An Exploratory Study on Bridging Biometric Insights to Emotional Well-Being

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Abstract

This research investigates how interaction design can foster mental wellness by enabling mindful interpretation of biometric data from electronic devices. Real-time physical signals—such as heart rate, temperature, and posture—serve as key indicators of the often-overlooked connection between physical symptoms and mental states. This study seeks to bridge that gap, encouraging users to adopt intentional habits that promote self-awareness. The aim of this research is to make these connections become more accessible and actionable, helping individuals understand how their body's responses relate to their mental health.

The research employs a practice-based methodology, combining iterative prototype design with qualitative interviews. Prototypes visualize biometric signals in intuitive ways, offering actionable insights that guide users in recognizing patterns in their data. Participant interviews focus on their experiences with wearable devices, exploring whether and how biometric feedback fosters deeper awareness of mental states and behaviors. This dual approach provides a comprehensive exploration of the research questions: How do embodied interactions within physical and digital environments collectively shape and influence actions and behaviors? And how can biometric data foster a mindful connection between users and their senses?

The study emphasizes the integration of physical and digital environments, exploring their combined impact on user behaviors and mental wellness. By presenting real-time biometric data through interfaces, prototypes transform abstract metrics into tangible experiences, enabling users to engage more fully with their physical and emotional states. The research also investigates the role of environmental contexts—adjustable or non-adjustable environmental settings—in shaping users' awareness and engagement with biometric feedback.

This work contributes to the fields of interaction design and health informatics by illustrating how biometric data can inspire self-awareness and behavior change. It moves beyond conventional health-tracking systems, focusing on the emotional and cognitive dimensions of biometric feedback. By enabling users to interpret their body's data to mental health, this study demonstrates the potential of technology to support emotional self-regulation and foster a more compassionate relationship with one's body. The findings underscore the importance of designing systems that bridge physical, digital, and emotional experiences to enrich everyday life and promote mental wellness.

Background Narrative

Where this research begins…

As an interaction designer who is always eager to use my skills to make the world a little better than I found it, I am passionate about exploring the field more deeply. Over the past few years, I have found myself unintentionally observing people's behaviours and trying to uncover the messages behind them. For example, one of my friends would rub her fluffy keychain whenever a conversation made her feel anxious. She wouldn't notice her behaviour, but those around her did. Since I began paying closer attention to the people around me, I've noticed more common clues of unconscious physical behaviours that happen in particular situations, revealing mental or wellness messages that people themselves often overlook.

I relate to this on a personal level. When I am stressed or anxious, I tend to lose focus and daydream about escaping reality, often imagining a walk in the forest or a nearby park to ease my tension. This became especially clear to me during the summer when I decided to take a break from the busy city life and attend a retreat in rural Hawaii. There, I experienced a different lifestyle, where the island's quiet rhythm of sunrise and sunset promotes a natural and simple way of life. This immersion helped me reconnect with nature and my inner self.

After returning from Hawaii, I felt more confident about the direction I wanted to pursue in my research. I began to explore the concept of embodied interactions—how people engage with technology and their environment through physical movements and senses, such as gestures and motion. Embodied interaction can be used to create entirely new interaction models that go beyond the conventional two-dimensional

interfaces of websites or mobiles. It emphasizes user-centred design by gathering information from physical behaviours, like facial expressions and gestures, and analyzing them for deeper insights into a person’s emotional state.

This ties back to my curiosity and interest in observing people's behaviours and actions. I hope to use design to help improve wellness by encouraging people to form small, positive habits within their daily routines. Alongside embodied behaviours, I am also curious about how spaces and environments might unconsciously affect our mental wellness.

One of the methods I’ve been using in my research is auto-ethnography. Through auto-ethnography, I have used my own experiences to help me study my own embodied interaction, recording my behaviours to better understand how physical movements and environment influence my own mental wellness.

By integrating biometric insights with design research, I aim to explore how embodied interaction can inform interventions that enhance self-awareness and emotional well-being. This research focuses on leveraging real-time body signals to help individuals recognize and interpret their physiological responses, fostering a deeper connection between mental health, bodily awareness, and the surrounding environment.

Introduction

The integration of wearable technologies and biometric data into everyday life has opened new avenues for understanding and supporting mental wellness. However, while these systems collect abundant data, they often fail to translate these metrics into meaningful insights that users can connect to their daily experiences. This disconnect between data collection and actionable understanding highlights an opportunity for interaction design to play a transformative role.

The foundation of this research draws on the concept of embodied cognition, which challenges traditional notions of cognitive processes. According to Main (2024), "Embodied cognition is a concept in cognitive science suggesting our cognitive processes are deeply rooted in the body's interactions with the environment. Traditional views of human cognition often depict mental faculties as computations performed by a brain in isolation from bodily experiences" (para. 1). The embodied cognition hypothesis proposes that cognitive functions cannot be entirely separated from physical embodiment, emphasizing that "our sensorimotor systems play a constitutive role in shaping the mind" (Main, 2024, para. 1).

Building on this foundation, embodied interaction extends these principles into design practice. Smith (2013) describes embodied interaction as a method that emphasizes the user's physical body and sensory experiences as integral to understanding and acting on feedback from digital systems. By transforming abstract data into meaningful and tangible insights, embodied interaction fosters deeper engagement with wellness technologies and supports self-awareness.

This thesis positions itself at the intersection of interaction design and health informatics, focusing on how embodied interaction can foster meaningful engagement with biometric data. By bridging physical and digital environments, the research investigates how design can support users in recognizing patterns, fostering self-awareness, and encouraging intentional actions to promote mental wellness.

Designing for mental wellness requires addressing not only technical challenges but also contextual and experiential factors. For instance, the way biometric feedback is presented and aligned with a user's environment—whether physical (e.g., home or workplace) or digital (e.g., app interfaces)—significantly influences their ability to engage with and act on the data. This thesis explores these dynamics through a practice-based methodology emphasizing iterative design and qualitative evaluation.

The document begins by framing the theoretical foundations and research context, including the potential of biometric data and embodied interaction in supporting self-awareness. Subsequent sections detail the design and testing of interactive prototypes, which aim to make real-time biometric feedback intuitive and actionable. Participant interviews provide insights into how users perceive and interact with these systems, revealing opportunities for further innovation in the design of wellness technologies.

By exploring the interplay between embodied interaction, biometric data, and environmental contexts, this research contributes to a broader understanding of how interaction design can enhance mental wellness. The findings aim to provide a framework for designing tools that

prioritize user autonomy, emotional self-regulation, and a mindful connection to one's physical and emotional states.

Framing the Research: Questions, Key Concepts, and Definitions

This section establishes the foundation of the thesis by presenting the research question, defining essential terms, and clarifying their relevance within the study. These elements provide a clear framework for exploring how interaction design influences behavior and mental wellness.

Research Question

This thesis investigates the following central question:
How does combining physical and digital environments collectively shape and influence actions and behaviors, and how can symptom diagnosis foster a mindful connection between users and their senses?

This question addresses two key aspects:

1. The relationship between physical and digital environments in shaping user behavior.
2. The potential for symptom diagnosis to guide users toward greater mindfulness and self-awareness.

By focusing on these areas, the research aims to uncover actionable insights that enhance the connection between biometric data, design, and mental wellness.

Key Terms & Definitions

The research relies on several critical terms. The following definitions explain these concepts as they relate to the thesis:

Biometric Data

Biometric data refers to measurable physical or behavioral traits, such as fingerprints, facial scans, voice recognition, or heart rate, used for identification or analysis (Innovatrics, n.d.). In this thesis, biometric data specifically focuses on real-time physiological indicators like heart rate, temperature, and posture. These data points reflect emotional or mental states and form the foundation for designing interactive systems that support self-awareness and mindful behavior. By contextualizing this data through embodied interaction, the research aims to make these signals more accessible and meaningful for users.

Embodied Interaction

Embodied interaction involves engaging the physical body and senses as integral elements of interaction with technology. This concept highlights the role of sensory input and physical engagement in creating intuitive and meaningful experiences (Smith, 2013). In this thesis, embodied interaction is applied to design systems that encourage users to intuitively connect with their biometric data. Rather than relying solely on abstract visualizations like graphs, the research focuses on creating interactions that feel natural and grounded in users' lived

experiences. This approach fosters a mindful relationship between users' physical states and emotions.

Quantified Self (QS)

The Quantified Self (QS) movement promotes the use of technology to track and quantify various aspects of daily life, such as physical activity, sleep, and emotional states, with the goal of gaining self-knowledge and improving performance (Wikipedia, 2024). This research applies QS principles to explore how wearable devices and biometric data can enhance self-awareness. By using these technologies to quantify physiological signals, the thesis examines how individuals can better understand their behaviors and make intentional adjustments for improved mental wellness.

Symptom Diagnosis

The process of recognizing patterns or signals in biometric data that reveal physical or emotional states. This research reinterprets symptom diagnosis as a mindful practice that empowers users to take intentional actions based on their bodily cues.

