation is so core to science.

**Nell Tenhaaf**

Representation is core to various kinds of practices. But I got really fed up with this critique of science and I turned to A-life. It has a more positive sense of modeling and theorizing that offered alternatives rather than just the critical stance. It contributes to the art, science and technology debates from the point of view of curiosity.

**Kim Sawchuk**

What about agency?

**Nell Tenhaaf**

A-life is all about agents - artificial agents - computer models, but agents are autonomous entities. The term is at the core of life processes and relational processes, how things interact with each other, how do you break it down just to map the interactions. That's what I like - dynamics with lots of different levels and then within those dynamics different kind of agents or things that have agency.

**Melanie Baljko**

My notion of agency is a bit different coming from a different background.

**Nell Tenhaaf**

That's out of A-life for me. That's a fundamental idea about relations. It's about looking into the mechanisms of

anthropomorphism. Your agent has to be instantiated. I think that is what is interesting.

**Melanie Baljko**

That is the embodiment part. It's important that an embodiment is more than a representation. It's representation plus something and I don't know what the plus something is, but that is the magical part of it. AI managed to go thirty years without acknowledging embodiment and how important it is for an agent to be embodied. Rodney Brooks was one of the first in the scientific AI community - he was one of the early acknowledgers of the role of embodiment. He was also very controversial because not only did he say embodiment was important, he also said that high level behaviours were not the only important ones. He said just responding to the environment - low level behaviours - would elicit intelligent behaviour.

**Nell Tenhaaf**

And that is what A-life took up right from the start. You had to have embodiment and you had to have low level leads to high level. Good old fashioned AI was top down. A-life is embodied and bottom-up. The technical term A-life is subsumption. You build something - a robot usually - defining simple behaviours like move forward, backward, left, right as one layer that feeds into more abstract layers like the belief or intention that Mel was describing. All of the robot's behaviour emerges from that architecture.

**Kim Sawchuk**

At the Science Centre demonstration we observed how your prototype offers a simple model for interactions that instigated a whole range of responses.

**Nell Tenhaaf**

Indeed. We observed groups of people who believed they were connected to the virtual agents they were seeing. There was this wonderful confusion between following the thing that you're seeing and actually moving it. If they were moving fast enough, then it didn't

matter if they were in control or not. They thought they were driving the system. This isn't necessarily thinking on some kind of conscious level but a kind of imaginative attribution that accompanied the interaction.

**Melanie Baljko**

People bring baggage to any interaction: their mental models. I don't know where the mental models were coming from for the interactants of this artwork: probably from interactions with computational media in general. Like the idea of low-fidelity embodiment, we're creating as simple a task as possible to elicit these complex emergent behaviours. What people do is a function of what they perceive the environment to afford to them, what the sensors are and what the system does for them. They come with the baggage of mental models but they build up a perception of what the space affords.

**Kim Sawchuk**

Also, they have a cultural understanding of what you do at a Science Centre as opposed to a gallery.

**Melanie Baljko**

That's the baggage part of it. In interaction and through feedback they understand that there is a camera sensor and that their own body is being sensed and having an effect on the system. The participants are building up mental models and the *minimal* cues you give prime that kind of thinking.

**Nell Tenhaaf**

With the attribution of agency, you place yourself in a group or population of agents. The focus is really more on understanding the experiential dimensions of the work rather than providing a description of the significance of an object or artifact. Much of the other work in HCI is dealing with everyday objects designed for people's lives.

**Melanie Baljko**

But the HCI community is starting to realize that workplace productivity is not the be all and end all. The term "aesthetics of

interaction" is now starting to be used.

**Nell Tenhaaf**

However their ideas about aesthetics are very traditional.

**Melanie Baljko**

The HCI community needs more cultural theorists to say, "well, there is a language for experience and here it is."

**Kim Sawchuk**

This is crucial when an artwork isn't just the object, but instigates a performative dynamic.

**Melanie Baljko**

I think that is apt.

**Kim Sawchuk**

Nell, your work has had a long tradition with links to feminism. How does the current work maintain the connection?

**Nell Tenhaaf**

Whenever I use the term "alternative," like A-life as an alternative mode of inquiry, that is my feminism speaking. It's a feminism that embodies a current of looking at things differently, being a bit rebellious, doing the thing that's not been brought forward. Certainly, I think that I was waiting for a woman practitioner in computer science. It's not about comfort - it's an energy, a dynamism of saying, "we can do this when they said we couldn't." And I am always supporting my women students, especially making sure that they don't feel intimidated by technology. It's really a set of pragmatic things for me at this point.

**Kim Sawchuk**

You haven't given up your feminism but mentioned that now you see it in relation to science and technology rather than in an oppositional tension....

**Nell Tenhaaf**

...through this idea of alternative practices because feminism for me has always been about valorizing differences and you say,

"yeah, well it is different and that's the strength of it." And then you find the ways to promote that difference.

**Kim Sawchuk**

So feminism promotes what may be at the margins. Does that connect to your interest in lo-fi embodiment and your DIY attitude that advocates making do with the most minimal means?

**Nell Tenhaaf**

I guess we never framed it that way, but you're right.

**Kim Sawchuk**

Embodiment, experience and agency are key concepts in feminism, as is understanding forms of cognition as embodied, relational knowledge. Your interactive systems promote negotiation *with* others. It's not an interaction that is just about competing *against* other individuals.

**Melanie Baljko**

That's linked to the "leaky pipeline" problem in the field of computer science, which describes the disproportionate attrition of women in all the stages from high school, to undergraduate, graduate and then in academia. It's very skewed.

**Nell Tenhaaf**

Women start off but many more drop out.

**Melanie Baljko**

Sociologists have studied this and one of the things they hypothesize is that maybe there is a wrong emphasis early on in the educational pipeline on solitary, singular tasks as opposed to collaborative things. There is also the lack of emphasis on the relevance of computing to society. These things are thought to be turnoffs for female students, which is why they end up in other fields. My cohort as an incoming grad student had fifty students and only two females. In my department there are five of us. I think the collaborative tasks versus solitary tasks is a big issue.

**Kim Sawchuk**

On that note, I'd like to thank both of you for your time and your insights.

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