

# Noura Howell

I am a design researcher who critically reimagines data, focusing on biosensing technologies: sensors producing data about human bodies, behaviors, thoughts, and feelings. As the internet-of-things and wearable technologies bring biosensory data into daily life, I investigate the role of data in everyday meaning-making and living ‘well’. My work sits at the intersection of human-computer interaction, user experience design, and human-centered data science. I design and build biosensing technologies and study people’s experiences around these artifacts. My work contributes experientially grounded alternative design tactics for making meaning with biosensory data.

Biosensory data is increasingly enrolled to guide how people live their lives. Consumer devices promise data-driven algorithmic suggestions for individual self-improvement (Schüll 2016). Data science is one powerful approach to making sense of this data, yet it is not the only way of knowing with data. Questions of how to live productively, safely, in a healthy way—how to live ‘well’—are much older and broader than this relatively recent wave of data-driven approaches. Helping people shape the way they live, both individually and collectively, merits a more holistic approach that includes many different ways of knowing.

I contribute design tactics for alternative forms of meaning-making with data: **What if designs gave people the agency and authority to make their own meaning with their own data? How might data displays support emotional, social, and embodied ways of knowing?** My designs explore the potential of engaging these tactics.

My methods combine human-computer interaction (HCI), computer science (CS), and art. In HCI lingo, I design, deploy, and study interactions around technology through observation and interviews. As



My designs challenge data narratives and imagine alternatives. The *Heart Sounds Bench* invites people to listen to their heart sounds emanating into public space. The simplicity of the design opens way to a forceful critique of the push for transparency via data, taking up postcolonial philosopher Glissant's (1997) call for the *right to opacity*. Instead of transparency, I propose *life-affirmation* as a critical alternative for public biosensing.

speculative designs, these artifacts foster reflection and discussion on sociotechnical futures (Dunne & Raby 2013). To CS, I build technology that offers conceptual innovations as critical technical practice (Agre 1997). I rework taken-for-granted concepts such as sensing and data to open new approaches to building technology. I publish at top tier HCI conferences such as CHI, DIS, and CSCW. My design tactics speak to designers and computer scientists at these venues. My art is in the situations that happen around the artifacts I create. Inspired by participatory art such as Pauline Oliveros' *Heart Chant* and tangible interactive data visualizations such as those of the Domestic Data Streamers, my approach centers bodies, feelings, and relation. I work with code, electronics, textiles, wood, and sound, and am always happy to try something new.

In the following sections, I unpack my dissertation work surfacing conceptual reworkings for biosensing designs and then chart my future research agenda.

## Heart Sounds Bench

*How might public biosensing affirm our shared vitality?*

Biosensing technologies are increasingly embedded in public infrastructure. Sensors produce data such as video, heartrate, skin conductance, and much more. Claims to data-driven insight include predictions about emotions, mental illness, identity recognition, and criminal potential. An implicit goal with this data is to make people more transparently knowable.

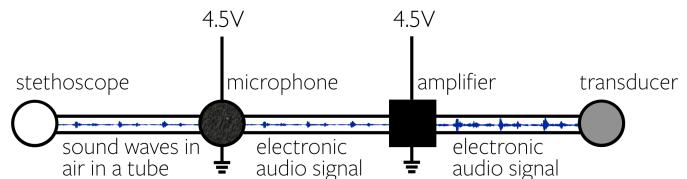
I push back on this drive to make people transparent via data insights. Western ways of knowing tend to recognize people as valid by making them transparent according to dominant systems of measurement, comparison, and judgment. Too much gets lost in translation. The *right to opacity* means recognizing others' validity even before or without understanding (Glissant 1997). People have valid ways of being, feeling, and knowing outside of dominant logics of measurement and control (Foucault 1982).

To engage these ideas, I created the *Heart Sounds Bench* (Howell et al. 2019). Sitting on the bench, people can use a stethoscope to listen to their heart sounds emanating into the broader environment. A pilot study with pairs of strangers indoors probed the experiential potential of this design. The live unfiltered heart sounds made this data opaque in the sense that participants did not feel they gained any categorical or analytical insight from the data. Instead, they described feeling a more visceral recognition of their own and others' vitality and vulnerability. **The Heart Sounds Bench explores life-affirmation as an alternative design goal for biosensing technology in public space. Instead of pushing to make people transparent via data, life-affirmation recognizes and affirms people's living, breathing vitality while respecting their right to opacity.**

The Heart Sounds Bench makes a conceptual contribution by critiquing and reworking prevalent notions of the role of sensors and data in public space. The conceptual reworkings do not stem from only me as designer. Rather, they emerge through participatory



Pairs of strangers experiencing the Heart Sounds Bench.