Physical and Digital Environments

The spaces and interfaces users engage with, including tangible surroundings like homes or workplaces and digital tools like apps or wearable interfaces. This thesis explores how these environments combine to influence user behavior and wellness practices.

Understanding the Relationship Between Biometric Data and Mental Wellness

Biometric data serves as a vital tool for understanding the connection between physical symptoms and mental wellness (Persiani et. al., 2021). Indicators such as heart rate, temperature, and posture reflect underlying emotional states, such as stress, calmness, or fatigue (Kasparian & Badawy, 2022). For example, datasets like EmoWear have demonstrated how wearable devices can capture physiological and motion data for emotion recognition and context awareness (Rahmani et al., 2024). However, wearable technologies often present these signals in abstract formats, leaving users to interpret graphs or numerical data that lack context or actionable insights.

Embodied interaction offers a pathway to address this disconnect by leveraging the body's physical engagement as an integral part of the interaction process (Fernandez et.al, 2023). This concept is deeply rooted in embodied cognition, which emphasizes that cognitive processes are inseparable from bodily experiences. Antonio Damasio, a professor of psychology, philosophy, and neurology, highlights the role of interoception—the internal awareness of bodily states—in shaping thoughts and emotions: "Our thoughts and our feelings and emotions are not just influenced by our bodies but [are] actually inconceivable without them. All of our mental activity is a consequence of body/brain interactions" (Warren & Franke, 2024, para. 8). In design, embodied interaction extends this principle by integrating physical gestures, postures, or environmental engagement to make biometric data more relatable and meaningful (Smith, 2013).

The potential of wearable devices to capture and interpret physiological data, such as electrodermal activity (EDA) combined with heart rate (HR), demonstrates the efficacy of such systems in predicting stress with high accuracy when paired with machine learning models (NCBI, 2024). While these technologies have proven effective in identifying physiological responses, there is still a significant gap in how these insights are delivered to users and how they promote mindfulness or behavioral changes. The American Psychological Association (2021) highlights that wearable devices have the potential to go beyond tracking to act as tools for therapy, capturing real-world data about users' daily experiences and helping individuals manage symptoms of anxiety or depression.

The relationship between biometric data and mental wellness also depends on the environments in which these interactions occur. Physical spaces, such as homes or workplaces, and digital interfaces, such as mobile applications, shape how users perceive and act upon their biometric feedback. For instance, stress feedback delivered during work hours may prompt users to take short breaks or adjust their posture, while feedback at home might encourage mindfulness exercises or relaxation techniques. This interplay between physical and digital environments forms the foundation for designing systems that integrate contextual relevance into wellness interventions.

Current systems often prioritize fitness tracking or physical health metrics over emotional or cognitive wellness. Despite advancements in physiological monitoring, few wearable technologies effectively contextualize their findings in ways that foster deeper engagement or promote behavioral shifts (APA, 2021). By addressing these gaps, this research explores how interaction design can reframe biometric feedback into embodied, actionable insights that align with users' lived experiences, empowering them to take intentional steps toward improved mental wellness.

Ethical Considerations

There are important ethical considerations that need to be taken into account when undertaking this kind of research. For example, talking about issues such as mental well-being and their emotional state could be uncomfortable for people to engage with. So too, monitoring people could be seen as impacting on their privacy and could also make people feel uncomfortable. Realizing this, the use of the Emily Carr University Research Ethics Board (REB) process helped mitigate some of these ethical concerns. But, these are important issues to consider and moving forward it would be important for other researchers wanting to pursue similar topics to carefully consider the ethical implications of this kind of research.

Acknowledging the ethical implications of collecting and responding to biometric data is an important aspect for this kind of work. The project worked to ensure that participants maintained full control over when and how data was recorded, and consent was explicitly obtained for every phase of the research. Future implementations of this design should also look to how to prioritize user autonomy, privacy, and data transparency, as misinterpretation of biometric cues, particularly without context, poses a risk for undue anxiety or behavior shifts. In the next section I outline all the elements I utilized in order to help provide an ethical environment for the research for this project.

Ensuring Ethical Standards in Research

This study adheres to Emily Carr University's research ethics standards and the principles of respect for persons, concern for welfare, and justice:

1. **Ethics Board Approval:**

   The project was reviewed and approved by the ECU Research Ethics Board. Participants were informed of the Ethics Board's contact (ethics@ecuad.ca) should any concerns arise.

2. **Informed Consent & Voluntariness:**

   Clear Information: Every participant received a detailed consent form outlining study objectives, procedures (one-week diary + 30 min interview), benefits (e.g., gift card), and any potential risks.

   Voluntary Participation: Participation is entirely voluntary; participants may skip questions or withdraw at any time, with the option to have their data removed up to one month after consenting .

3. **Privacy, Confidentiality & Anonymity:**

   Anonymized Data Collection: Diary entries are submitted without names or identifiers; interview notes omit identifying details.

Limited Use of Contact Information: Email / IDs are used solely to schedule sessions and are not linked to research data.

Secure Storage: All data are stored on a password-protected ECU OneDrive for one year, after which they are permanently deleted. Access is restricted to the principal investigator and supervisor .

4. **Minimizing Harm & Supporting Well-Being:**

   Emotional Safety: Reflective questions may evoke personal emotions; participants can skip any prompt they find uncomfortable.

   Support & Debriefing: Researchers provide debriefing and can refer participants to counseling or other support services if needed.

5. **Data Use & Publication:**

   Transparent Dissemination: Findings may appear in the thesis, journals, or conferences—but individual participants will never be identifiable.

   Participant Access: Participants may request a summary of results or a copy of the final thesis.

6. **Autonomy & Control in Design:**

   In prototype interactions, users retain full control over when monitoring sessions start or stop and what biometric signals they share, reinforcing respect for personal agency.

User Research Insights and Findings

1.1 Autoethnography

Day 1 – July 21st

Steps total: 7032

Feelings:

- Excited - Traveling to a new place, anticipation after planning the trip for nearly a month.
- Nervous and Anxious -Flight delay; repeatedly checking on flight updates; crowded and chaotic Seattle airport.
- Relief - Finally boarding the plane.

Diary:

My friend and I met at the YVR Airport and were very excited about this trip since we'd been planning it for nearly a month. We were a little concerned about the defective software update from CrowdStrike, which disrupted IT systems two days ago, but since checking in and passing through customs went smoothly, we felt the issue might have been resolved.

Things got worse when we transferred at the Seattle airport. We were happily waiting for our scheduled flight, but it kept getting delayed. With nothing to do besides wandering around the airport shops and restaurants, I found myself constantly checking my phone for new notifications or updates, feeling my anxiety rise with each check. After spending hours in the crowded airport, we noticed more and more passengers were also experiencing flight issues, making the airport feel even more chaotic. I eventually fell asleep for about an hour while

waiting, exhausted from the steps I'd taken and running on only a few hours of sleep due to excitement.

After nearly 10 hours of waiting, my friend and I finally boarded the plane around 8:30 pm. When we finally got on the plane, I felt immediate relief from the stress. Reflecting back on this event, I realized how clearly my physical sensations, like the tension in my shoulders and restlessness, were influenced by both the physical environment of the crowded airport and the uncertainty caused by digital disruptions.

Day 2 – July 22nd

Steps total: 6670

Feelings:

- Nervous - Flight delay.
- Excited - New place.
- Shocked - Airport facilities.
- Happy - People loved my dish.

Diary:

When I finally arrived at Kona airport, on the Big Island of Hawaii, it was 1 am. I sent a message to the person in charge of our originally scheduled retreat, explaining the delays and that it might be too late to head there directly. They still offered to pick us up, but considering it was already late and we still needed to pick up our rental car the next day near the airport, we decided to postpone our retreat arrival. From this event, I noticed that despite my exhaustion from the delays and late hour, my anxiety began to ease once we made this practical decision.

The Kona airport surprised me as it was open-air and publicly accessible, including the luggage pickup area. While waiting for our luggage, we quickly booked a nearby hotel to make the next day's rental car pickup easier. We took a taxi and finally rested at around 2 am. I noticed a strong connection between the minimal sleep I got due to the late arrival and my physical state the next morning—I felt tired but motivated to explore, driven by excitement.

When we woke up we walked about 10 minutes to grab brunch (avocado toast). We ate at the patio, where we could watch pedestrians walking up and down the road on the street and cars coming and going. After brunch, we took a leisurely 15-minute walk to the nearby beach. People around us appeared relaxed, some even reading books by the shore. The water was remarkably clear, letting us see colorful fish swimming near the shore. From this experience, I noticed how the calming beach environment and my increased physical activity significantly boosted my mood, helping offset my earlier fatigue.

We stayed for an hour before returning to the hotel around 1 pm to pick up our luggage and collect our rental car. Then we headed toward the retreat, stopping briefly to purchase groceries and supplies, aware the retreat was in a rural area far from supermarkets.

