Personal Reflection as Creative Practice in Collaboration with Biosensing Machines

Noura Howell

University of California, Berkeley

Berkeley, CA 94720, USA

noura@berkeley.edu

Abstract

Personal reflection with biosensing machines, such as step counters or heart rate sensors, places human and machine into a collaborative relationship of creating and interpreting data. Biosensory data are at once intimate and interpersonal, embodied and abstracted, objective and subjective, posing unique challenges for data analysis for personal meaning making. My work explores collaborative human-machine interpretation with biosensing. I design material representations of biosensory data and study the interpretive relationships humans develop with these in daily life, such as color-changing clothing that responds to the skin conductance of the wearer. Different materials suggest different associations and interpretations, fostering different kinds of "interpretive relationships" than typical data analysis of a graph on a screen. Although personal reflection may not typically be construed as creative practice, I posit that important parallels exist and would like to explore these further by participating in this workshop.

Author Keywords

Biosensing; thermochromic; reflective design.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.
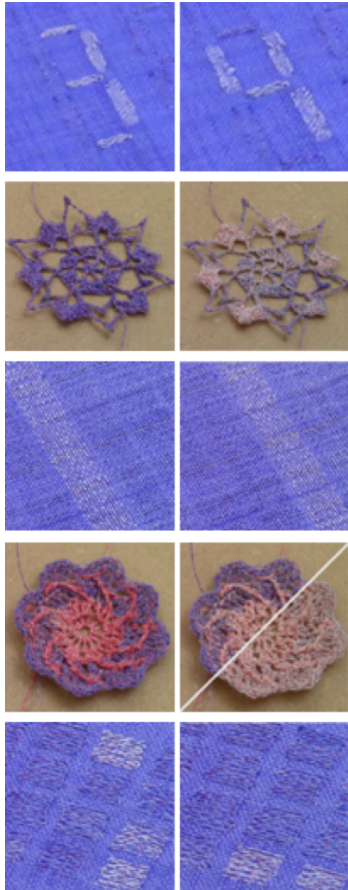
Figure 1: Color-changing fabric weaves and crochet to display information. Fabric displays evoke different associations and interpretive relationships (from prior work [1]).

Biosensing & Personal Reflection

Biosensing is on the rise in daily life. For example, the Feel wristband monitors skin conductance, pulse, and temperature to track mood and give wellness advice [18], and Affectiva uses facial analysis to detect emotions [19]. Prevailing trends in biosensing promote individualistic, algorithmically defined emotions, wellness, and self-improvement. My stance is that this alone is far too limiting, and that biosensing designs should foreground the subjective, creative process of personal meaning making in order to support a multiplicity of values, experiences, and interpretations.

Interfaces for personal reflection with biosensory data tend toward two extremes: At one end, a time series graph of a physiological signal with no added annotation frames the data as passively observed fact and provides no guidance for human sensemaking. At the other end, some devices impose their own interpretation such as "happiness" or "stress" (e.g., [18,20]), leaving little space for human-driven emotional meaning making. So, interfaces tend to give the machine too little or too much initiative in the process of personal meaning making with biosensing.

I believe mixed initiative creative interfaces and personal reflection with biosensing have some interesting parallels, and that participating in this workshop could greatly inform my work. Creative practice can be part of meaning making, self expression, exploration, or contribute to one's sense of identity, and so too can personal reflection. Rather than viewing personal reflection as some deterministic process of seeking one's single true self, I see it more as an ongoing process of exploring and creating multiple possible aspects of one's identity. These explorations manifest in the mind, in social interactions, and through creative expression. Some core aspects of personality or identity may be fixed, but personal growth is a lifelong creative process.

Beyond personal reflection, other work has explored enrolling biosensing for creative expression, such as accelerometers or heart rate sensors worn by dancers that influence timbre or rhythm for musicians (e.g., [8,14]), or installations that transform and combine participants' heart rate into interactive visualizations (e.g., [11]). Such projects begin to reconceptualize biosensing, emphasizing emergent co-created meaning between human and machine.