I build the electronics for my designs.

situations and are grounded in lived emotional experiences of participants. By presenting this work to engineers and designers working with biosensing technology, I work to shift prevalent approaches to biosensing and data science.

This project typifies my approach. I critically question fundamental ideas about data, such as enrolling data for knowing people more transparently. I explore conceptual reworkings, such as favoring opacity over transparency, through designing and building speculative biosensing technology. These designs foster open-ended emotional experiences with biosensory data. Studying how people interact with the designs helps contribute experientially grounded critical alternatives to dominant techno-logics of data.

## Color-Changing Data Display Garments

*How might wearable biosensing invite embodied, social, emotional ways of knowing with data?*

Affective computing enrolls biosensory data, such as facial expression, heart rate, and skin conductance, to ‘detect’ categories of emotion. Consumer products promise algorithmically guided wellness using these emotional categories. Critics of affective computing highlight ways in which emotions are culturally situated and socially performed (Boehner et al. 2007).

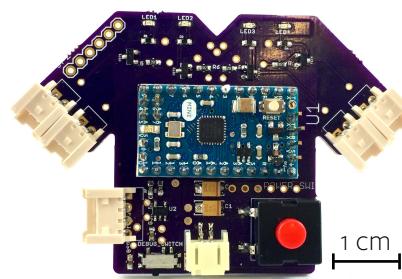
Instead of enrolling data to tell people how they feel in terms of discrete categories, my designs invite people to reflect on their feelings while situated in social and cultural contexts. I draw from reflective design (Sengers 2005) and ambiguity as a resource for design (Gaver 2003). Reflective design encourages both designers and those experiencing designs to critically reflect on latent assumptions and take a more active role in meaning-making. Ambiguity can help prompt reflection—instead of presenting one clear indisputable message, an ambiguous data display can invite people to form their own interpretations.

I created wearable sensor-and-data-display garments designed to prompt open-ended emotional reflection (figure at top right, Howell et al. 2016, Howell et al. 2018, Devendorf, Lo, Howell et al. 2016). This wearable technology looks and feels like an ordinary shirt. Pinstripes embroidered in the sleeve gradually change color in response to sudden increases in skin conductance, an ambiguous indicator of various kinds of excitement such as feeling stressed or happily excited. Pairs of friends wore the shirts throughout a variety of contexts in their daily lives. The subtle display prompted moments of social emotional reflection. Instead of categorizing emotion, the biosensing technology served as an invitation to ask oneself or a friend about their feelings.

The technology is humble in its knowledge claims, merely suggesting a potential moment of excitement. It leverages ambiguity to invite open-ended social interpretation. The outward-facing nature of the



I create wearable sensor-and-data-display technology that looks and feels like ordinary clothing. The subtle embroidered color-changing fabric display responds to emotional biosensory data, prompting two friends at lunch to reflect on their feelings.



Control hardware embedded in the garment. I do the code and electronics for my designs. For this project, I designed the breadboard circuit, a research assistant adapted it into Eagle for the PCB, and I did the surface-mount soldering.



I crochet, weave, and embroider color-changing data displays using thermochromic conductive thread. For example, this single crochet motif can display three different states.

display surfaces the possibility of enrolling data displays for social performance. Wearers wanted the display to help enact their care for their friends, shared joyful laughter at jokes, or to help validate their feelings. **Rather than ‘discovering’ the ‘true emotional state’ of an individual, this work explores how emotional biosensing can take a more situated role in supporting the ongoing enactment of social performances and emotional meaning making.**

## Ongoing Work

I have an active ongoing research program of collaborative and lead-authorship projects.