We finally arrived at the retreat gate at 3:51 pm. After parking, our host kindly helped carry our luggage upstairs and gave us a tour of the retreat facilities. That night, I made borscht. At 7:10 pm, we enjoyed dinner in the shared kitchen with an Australian couple. Everyone praised my dish, which made me very happy. The gentleman kindly helped with the dishes, and then we

went to bed early. I noticed going to bed earlier significantly improved my sense of well-being and relaxation, contrasting sharply with my stressful experience the previous night.

Day 3 – July 23rd

Steps total: 4084

Feelings:

- Nervous - Unexpected participation request.
- Excited - New activities (bakery, chocolate tasting).
- Calm - Cutting ginger roots.
- Fun - Baking with others.
- Awe - Seeing the Milky Way.

Diary:

We woke up early and cooked our own breakfast at the retreat. After breakfast, we were unexpectedly asked to participate in a program that involved cutting ginger roots with a machete while releasing negative feelings. From this activity, I noticed a calming effect on my mind and body as I physically smashed ginger roots, allowing me to release negative energy and tension.

Around 11:30 am we went out to grab lunch. We grabbed local food – poke and walked around the area. We found a local chocolate store and joined chocolate tasting. It was my first time doing chocolate tasting and I felt excited. Afterward, we visited a café with live guitar music. From this event, I noticed how strongly my mood and physical relaxation were positively influenced by the soothing environment and gentle music.

In the afternoon, we returned to volunteer at the retreat. We filmed clips and participated in making sourdough bread. It was enjoyable to bake alongside others. I observed that physically engaging with baking and interacting with others created a strong sense of community, enhancing my emotional well-being.

After the 2 hours of volunteer work, we drove to the beach and enjoyed the sunset. We decided not to swim due to strong currents. Afterward, we grabbed food and headed back to the retreat, arriving around 9 pm. The clear night sky revealed the Milky Way, leaving us amazed. Seeing the stars vividly reminded me of the profound effects a calm, natural environment can have on my mental and emotional state. We quietly went to bed to avoid disturbing others who were already asleep.

Day 4 – July 24th

Steps total: 3623

Feeling:

- Surprised - Waking up naturally early.
- Annoyed - Unexpected land work and retreat rules.
- Calm - Removing weeds.
- Pleased - Playing fetch with the dog Snoopy.
- Controversial - Deciding to leave the retreat.
- Excited and Relieved - Moving to new accommodation.

Diary:

I woke up naturally early, which surprised me, but it felt logical considering the eventful day prior and the alignment with natural cycles. I noticed how my body's internal clock adjusted naturally, reflecting improved restfulness and alignment with my surroundings. The dog Snoopy invited me to play fetch, which made me pleased. We started our volunteer work by filming clips of baking sourdough. Then the host asked us to do land work, specifically removing weeds for an hour. Despite feeling initially annoyed by the unexpected request, I found that physically removing weeds gradually introduced a sense of calm and relaxation.

After finishing weed removal, we continued filming environmental clips around the retreat—avocado trees, pomelos, and tropical plants. We enjoyed freshly baked sourdough afterward. Later, the host spoke to us about following specific quiet hours and volunteer working hours, which had never been clearly communicated. My friend and I felt upset and discussed privately, deciding to leave the retreat as these unexpected rules created tension. Once we made the decision to leave, my earlier feelings of annoyance and discomfort shifted noticeably towards emotional relief.

We informed our host around noon, and although he proposed an alternative, we gratefully declined. The conversation made me emotional, and I cried, but leaving felt right emotionally. I noticed a sense of emotional clarity and relief after expressing my feelings. We reached our new accommodation around 7:30 pm. The new place was cozy with perfect facilities, even offering beach gear. Upon arrival, my excitement was physically evident through increased energy and a noticeable improvement in mood. It was a long day filled with many emotions, so we went to

bed early. As we settled into an early sleep, I recognized a sense of deep emotional and physical recovery from the day's ups and downs.

Day 5 – July 25th

Steps total: 2696

Feeling:

- Excited - Snorkeling activity anticipation.
- Embarrassed - Struggling with snorkeling; injury.
- Calm and Connected - Wearing plumeria flowers; comfortable swimming area.
- Heartwarming - Host's generosity with mangoes.

Diary:

After making a simple breakfast, we picked a few plumeria flowers from the tree in our yard and wore them in our hair. This making me feel closer to the land and giving me a sense of confidence. Perhaps seeing many others wearing similar flowers contributed to my sense of belonging and comfort in this new environment. Dressed in our swimsuits, we gathered beach essentials and snorkeling gear before driving to a nearby beach park. At the beach, we noticed kids snorkeling effortlessly in shallow waters and people doing yoga on kayaks, creating an inviting atmosphere. A tall lifeguard tower monitored the area, making it feel safe. Seeing how enjoyable snorkeling appeared, we eagerly decided to give it a try. However, my excitement turned into embarrassment when I struggled with the waves and fins, ultimately getting knocked down by a wave and scraping my knees. From this incident, I realized how my physical limitations and unfamiliarity with ocean conditions directly influenced my emotional response. I

also became aware of how heightened physical sensations—such as an increased heart rate and rapid breathing—were clear indicators of my anxiety and embarrassment in the water.

I then moved to a calmer snorkeling spot suitable for toddlers, the same beach we first visited upon arriving in Hawaii. Here, I comfortably enjoyed swimming and felt more at ease, spending the entire morning and part of the afternoon before heading back. In this calmer environment, I noticed my breathing became slower and deeper, reflecting increased relaxation and emotional comfort. Reflecting on this, I noticed how choosing an environment aligned with my abilities and comfort level significantly impacted my overall enjoyment and confidence. I also noticed that my mind is more clear, which could be because my sleep quality is improving; even though the steps walked are fewer today, the intense water activities we did might help me sleep better.

That evening, returning to our accommodation, we recalled noticing mangoes scattered in the yard while picking flowers earlier. Curious, we asked the host if the mangoes were edible or for purchase. Our host warmly surprised us by gifting two perfectly ripe mangoes. I felt deeply touched by the host's generosity and realized how small acts of kindness could greatly enhance my emotional well-being and sense of belonging.

Day 6 - July 26th

Steps total: 7324

Feeling:

- Excited (Night manta snorkel)
- Scared (Night manta snorkel)
- Harmony (green geckos at the cafe)

Diary:

On July 26th, we decided to drive about 30 minutes to a brunch café and then continue along a road leading to the southernmost point of the USA. When we arrived at the brunch spot, there was a small line, but we were excited because the reviews were amazing. Once seated, we found the atmosphere to be fantastic. We sat at a corner table near a fence where the restaurant staff placed small bits of jam for tiny, colorful green geckos to eat. Watching them lick the jam while I enjoyed my meal gave me a sense of harmony between myself and nature. I noticed my breathing slow slightly as I relaxed, a subtle physical sign of my growing calm. In the distance, I could see the Hawaiian coastline, where the sea and sky seemed to merge into one, both appearing in an endless shade of blue.

After brunch, we stopped at a roadside fruit shop that sold cacao and other exotic tropical fruits. We bought some uncommon fruits to try later in the evening. We also passed by an unattended, self-service bakery. The bakery was set up on the roadside, allowing people to stop, pick out what they wanted, calculate the price, and drop the money into a cash box. After tasting the bread, we realized that it had a mochi-like texture - the bread was chewy and sticky, something we really enjoyed. Many of the pastries incorporated fruits, resulting in a unique chewy and fruity combination that we hadn’t encountered elsewhere, making it feel like a special discovery.

Continuing along the road, we stopped at a small farm where we saw macaws, turkeys, ducks, and other animals freely roaming around. The farm also sold local coffee, so we purchased some before continuing our journey. After driving another 10–20 minutes, we finally arrived at

the southernmost point of the USA. The view was breathtaking—sheer coastal cliffs overlooking the ocean. There was a well-known cliff diving spot, but due to the dry season, the rope used to climb back up was about 10 meters above the water, making it impossible to return after jumping. We stayed for a while, taking in the spectacular scenery before heading back. I felt my pulse quicken once I walked closer to the cliffs, especially with the strong winds that day. I worried I might fall—intensifying my mix of fear and awe at the sheer drop.

On our drive back, we passed large wind turbines, likely part of a wind energy project. Eventually, we returned to a village center where we watched the sunset. The sky turned deep orange and red, resembling a fiery glow, which was quite different from Vancouver's pink-hued sunsets. Observing the vivid colors, I felt a gentle release of tension in my body, a sign of how deeply the natural environment affected my mood. After watching the sunset, we strolled along the roadside, exploring small shops before heading to dinner. We tried local Hawaiian poke and a traditional meat dumpling wrapped in leaves. The staff also strongly recommended we try a drink called 'Ava' (Kava), a traditional Polynesian and Hawaiian beverage made from the root of the kava plant. Consumed for centuries for its medicinal qualities, kava is known to alleviate anxiety and promote relaxation and mental clarity. Since we had booked a late-night manta ray snorkeling tour, they thought it would help us unwind beforehand. After drinking it, we did feel much calmer. I sensed a slower heartbeat and less tension in my shoulders, confirming the soothing effect.