My work focuses on personal reflection with biosensing while drawing from the reconceptualizations described above. I design for collaborative interpretive relationships between human and machine, where each has some initiative in meaning making. As part of this, I try to reveal the initiative, agency, or decisions already being made by biosensing machines. Although often framed as "facts" passively observed from the natural environment, biosensory data are co-constructed by our bodies in contact with a sensor, algorithms in the hardware, and the manner in which they are displayed. The human efforts and inescapably political decisions of engineers, scientists, and designers went into creating an electrical signal, deciding it was worthy of study, and presenting it. Revealing some of this embedded machine initiative may open up more of a dialogue in which humans feel they can question, challenge, and more freely interpret biosensory data.
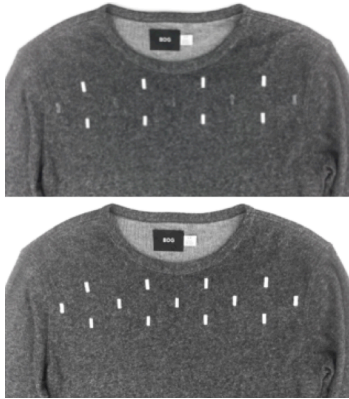
Figure 2: Shirt that senses and displays skin conductance. Small white rectangles gradually appear when the wearer's skin conductance spikes, an indication of excitement such as stress or happiness (from prior work [7]).

Overall, my designs foster interactions in which human, machine, and material initiatives are significantly different than in more typical consumer devices for personal reflection with biosensing. Rather than a time series graph or discrete emotional categories, the machine's display is a more ambiguous abstract pattern and more open to human initiative in interpretation. Rather than the hard fast-switching material of electronic screens, the softer slower thermochromic fabrics evoke different associations.

My work mixes machine, human, and material initiatives for personal reflection, engaging the physical properties of dynamic materials, such as thermochromic fabrics [2,9,10,12,13], to create volatile, unstable biosensing displays. By evoking associations with fashion and textiles, color-changing fabric displays may seem less like objective "fact" than a traditional time series graph on a screen, which may encourage users to take more initiative in forming interpretations. The thermochromic fabric itself also takes its own initiative, responding to environmental temperature as well as biosensors, and changing on its own slower time scale of a few minutes rather than milliseconds. This fosters interactions that are slower [6], leveraging ambiguity [4] to foster reflection and open ended interpretation [15,16]. In the following sections, I describe in more detail my work with color-changing fabric biosensing displays.

Personal Reflection with Clothing-Based Biosensing Displays

With Ebb [1] in collaboration with Project Jacquard [13], we explored associations around color-changing fabrics and information display in the context of fashion and personal style. Through material explorations [3,17], we developed thermochromic color-changing fabrics (Fig. 1). We engaged fashion designers and everyday wearers in envisioning what role these fabrics might play in their design practice and sense of style. Participants expressed appreciation for the slowness and low resolution of this material, likening it more to a canvas than a screen, and envisioned slow, gentle, subtle displays. We asked, how might these displays shift our interactions with information?

The next piece [7] explored the social meaning of clothing-based biosensory representations. I developed Hint, a t-shirt whose thermochromic screenprint pattern responds to the wearer's skin conductance (Fig. 2), and studied how pairs of friends, each wearing Hint shirts, conversed and interpreted the display. I found that in this context biosensing display became part of social performance [5]. What if wearers crafted their display to support their intended performance? What role might the biosensing display play in social interaction?

With Ripple, I adapted and extended the design of Hint to be robust and comfortable enough for daily life, and studied wearers' interpretations with the display over the course of two days of going about their daily lives. From making music in the studio with friends, to work, to socializing at a bar, participants interpreted the display in a wide variety of contexts. Participants began to build an interpretive relationship with their display, relating it to aspects of their personality, events in their day, or their emotions [currently under review].

As a third year PhD student (pre-qualifying exams), I see my work thus far as one initial foray into personal reflection with biosensing, with still many open questions and improvements to be made. For future work, I am exploring other material representations, more socially situated meaning making, and rethinking the relationship between human, biosensor, and display. I think framing biosensory data, mediated by its material display, as having its own initiative or voice rather than just as passively observed facts, can foster interactions that mix human and machine agency in creative and personal growth with biosensing.