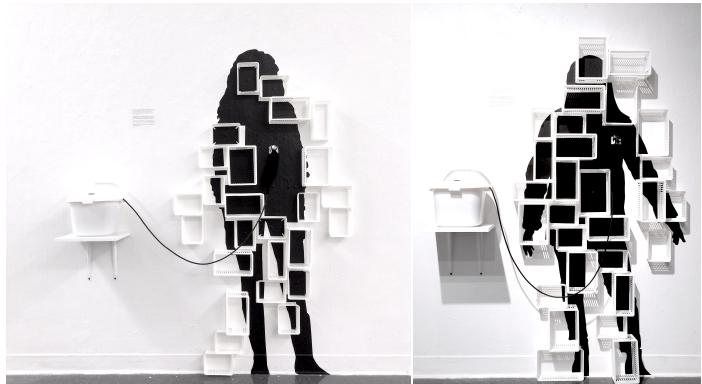


**Menstrual Biosensing Speculative Designs:** We created a set of speculative designs exploring ethical issues of potential future menstrual tracking technologies. Presenting these designs as a product catalog frames these technologies as desirable near-future possibilities to invite critical reflection by readers: The designs at first seem like ‘believable’ products but upon closer inspection reveal disturbing details. For example, speculative design *Lithe Power* underwear embeds biosensors to track exercise, as several real consumer products already do. Yet, our speculative design intentionally goes a bit too far: It encourages intense workouts during peak menstrual flow and automatically shares emotional states with a male partner. This is playing on problematic tropes of heteronormativity and making the unruly, weak female body more manageable and controllable via data. Overall, our set of speculative menstrual biosensing designs invite critical reflection on prevalent narratives of ‘wellness’ at home and work.

### ▷ Menstrual Biosensing Speculative Designs

Biosensors are embedded in bras, underwear, and tampons to track intimate data such as breathing, mood, or menstruation. To explore ethical issues in the emergent context of menstrual biosensing, we created a set of speculative designs imagining future technologies, framed as a product catalog for fictional company Vivewell. Blending the language of innovation techno-culture with luxury lifestyle brands, the speculative designs surface privacy and gender issues for critical reflection.

One outcome of this research is a zine that prompts critical questioning of biosensing technology futures, as well as a pictorial case study of how privacy policies can inform speculative design (Fox, Howell et al. 2019). Next, are interviewing expert stakeholders using the



**Heart Sounds Buckets:** An interactive installation inviting gallery visitors to listen to their heart sounds in white plastic buckets. In contrast to the Heart Sounds Bench’s emphasis on affirmation, the buckets feel more like an odd individual accessory. They buckets can feel like a toy for bodily exploration or a burdensome distended organ. Pictured at the Worth Ryder Gallery in Berkeley, CA, in 2019.

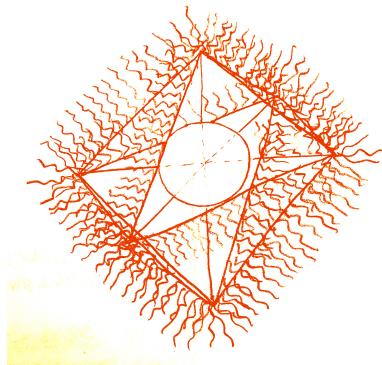
zine as a probe to surface how policy makers, advocates, designers, and engineers conceptualize the ethics of intimate surveillance. This project is a collaboration with Sarah Fox, Richmond Wong, and Francesca Spektor.

### ▷ Heart Sounds Buckets

This interactive installation invites gallery visitors to listen to their heart sounds in cheap plastic buckets. Gallery visitors walk around holding the bucket as it reverberates with their heart. This project enrolls the same heart sounds data as the Heart Sounds Bench, but for very different conceptual goals. Whereas a bench feels supportive and shared, carrying the weight of one’s individual bucket feels like a distended organ in a sterile white plastic container. It explores a feeling of externalizing or delegating bodily functions to technology. This work is led by me in collaboration with Stephanie Tang and Kimiko Ryokai.

### ▷ FEELER / CRAWLER / OCTOPOETS

I propose enrolling biosensing to support more poetic, unscripted ways of experiencing daily life. FEELER / CRAWLER / OCTOPOETS wander the environment and invite others to wander too. Their senses/sensors comprise their own quirky perspective, not the all-seeing authority of data surveillance. Some have skin with sensing pigments that change color in response



FEELER/CRAWLER/OCTOPOETS invite sensing and feeling differently. This rough sketch illustrates an octahedron with squiggly feelers used for crawling, sensing, and expressing feelings.

to temperature, pH, carbon monoxide, UV, and ozone. Some sense touch with conductive fabric and piezo discs, and respond with electrical signals transduced into sound. With protruding feelers, some crawl around accumulating (recording, sensing) material traces of dust, dirt, leaves, and DNA.