By 11 PM, we arrived at the meeting point for the manta ray snorkeling tour. Along with a group of people, we boarded a boat and set off. Each person had a handle to hold onto, attached to a large floating structure with built-in lights. The lights illuminated the water,

allowing us to clearly see the manta rays as they fed on plankton. I noticed a surge of excitement and a hint of fear, reflected in my elevated breathing rate, as these enormous creatures approached. The massive creatures swam in circles right in front of us, their mouths wide open as they gracefully glided through the water. At the same time, vibrant fish swam around, adding to the incredible experience. We spent about 30 minutes watching them before heading back, deeply moved by the experience of witnessing these majestic creatures up close.

When we returned, I felt extremely sleepy, almost forcing myself to shower. The combination of walking over 7,000 steps, strong emotional highs, and physical exertion left me exhausted, likely burned a large amount of calories.

Day 7 – July 27th

Steps total: 7094

Feeling:

- Amazement – Driving through the volcanic region with black lava landscapes and misty tropical plants.
- Excitement – Exploring Hilo Public Market and discovering unique local foods like mashed purple sweet potatoes in poke.
- Disappointment – Finding the waves too strong for swimming and deciding not to go in the water.
- Calmness – Watching the sea turtles swim peacefully.
- Satisfaction – Ending the day by tasting the crisp and sweet white persimmons.

Diary:

We slept in a little longer in the morning and had a quick bite to eat before heading to Hilo. I noticed that sleeping in gave me a renewed sense of energy, suggesting my body needed extra rest after the previous day's activities. Hilo is located on the northeastern side of the island, and it took us over an hour to drive there from where we were staying. The route passed through the volcanic region of Hawaii, meaning the highway cut directly across the volcanic landscape.

Since I had never been to a volcanic area before, I wasn't very familiar with the terrain. Driving through it was quite a stunning experience—on both sides of the highway, there were vast stretches of black, soil-like material and landscapes shaped by solidified lava. My heartbeat seemed to pick up slightly as I took in these otherworldly views, a physical reflection of my amazement. As we continued driving, we encountered patches of mist, and within the mist, there were tropical plants with vine-like structures that looked unfamiliar to me. It felt as if we had entered a magical world.

When we arrived in Hilo, we managed to get to the Hilo Public Market just before it closed. We walked around the market, bought some souvenirs, and picked up some fruits since the prices were relatively cheap. After exploring the market, we had lunch at a nearby poke restaurant. This place was unique because their poke bowls came with mashed purple sweet potatoes, which seem to be a popular food in Hawaii. After lunch, we drove to a local beach that seemed to be a popular spot for Hilo residents to go swimming. However, when we arrived at the first beach, we found that the waves were too strong for safe swimming for us, so we looked for another nearby spot. In the end, I chose not to swim at any of the beaches that day because, as someone who isn't a strong swimmer, I didn't feel entirely safe in the

water. I noticed my shoulders tense briefly at the sight of the strong waves, a clear sign of my apprehension.

Despite that, we had a lucky encounter - we found a large tide pool that was connected to the ocean and spotted two sea turtles swimming freely. They moved leisurely through the water, occasionally nibbling on seaweed. Watching them felt incredibly calming, as if they carried a peaceful energy that naturally put me at ease. I felt my breathing slow down, mirroring the turtles' serene movements, reinforcing my calmness. We stayed there for a while, and by the time we left, it was around 6:30 or 7:00 PM, just as the sky was starting to darken. On our way back, we stopped by a coffee shop and a supermarket in Hilo to pick up some groceries so we could cook at our place later. That night, we finally tried the white persimmons we had bought a few days earlier. Their texture was quite interesting—crisp, yet sweet, with a pale yellow interior that resembled the color of star fruit. Tasting them brought a sense of delight and satisfaction. By the end of the day, I felt pleasantly tired from walking over 7,000 steps and absorbing so many new sights, which seemed to contribute to a deeper feeling of overall contentment.

Day 8 – July 28th

Steps total: 10426

Feeling:

- Fear – Jumping into the ocean from the boat for snorkeling.
- Reassurance – The instructor guiding me on how to stay afloat safely.
- Amazement – Seeing the vibrant underwater world with colorful corals, fish, and sea urchins.

- Gratitude – Receiving kindness from our host, who shared mangoes with us, and gifting a pineapple in return.
- Contentment – Enjoying our last dinner with poke, tacos, and live music before heading to the airport.

Diary:

The morning of the 28th marked the last day of our trip. I noticed a flutter of nervous energy in my chest, reflecting both excitement and residual fear from my previous snorkeling experiences. We woke up early because we had booked an 8 AM boat snorkeling tour. The boat ride to the snorkeling site took about 15–20 minutes. I was still a bit scared of jumping into the ocean from the boat, so I initially planned to wear both float sleeves and a life vest. However, the boat instructor noticed this and told me that wearing both would create too much buoyancy. He suggested that I only wear one. Seeing my hesitation, he asked me what I was afraid of, and I admitted that I had a fear of the ocean. Understanding my concern, he reassured me and suggested I wear just the life vest and hold onto a pool noodle for extra support, ensuring that I would have enough buoyancy.

Encouraged by his words, I decided to be brave and give it a try. As soon as I entered the water, I felt an initial jolt of adrenaline,*a sign of my lingering fear. However, I soon felt safe floating in the water, which gradually helped me overcome my fear. As someone who doesn't know how to swim, this was a big step forward for me.

The water was incredibly clear, allowing me to see the coral reef below. The corals came in various shapes and colors—some were bright yellow and full, resembling cauliflower, while

others were a deeper yellow with a more compact structure. Among the corals, I spotted a variety of fish, including vibrant yellow and blue ones, as well as clownfish like Nemo. I also saw purple sea urchins with spiky bodies. The underwater world felt mysterious and fascinating, with countless fish swimming around freely. As I continued snorkeling,I noticed my breathing become steadier and my heart rate slowed, signs that my fear of the ocean was fading. By the end of the session, I felt confident enough to let go of the noodle and just wear the life vest. We stayed in the water until around 10:30 AM before heading back to the dock. After returning, we had breakfast, packed our belongings, and checked out of our accommodation. Before leaving, we gave our host a pineapple as a token of appreciation, as he had kindly shared mangoes with us for the past two days. This simple act of exchange made me reflect on the kindness and generosity between people, and I truly valued this warm and friendly interaction.

After checking out, we went to a local coffee shop, had a light meal, and tried Hawaiian purple sweet potato coffee. Later, we visited a gift shop and bought some special Hawaiian tanning toys. Since we still had time before our flight, we wandered around the area near the airport for a final stroll. For dinner, we went to a well-rated local restaurant, where we enjoyed poke, tacos, and a refreshing pineapple drink. As we ate, we listened to live music performed by a local singer, making for a perfect ending to our trip.

At around 8:30 PM, we arrived at the airport. However, before checking in, we had a small mishap—our luggage exceeded the weight limit, and we only had one checked baggage allowance. As a result, we had to open our suitcases at the check-in counter and rearrange our belongings, transferring some items into our carry-ons to free up space. Though this process took a bit of time, the check-in staff was incredibly kind and did not ask us to rejoin the line.

Instead, they patiently helped us sort out our luggage, and once everything was within the weight limit, they processed our check-in smoothly. With everything settled, we boarded our flight to Seattle. Even though I slept for a few hours on the plane, I still felt tired after arriving home, likely due to having walked the highest number of steps on this day.

1.2 Autoethnography Analysis

In the context of my thesis on leveraging real-time biometric signals to enhance mental health and self-awareness, my journey through Hawaii—recorded in Day 1–8 diaries—offered a practical setting for a holistic autoethnography. I systematically noted biometric data such as steps taken, sleep quality, and emotional responses, alongside the varied physical environments I inhabited. This approach proved fundamental in uncovering how environmental factors and digital disruptions intertwined with mental well-being.

Physical and Digital Environments

From the outset, digital uncertainties played a significant role in shaping my experiences. For example, on Day 1, the flight delay caused by a defective software update heightened my anxiety—an observation underscored by tense shoulders and restlessness while constantly checking my phone for updates. In contrast, the natural scenery of Hawaii (Days 2–5) brought moments of ease, with beaches and open-air settings promoting calmer breathing patterns and a sense of well-being. I noticed that physically engaging in activities—such as cutting ginger roots or baking sourdough—further reduced my stress levels, reflecting a shift away from digitally induced anxiety to more embodied, present-focused tasks.

Influence on Sleep and Biometric Cues

A recurring theme in my diaries was how environmental cues influenced my circadian rhythms and sleep. On Day 4, I woke up earlier than usual, aligning more closely with natural cycles, while on Day 5, the combination of fewer steps but increased water activity (snorkeling) contributed to better sleep quality. Similarly, on Day 8, even though I rested for a few hours on the plane home, the particularly high step count left me feeling physically tired afterward—an instructive reminder that raw step data alone does not fully capture fatigue if emotional highs, fear responses, and adrenaline (as when snorkelling at night) are also factors.