References

1. Laura Devendorf, Joanne Lo, Noura Howell, Lin Lee Jung, Nan-Wei Gong, M. Emre Karagozler, Shiho Fukuhara, Ivan Poupyrev, Eric Paulos, and Kimiko Ryokai. 2016. "I don't want to wear a screen": Probing perceptions of and possibilities for dynamic displays on clothing. *Proceedings of the 34th Annual ACM Conference on Human Factors in Computing Systems (CHI'16)*.

2. Delia Dumitrescu, Marjan Kooroshnia, and Hanna Landin. 2014. Exploring the relation between time-based textile patterns and digital environments. *Ambience*. Retrieved March 12, 2016 from http://hdl.handle.net/2320/14141

3. Ylva Fernaeus and Petra Sundström. 2012. The Material Move How Materials Matter in Interaction Design Research. *Proceedings of the Designing Interactive Systems Conference*, ACM, 486–495. http://doi.org/10.1145/2317956.2318029

4. William W. Gaver, Jacob Beaver, and Steve Benford. 2003. Ambiguity As a Resource for Design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, 233–240. http://doi.org/10.1145/642611.642653

5. Erving Goffman. 1959. *The presentation of self in everyday life*. Anchor Books, New York.

6. Lars Hallnäs and Johan Redström. 2001. Slow Technology – Designing for Reflection. *Personal Ubiquitous Comput.* 5, 3: 201–212. http://doi.org/10.1007/PL00000019

7. Noura Howell, Laura Devendorf, Rundong (Kevin) Tian, Tomás Vega, Nan-Wei Gong, Ivan Poupyrev, Eric Paulos, and Kimiko Ryokai. 2016. Biosignals as social cues: Ambiguity and emotional interpretation in social displays of skin conductance. *Designing Interactive Systems (DIS)*.

8. Teoma Jackson Naccarato and John MacCallum. 2016. From representation to relationality: Bodies, biosensors and mediated environments. *Journal of Dance & Somatic Practices* 8, 1: 57–72. http://doi.org/10.1386/jdsp.8.1.57_1

9. Linnéa Nilsson, Mika Satomi, Anna Vallgårda, and Linda Worbin. 2011. Understanding the Complexity of Designing Dynamic Textile Patterns. *Ambience*.

10. Maggie Orth. 2009. *100 Electronic Art Years*. Retrieved from http://www.maggieorth.com/art_100EAYears.html

11. Rakhi Parekh. 2014. *The Ripple*. Retrieved from http://www.rakhiparekh.me/work-08.html

12. E. R. Post, M. Orth, P. R. Russo, and N. Gershenfeld. 2000. E-broidery: Design and fabrication of textile-based computing. *IBM Systems Journal* 39, 3.4: 840–860. http://doi.org/10.1147/sj.393.0840

13. Ivan Poupyrev, Nan-Wei Gong, Shiho Fukuhara, M. Emre Karagozler, Carsten Schwesig, and Karen Robinson. 2016. Project Jacquard: Manufacturing Digital Textiles at Scale. *Proceedings of the 34th Annual ACM Conference on Human Factors in Computing Systems*.

14. Scott Rubin and Thin Edge New Music Collective. 2016. *Naked to the Sky*. Retrieved from https://www.youtube.com/watch?v=yeIptvATmE0

15. Phoebe Sengers, Kirsten Boehner, Shay David, and Joseph "Jofish" Kaye. 2005. Reflective Design. *Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility*, ACM, 49–58. http://doi.org/10.1145/1094562.1094569

16. Phoebe Sengers and Bill Gaver. 2006. Staying Open to Interpretation: Engaging Multiple Meanings in Design and Evaluation. *Proceedings of*

the 6th Conference on Designing Interactive Systems (DIS'06), ACM, 99–108. http://doi.org/10.1145/1142405.1142422

17. Anna Vallgårda and Johan Redström. 2007. Computational Composites. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, 513–522. http://doi.org/10.1145/1240624.1240706

18. *Feel*. Retrieved January 12, 2016 from http://www.myfeel.co/

19. *Affectiva*. Retrieved from http://www.affectiva.com/

20. Spire. *Spire*. Retrieved May 24, 2016 from http://www.spire.io