As alien visitors, FEELER / CRAWLER / OCTOPOETS sometimes ask earthlings to show them around, positioning people as authoritative local hosts. The role of host is one who belongs and can choose to welcome outsiders, and who has the authority to help make sense of data. Through participatory workshops with artists, I will explore the potential of these absurd robots to foster *defamiliarization*, or creative alternative ways of perceiving the everyday.

FEELER / CRAWLER / OCTOPOETS blur divisions between sensors, senses, feelers, feelings, and knowledge. They crawl in the com-post (Haraway 2016) of post-human poetics of relation (Glissant 1997). These absurd creatures suggest being more humble about the kinds of knowledge claims we make with biosensing. They invite us to be curious, open, playful, and joyful with new ways of sensing, feeling, and experiencing urban space and daily life.

## ▷ Heart Sounds Bench Public Deployment

The indoor pilot study with the Heart Sounds Bench revealed interesting potential. Now, I am redesigning the Heart Sounds Bench from the ground up for deployment as public pop-up art, working with the City of Berkeley to temporarily install the bench in a variety of locations. This requires engineering and design work to make the bench more robust, self-explanatory, and portable. Curious to see a wide range of unexpected interactions in public space, this will be a mix of study techniques including passively observing passerby, participatory facilitation with passerby, and inviting participants to come out. I am project lead with research assistants Stephanie Tang and Victor Iancu, and advised by Kimiko Ryokai and Greg Niemeyer.

## ▷ Reflective Tactics for Design Futuring

How can design—creating artifacts or experiences in the present—help imagine alternative futures? We reflect on emergent futures-oriented approaches in design research, such as speculative design and design fiction. We contribute reflective tactics for design researchers to better articulate the aims and knowledge contributions of their work, generate new work, and analyze the effectiveness of their own and others' work. This is a collaborative paper (currently under review) with Sandjar Kozubaev, Chris Elsden, Marie Louise Juul Søndergaard, Nick Merrill, Britta Schulte, and Richmond Wong.

## **Research Agenda:**

### **‘Data Science, meet Emotional Knowing’**

*“Our feelings and the honest exploration of them become sanctuaries and spawning grounds for the most radical and daring of ideas.” —Lorde 1977*

Biosensory data is on the rise in daily life. Biosensing technologies produce data about people’s bodies, behaviors, thoughts, and feelings. Sensors are embedded in clothing, wearable accessories, pills, walls, furniture, and mobile phones. Using biosensory data, data science produces insights about how individuals can be more productive, happier, healthier, safer, etc. Of course there is great positive potential here, and data science has proven itself to be one of the great epistemological approaches of our time. Yet, I critique data science rhetoric.

My approach to critique is deeply interdisciplinary. I am not interested in railing away in an echo chamber. My style is friendly intellectual conversations where we learn from each other. I often meet with data scientists, artists, designers, critical theorists, and hands-on makers. My ‘disciplinary home’ is in working across diverse communities of practice. Different disciplines each have their own approaches, and I am not trying to impose one approach onto another discipline. **What I do is generative, generous critique, suggesting, ‘What if we tried things a little bit differently?’ and offering designerly explorations of those conceptual reworkings.**

Data science is one powerful way of knowing, yet it is not the only way of knowing. Sometimes claims of what data science can accomplish overreach. No one epistemological frame is the panacea for complex sociotechnical issues. I think data science is most productive when it closely engages already-existing approaches in different disciplines where it is applied.

As biosensory data is increasingly enrolled to make sense of how to live ‘well’, it would be too limited to use only data science as a way of knowing with this data. People have been grappling with questions of

how they want to live, individually and collectively, for a long time. What does it mean to be productive, happy, or healthy? Whose values are those? I call for more diverse approaches to meaning-making with biosensory data. My designs explore tactics for fostering emotional, social, and embodied ways of knowing with biosensory data. **How can design support emotional, social, embodied ways of knowing with biosensory data?**

My research agenda finds opportunities to critique, rework, and broaden biosensing technology and the data produced by it, to explore different approaches to emotional knowing with data. I synthesize key conceptual reworkings for emotional biosensing design: sociomaterial performativity and affirmative biopolitics. Emerging from my dissertation, these conceptual reworkings open new areas that my research agenda will explore.