Communal and Natural Elements

Though part of my stay involved a retreat with communal living guidelines, I ultimately left (Day 4) due to unexpected rules and schedules. Nonetheless, experiencing different communal settings and interacting with various people revealed how shared daily patterns can foster aligned sleep-wake cycles and collective mindfulness. Meanwhile, close encounters with nature—such as watching sea turtles on Day 7 or manta rays at night on Day 6—led to measurable physical relaxation (slowed heart rate, calmer breathing) and heightened emotional well-being.

Enhancing Mental Health Through Design

These experiences reinforce the potential for intentional modifications of physical and digital environments to support mental health. Daily diaries showed that exchanging stressful digital inputs (like constant phone-checking) for embodied engagement (weeding, snorkeling, cutting ginger roots, or connecting with wildlife) improved my emotional state and reduced anxiety. In

many instances, I observed direct correlations between my biometric indicators (heart rate, breathing patterns, tension in shoulders) and the immediate environment—whether it was a bustling airport terminal, a peaceful tide pool, or a rural farm.

Implications for Biometric-Driven Interventions

By systematically capturing these biometric and environmental data points, I gained insights into how specific design interventions might nurture mental wellness. Specifically, from my own experiences, I realized that emphasizing nature-oriented settings, encouraging mindful physical tasks, and reducing or reframing digital stressors (e.g., phone notifications) might be able to create a more balanced, health-supportive system. For instance, when my schedule aligned with natural cycles—going to bed earlier or waking up with sunrise—I noticed deeper rest and clearer mental focus the following day.

Conclusion of Autoethnographic Study

Through this autoethnographic lens, it becomes evident that mindful adjustments to both physical spaces and digital behaviours can significantly influence mental well-being. My day-to-day observations revealed a nuanced interplay between biometric signals (e.g., step counts, heart rate changes) and emotional states, driven by environmental contexts such as crowded airports, oceanic adventures, and communal living constraints. These findings lend credence to the broader thesis that a blend of real-time biometric tracking and thoughtful environmental design can meaningfully enhance self-awareness and mental health. By ensuring that human-centric technologies and natural environments mutually reinforce positive habits, we can begin to create more intuitive, well-balanced ecosystems for everyday life.

2. Open studio insight gathering

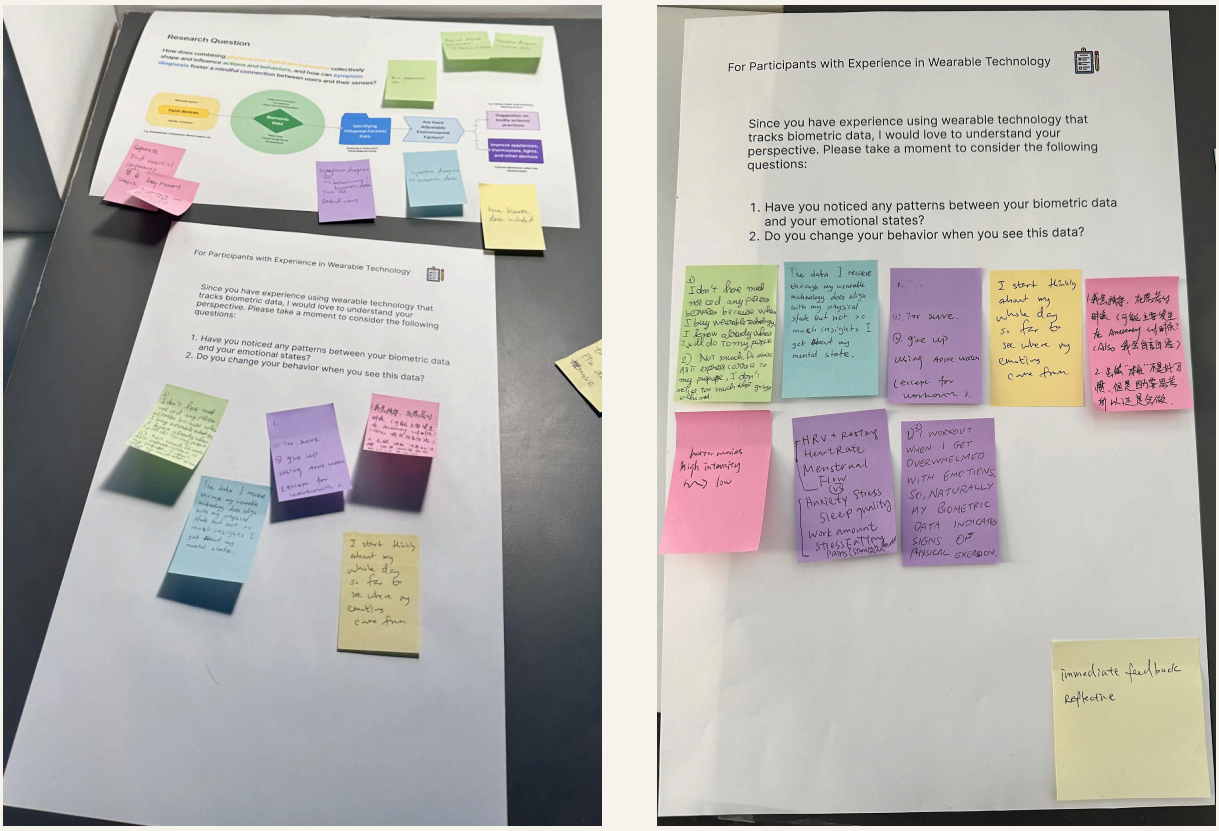


Figure 1. Open Studio Insight Gathering on Wearable Technology

During the open studio session, I introduced my research concept focused on the interaction between wearable technology and emotional well-being. I posed two questions to the audience regarding their experiences with wearable devices and their awareness of potential relationships between biometric data and emotional states (refer to Figure 1). The main response showed that while people understand how biometrics, like heart rate and sleep, are used to track physical health, many were unsure about how these measures could reflect changes in their emotions. This uncertainty about linking physical data to feelings became a key topic of the session.

This new understanding led participants to reflect deeply. They considered how their daily actions and the corresponding biometric data might affect their emotional health. For instance, one attendee noted that they often exercise when feeling anxious, a behavior they hadn’t consciously linked to their emotional state until the session. This insight sparked interest in how wearable technology could offer more deliberate insights into such patterns, possibly helping them manage their emotional responses more proactively.

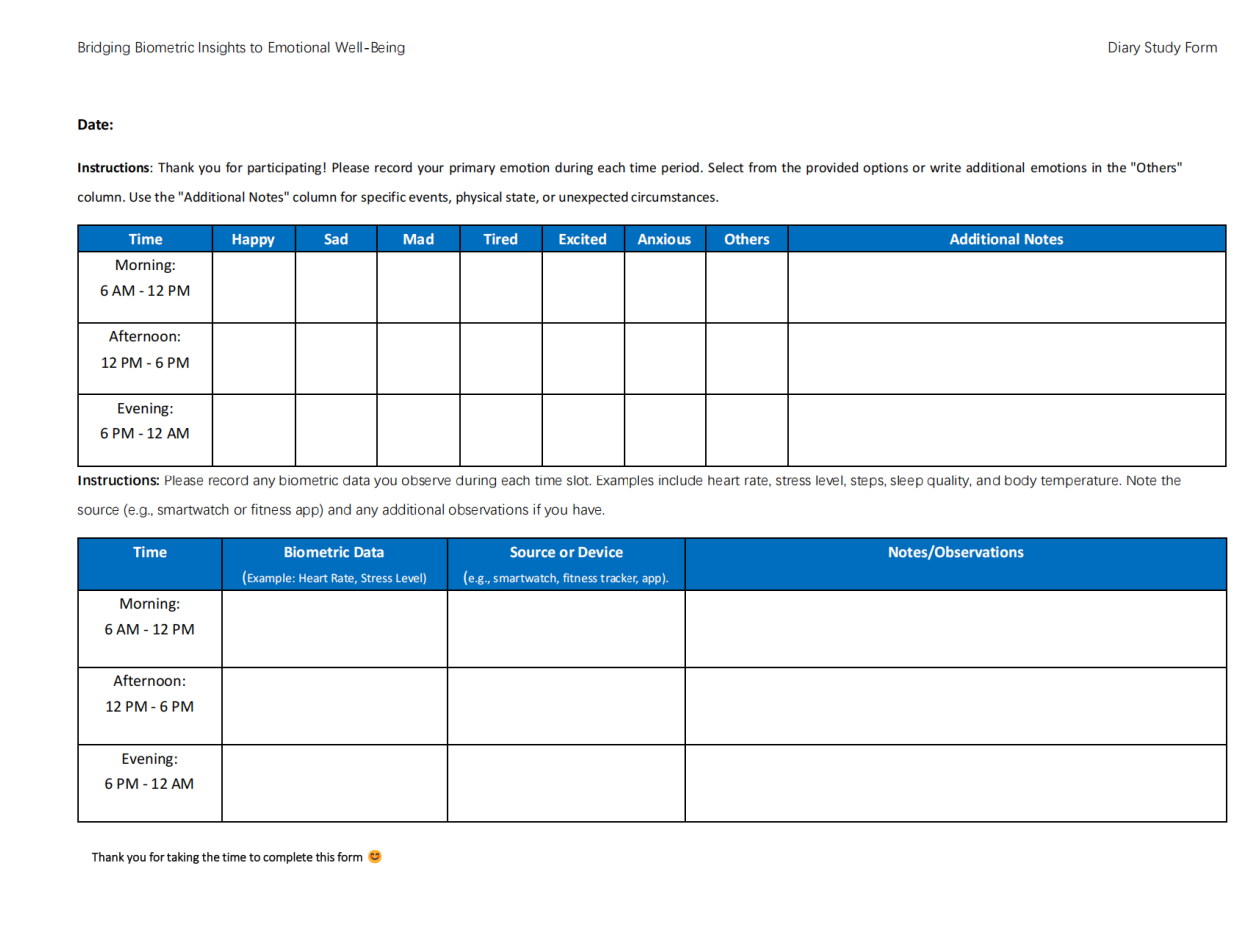
A recurring critique centered on the temporal misalignment of device-generated recommendations. Multiple participants described dismissing notifications during work-related tasks due to perceived incompatibility with situational demands. This feedback highlights systemic limitations in current intervention strategies, particularly their failure to adapt to users’ dynamic cognitive loads and environmental contexts.

These observations collectively underscore opportunities for redesigning feedback mechanisms. Potential improvements include implementing delayed analysis during low-intensity periods and integrating ambient environmental adjustments—approaches that align with embodied interaction principles prioritizing contextual sensitivity over intrusive alerts.

3.1 Participant Research Activity Details

To explore the relationship between emotional well-being and productivity further, I conducted a research activity involving six participants, inspired by methodologies similar to those used by Grassi (2024). Grassi's research has demonstrated the significant impact that awareness of one's own and others' emotional states can have on productivity and well-being in professional

environments (Grassi, 2024). Building on this foundation, participants in my study were asked to complete a one-week diary study to record their emotions, biometric data, and observations, followed by an interview to discuss their experiences. This approach aligns with Grassi's emphasis on the benefits of self-monitoring of emotional and stress states to enhance personal and professional outcomes.



Bridging Biometric Insights to Emotional Well-Being — Diary Study Form

Date:

Instructions: Thank you for participating! Please record your primary emotion during each time period. Select from the provided options or write additional emotions in the "Others" column. Use the "Additional Notes" column for specific events, physical state, or unexpected circumstances.

Time	Happy	Sad	Mad	Tired	Excited	Anxious	Others	Additional Notes
Morning: 6 AM - 12 PM								
Afternoon: 12 PM - 6 PM								
Evening: 6 PM - 12 AM								

Instructions: Please record any biometric data you observe during each time slot. Examples include heart rate, stress level, steps, sleep quality, and body temperature. Note the source (e.g., smartwatch or fitness app) and any additional observations if you have.

Time	Biometric Data (Example: Heart Rate, Stress Level)	Source or Device (e.g., smartwatch, fitness tracker, app).	Notes/Observations
Morning: 6 AM - 12 PM			
Afternoon: 12 PM - 6 PM			
Evening: 6 PM - 12 AM			

Thank you for taking the time to complete this form 😊

Figure 2. Participant's diary study form

The research activities included daily diary entries and a follow-up interview conducted one week after the diary submission. This method was designed to capture both self-reported emotions and physiological responses, enabling a detailed analysis of the interplay between these factors. The diary form, as shown in *Figure 2*, was divided into two sections: the top

section for recording emotional flows and the bottom for biometric data records. This dual-faceted approach is based on the premise that integrating self-reported emotions with biometric data can provide a comprehensive overview of an individual's emotional landscape throughout the day. This is similar to the visualization tool utilized by Grassi (2024) in her studies with software developers.

After the data collection phase, the recorded emotions and biometric data were compared across the same time slots to identify patterns and correlations, following Grassi's (2024) methodology for enhancing emotional awareness through technological tools. This comparison aimed to uncover insights into how biometric indicators and self-reported emotions interact, potentially affecting an individual's productivity and well-being.

3.2 Trends in Biometric Feedback Interpretation

Based on all the participants' interviews after the 7-day diary log session, they mentioned that this research activity helped them actively pay attention to their biometric data. They tended to be more mindful of their mental wellness and had started to self-monitor how their biometric data reveals messages about their feelings. During the interviews, as we reviewed their diary study forms day by day, we began to notice trends between heart rates and emotions.

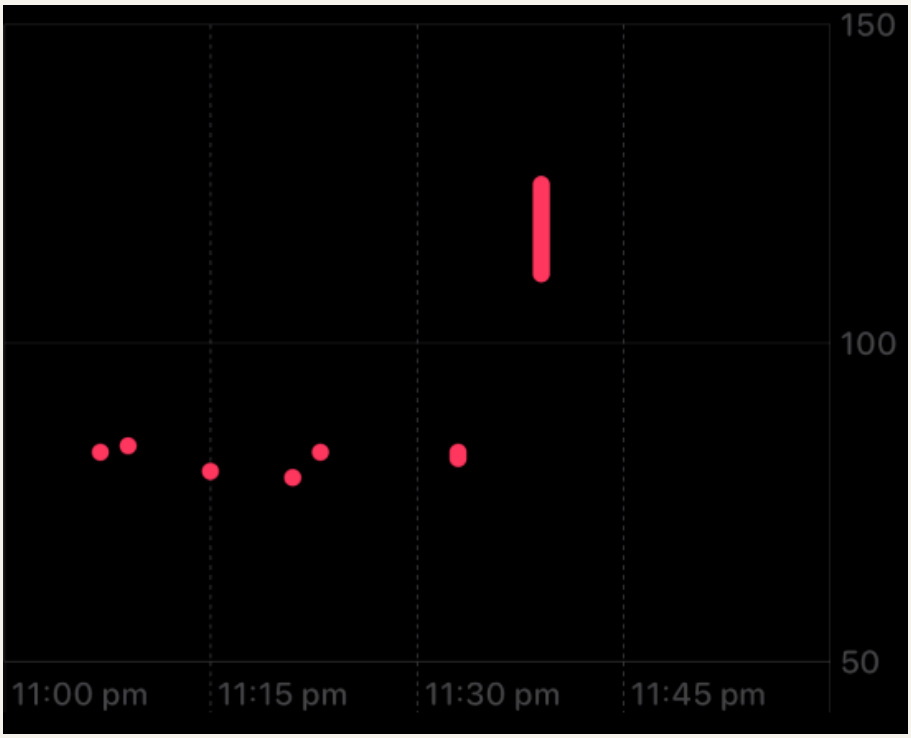


Figure 3. Heart Rate graph in beats per minute (BPM) for the person who does not engage in regular workouts

Figure 3 shows the heart rate data (in beats per minute, BPM) for a participant who does not engage in regular exercise. This graph appears mostly steady, with noticeable spikes whenever the participant undertakes even mild physical activity or experiences strong emotions. Participants in this group observed that when their heart rate suddenly increased, they were often in a notably positive mood such as feeling excited or energetic, or they were feeling anxious or angry. A closer look at daily diary entries confirmed that emotional peaks, especially anxiety, frequently coincided with a distinct rise in hourly heart rate.