#### ► Sociomaterial Performativity

Sociomaterial performativity (Howell et al. 2018) emphasizes the material, embodied, and socioculturally situated qualities of data. Biosensory data has material qualities—it is often produced by physical and electrical responses of sensors *intra-acting* (Barad 2003) with people’s bodies and the environment. Data has social aspects, from the many people doing data collection and analysis to the social impacts of resulting insights. Data has performative aspects: Whenever people engage it, data becomes enrolled in ongoing social enactments of sense-making. Data insights are not only objective, but also subjective: They present a view from somewhere (Haraway 1988), from the many people and materials entangled in their creation and proliferation.

My work on sociomaterial performativity invites designers and computer scientists working with biosensory data to more broadly consider many social and material factors that influence data insights. These considerations strengthen and clarify data insights by adding contextual nuance. They also diversify the kinds of insights that are considered valid with biosensory

data to include emotional, embodied, and social ways of knowing.

My dissertation work on color-changing garments began to explore supporting sociomaterial performativity through design, but only marks the beginning. **My research agenda will explore questions around balancing ambiguity with interpretability, supporting situated social performances, and supporting more diverse ways of knowing with biosensory data.**

#### ▷ Affirmative Biopolitics

As biosensory data is enrolled to address questions of how to live ‘well’, this raises biopolitical issues of who or what is granted the authority to produce knowledge about health and life (Rabinow & Rose 2006, Rose 2001). Data-driven categorization is a common approach to knowledge production with biosensory data, yet these categories are not neutral. They can embed ideas about who or what is ab/normal, un/healthy, un/safe, or un/productive. Categorization creates ‘others’ (Bowker & Star 1999), and such relational markers of difference can be closely linked to oppression.

An affirmative biopolitics resists the othering potential of categorization to support belonging<sup>1</sup>. Drawing from Braidotti’s (2011) take on Deleuze and Nietzsche, *affirmation* still values critique, contestation, and acknowledging social issues, yet it emphasizes the creative potential of enduring these difficult times. My dissertation work on the Heart Sounds Bench began exploring affirmation as a design goal (Howell et al. 2019), but there is much more work to be done.

**My research agenda will explore, what if designs prioritized care and affirmation over self-improvement? What if knowledge claims with biosensory data were more humble, to hold space for other ways of knowing and for respecting the complexity of human experiences?**

## Launching the Reconfig Group

As new faculty, I plan to launch the *Reconfig Group* to explore this research agenda. Our approach will emphasize:

**Re** *Again, iteration, never complete*

**Con** *Connection, together, contestation, critique*

**Fig** *Figure, creation, giving form*

**Re** emphasizes the process of iteration. Design iteration keeps adapting and refining. Conceptual iteration welcomes ongoing discussion. Iteration invites taking risks, trying something provisional. Iteration means staying humble, not claiming to have the final answers, only something worth exploring.

**Con** emphasizes the confluence of diverse approaches. Recruiting students and post docs from computer science, art, science and technology studies, philosophy of technology, hands-on making, and people with less traditional educational backgrounds, we will work within and across many disciplines. As faculty I will foster a strong sense of connection and supportive community in the group. With mutual respect and a spirit of conviviality, contestation and critique are stimulating and generative.

**Fig** emphasizes giving form, creating artifacts or approaches, making a suggestion about how things might be otherwise. While I value the importance of raising issues even when no solution is available, and the importance of purely conceptual reworking, my approach and what I have the expertise to lead a research group in doing is more empirical. Finding a way to explore ideas more concretely through an artifact or event, finding a way to open the project to experiences and insights of others, can provide grounded rigor to conceptual reconfigurations.

My work is well funded by the Center for Long-Term Cybersecurity, the Center for Technology, Society, and Policy, the Center for Information Technology Research in the Interest of Society, the Jacobs Institute

<sup>1</sup> Belonging, self/other, and recognition are significantly reworked by nomadic theory, but this is out of scope for this discussion.

for Design Innovation, Google ATAP, and HP Labs. As new faculty, I look forward to ramping up these efforts to secure funding from NSF (Cyber-Human Systems track of the Division of Information and Intelligent Systems) and through industry collaborations.

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