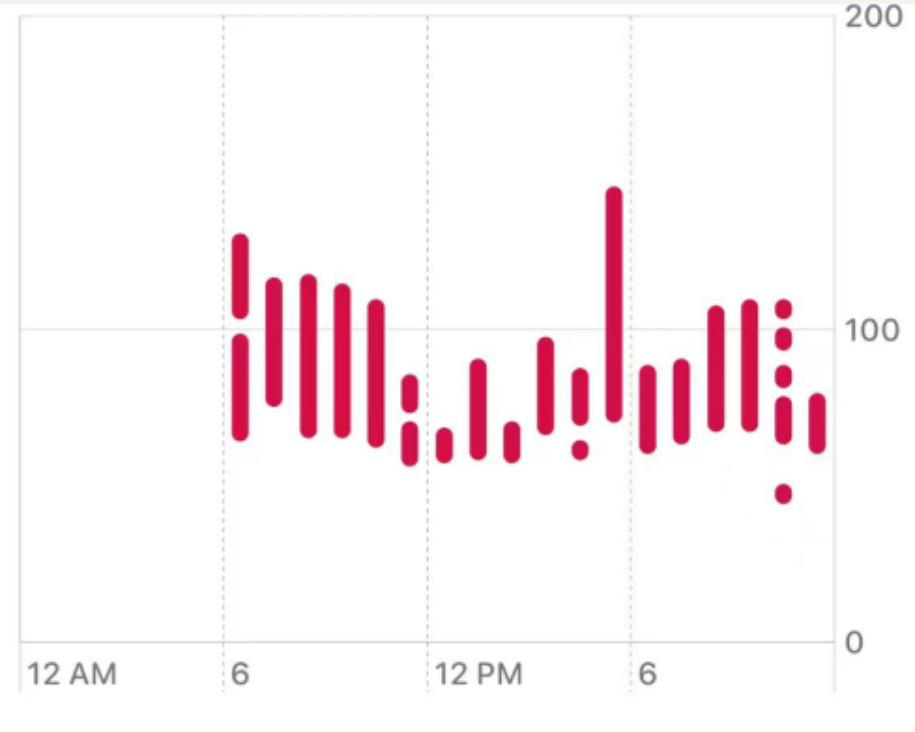


Figure 4. Heart Rate graph in beats per minute (BPM) for the person who engages in regular workouts

Figure 4 presents the heart rate data for a participant who works out regularly. Here, the overall baseline heart rate is higher, and the daily BPM range is broader because of workout sessions and improved cardio fitness. As a result, distinguishing emotional fluctuations from purely physical exertion is more difficult. Based on diary and interview responses, it appears that external factors, particularly noise, strongly influenced emotional responses in this group. Since their heart rate was elevated more frequently by exercise, participants highlighted how important it was to connect heart rate readings to contextual details, such as the time of day or specific stress triggers, in order to interpret changes in mood accurately.

3.3 Influence of Physical and Digital Spaces on User Engagement

Participants mentioned that their close friends or partners influence their emotions, as well as the progress of events or activities. If one needs to chase a deadline, the person can seem to be good but internally they would be anxious. However, the uncontrollable external factors could worsen the anxiety and lead to more emotion drops. If they were at home, they usually exhibited a calmer heart rate, as they were already in their preferred resting place. Home settings are preset to their preference, and can be adjusted anytime. There are situations where people do feel uncomfortable but was not sure what to change to make the space more suitable, and this is the opportunity space for a smart assistantship.

Furthermore, one participant highlighted a routine habit of morning coffee consumption, which noticeably altered their heart rate. Caffeine acts as a powerful external influence, energizing participants and enhancing productivity, yet it also has the potential to skew emotional perceptions.

3.4 Research Activity Feedback

All participants wore their wearable devices more often than usual during this 7-day period. They expressed that they found this activity insightful, especially when they reviewed their data with me during the interview sessions. They all discovered some personal emotional trends. Several participants felt that this activity itself is a mindful practice, particularly for those who chose to complete the entire form all at once at night, viewing it as more of a self-reflection journey.

Design concept

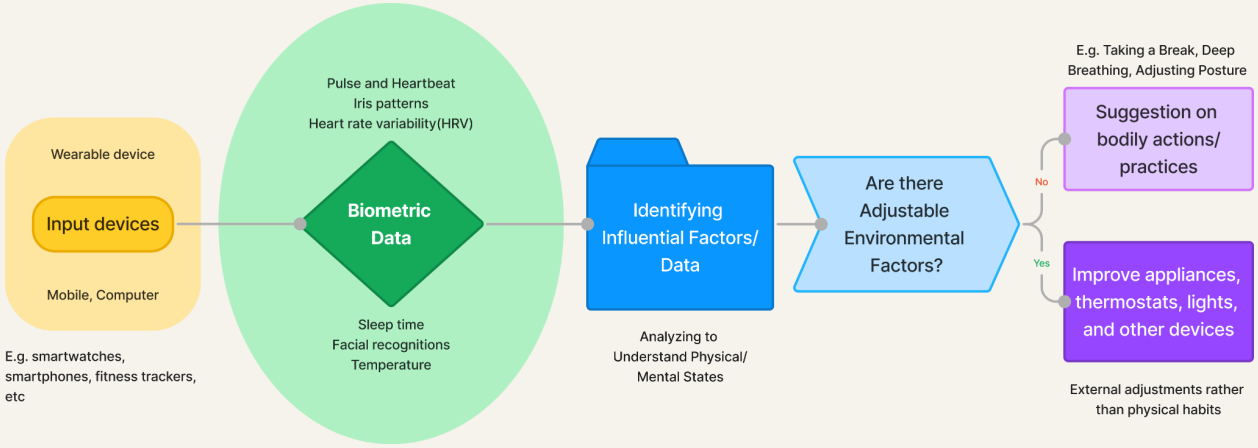


Figure 5. Concept system explanation

Drawing on all of these various data sources: my autoethnography, my studio work, and the participant research – I then began to think through what designed outcome might best be able to provide a mechanism to bring these various insights together. In this next section I present my initial design.

As shown in *Figure 5*, the process begins with collecting biometric data from input devices such as smartwatches, smartphones, and fitness trackers. This data is then analyzed to identify influential factors affecting the user's well-being. The system determines whether the detected factors are linked to adjustable external environmental conditions. This step is essential as if it is in a controllable environment such as home, and one or some factor is causing the emotional turbulence, the designed system will then suggest an adjustment on the affecting factors (such as adjusting thermostats) to improve the overall feeling. If it is non-adjustable such as it is in a public space, then the designed system will provide some simple suggestions (such as mindful practices like taking deep breaths) that will improve the overall feeling. The principle ensures the

system provides adaptable and context-sensitive interventions. By integrating both physical surroundings and digital interactions into the user experience.

Instead of presenting numerical data straight to users, the system processes real-time biometric signals and provides responses that help users develop a stronger awareness of their own physiological states. Not only that, it helps suggest appropriate adjustments to better support mental well-being. This approach shifts away from passive data collection and emphasizes meaningful interaction with personal information.

Design Outputs

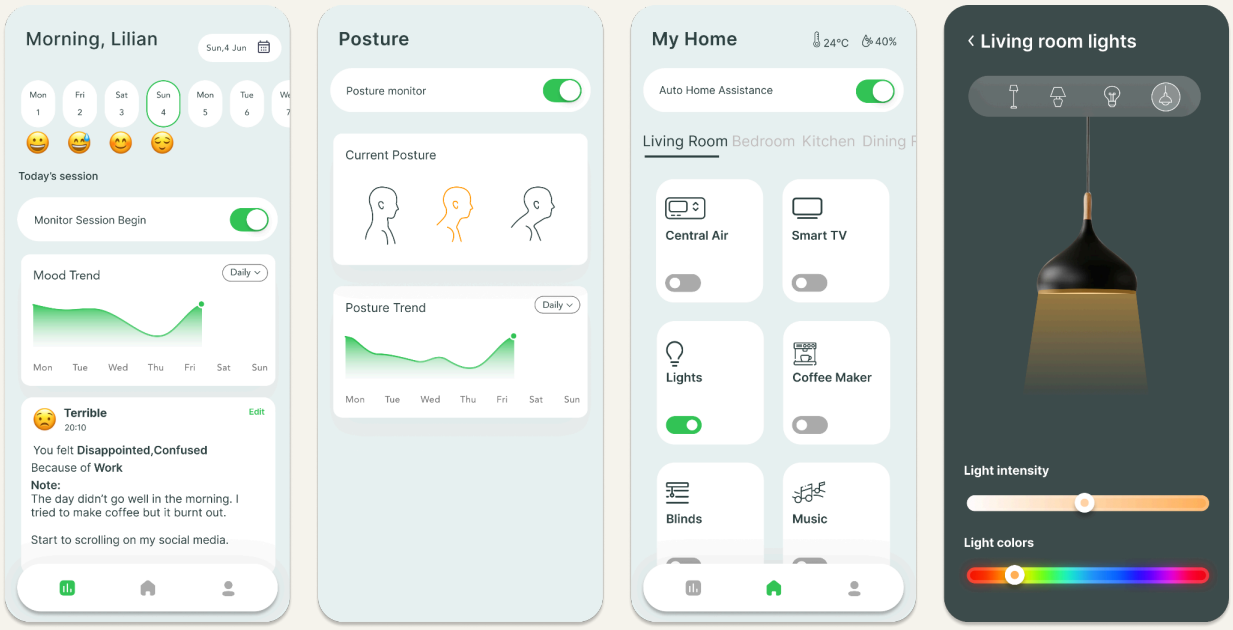


Figure 6. Mobile application mockups

To embody the system described above, a mobile application prototype was created (Figure 6). The prototype has five main features, each accessible from a centralized home screen:

1. **Daily Mood Overview**

   At the top of the home screen, the application displays a simple calendar-based visualization of the user's moods over time. Each day is color-coded or labeled with a concise emotional marker (e.g., calm, stressed, anxious). This quick overview helps users observe their longer-term patterns, rather than focusing solely on momentary data.

2. **Eye-Tracking & Smart Assistant Toggle**

   Below the mood overview is a switch that allows users to turn on "monitoring sessions." Once toggled on—and with user permission—the application integrates with a device's camera and biometric sensors (e.g., heart rate monitor). A built-in assistant then looks for emotional or physiological changes that correlate with the user's on-screen content. For example, if the user's heart rate spikes while scrolling through certain emails or news feeds, the assistant can gently prompt them to pause and take a break.

3. **Emotional Entry & Log**

   Users can capture their current emotional state manually or let the smart assistant generate entries automatically during an active monitoring session. The logs blend self-reported feelings with sensor data to add context; for instance, an entry might note "increased heart rate detected" alongside a user-tagged emotion of "anxiety" or "frustration."

4. **Posture & Movement Reminders**

   A separate interface tracks real-time posture or movement data if allowed by the user's wearable or smartphone sensors (e.g., accelerometer, gyroscope). When it detects

slouching, extended inactivity, or other risk factors (like staring at a screen for too long), the system issues a polite notification. This feature aims to mitigate discomfort and potential emotional tension by encouraging small corrective actions—such as sitting upright or taking a brief walk.

5. **Smart Home Controls**

   For users in an environment with adjustable features (e.g., connected lighting, thermostats, speakers), a simple interface provides quick access to those settings. The system might recommend dimming lights if the user's heart rate remains elevated in the evening or suggest soothing background music if data indicates ongoing stress. If the user grants permission, these adjustments can be triggered automatically based on biometric inputs (e.g., lowering room temperature when the user's heart rate suggests discomfort).

Additional Prototype Demonstration

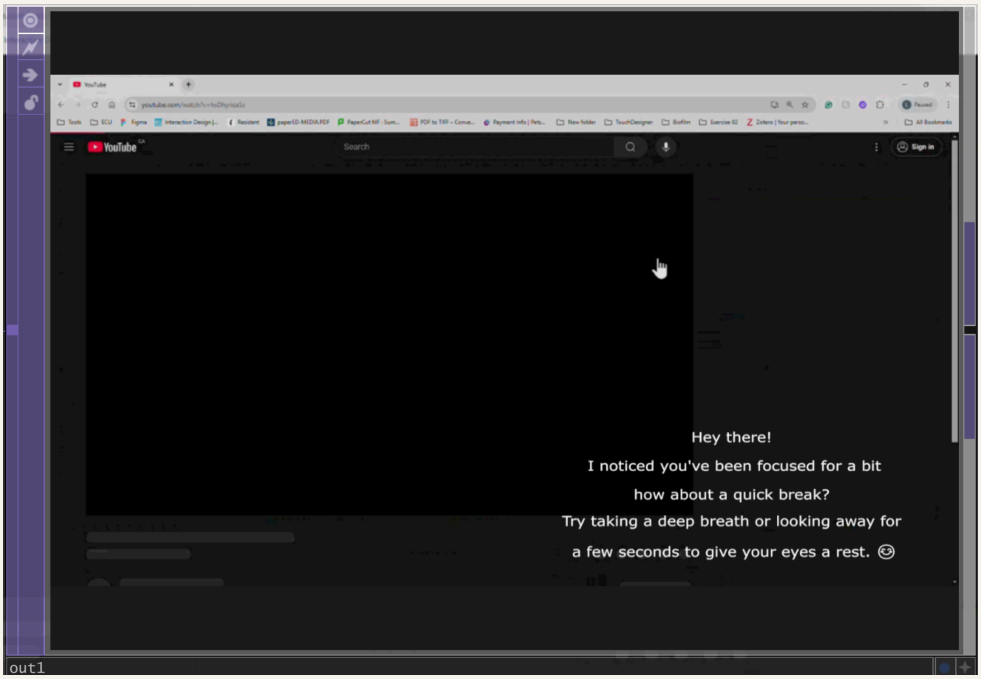


Figure 7. Touch designer interactive prototype screenshot

To further illustrate how eye-tracking can inform real-time notifications, a *TouchDesigner* prototype (Figure 7) was developed. This piece demonstrates how subtle physiological or behavioral cues—such as lingering eye focus on a specific application window—can automatically trigger context-sensitive messages. For instance, if the system detects a user's prolonged gaze on a high-stress email thread or news article, it may display a gentle notification suggesting a brief visual break (e.g., looking away, closing the stressful content, or transitioning to a more calming activity).

Through this prototype, the goal is to highlight how new interaction modalities (like eye-tracking) can be integrated into an ambient notification system that remains both supportive and

non-intrusive. The user remains in control: the application only monitors and responds to eye movement with explicit permission, aligning with privacy considerations while enriching the system's capacity to identify potential stressors in real time.

Contributions and Future Applications

My research studied both external and internal factors that might cause emotional flow. Based on different situations, my design concept will output suggestions to best fit. Tracking various biometric data will provide a more accurate analysis that people may not have explored before. Ethically, the design system will offer options for users to choose when to start giving permission for the design to extract their data for monitoring.

It will also benefit people who are actively monitoring their body and psychological health by making the monitoring process more accessible. For instance, someone experiencing increased stress might notice patterns in their heart rate and sleep quality data, prompting them to seek professional advice. They can then present this data to psychologists or counseling services, facilitating more informed discussions and targeted treatment plans based on their specific biometric trends.

Our perceptions of well-being can sometimes be deceptive, as our bodies convey more objective information through biometric markers. As Blanchflower and Bryson (2022) highlight,

research suggests that biometric markers of well-being, when used alongside self-reported measures, provide a more reliable assessment because 'self-reports of wellbeing can be unreliable' (p. 9), referencing earlier studies (Shedler et al., 1993; Johnston et al., 2009; Lauderdale & Rathouz, 2003). The research undertaken in this thesis has shown how people could enhance individuals' ability to monitor their own well-being effectively. My design combines quantified self-study with biometric data analysis and I think there are more options available to us in terms of using this approach moving forward to study our own bodies as still we seem to know very little about how they work.

Limitations

Sample Size and Participant Diversity

The participant studies in this thesis involved a small cohort and lacked broad demographic representation. As a result, findings may not generalize across different ages, cultural backgrounds, or levels of tech-savviness. Future research should recruit larger and more diverse samples to validate the robustness of the interaction concepts.

Biometric Data Scope

This work focused primarily on heart rate and step count, offering a narrow view of users' physiological states. Incorporating additional signals—such as skin conductance, respiration rate, and sleep metrics—would enable richer correlations between bodily responses and emotional well-being.

Technical Implementation Constraints

As a designer without formal computer-science training, prototype development relied on third-party tools and simplified models. Ensuring reliable real-time data processing, seamless device interoperability, and accurate AI-driven pattern recognition will require close collaboration with software engineers and data scientists.

Study Duration and Longitudinal Insights

Data collection was limited to a one-week diary study and short autoethnography. Longitudinal research over several months is necessary to determine whether users sustain new habits, how self-reported emotional logs evolve, and if biometric–emotion mappings remain consistent over time.

Reliability of Self-Report Measures

While diary entries provide valuable contextual insights, self-report diaries can sometimes be unreliable due to recall bias, social desirability effects, or inconsistent logging habits. Future studies should complement self-reports with passive sensing or ecological momentary assessment to improve data accuracy.

Contextual and Environmental Variability

Biometric signals and emotional states are highly sensitive to context—ambient noise, social interactions, and daily routines can all influence outcomes. Future iterations should integrate richer environmental sensing (e.g., geolocation, ambient sound levels) and adaptive machine-learning models capable of interpreting these contextual variables.

Conclusion

This research advances our understanding of how real-time biometric feedback can enhance mental wellness through interaction design. By integrating physical and digital environments, this study illuminates the role of embodied interaction in making biometric data actionable and relatable, thus fostering deeper self-awareness and emotional self-regulation.

Throughout the research, several significant findings emerged. First, the intuitive presentation of biometric data through user-centered design prototypes enabled participants to connect more meaningfully with their physical and emotional states. The qualitative interviews revealed that this approach not only improved participants' awareness of their mental states but also encouraged the adoption of healthier behaviors based on these insights.

However, the study recognizes several critical limitations—including the small sample size, narrow range of biometric signals, short study duration, reliance on simplified technical

implementations, and the inherent unreliability of self-report measures. Ethical considerations around user privacy, autonomy, and data transparency also highlight the necessity for careful and sensitive design practices. Addressing these challenges will require future studies to engage larger, diverse participant groups, expand biometric indicators, incorporate richer environmental contexts, and pursue multidisciplinary collaborations.

Lessons learned from this research emphasize the importance of considering both the physical environment and the design of digital interfaces in promoting effective engagement with health technologies. Future applications of this work could explore adaptive interventions that respond in real-time to users' emotional and physical changes, potentially offering more personalized and timely support for mental wellness.

In conclusion, this thesis contributes to the fields of interaction design and health informatics by demonstrating how technology can bridge the gap between human emotions and digital experiences. As we continue to explore this promising area, the insights gained here will hopefully inform the design of next-generation wellness technologies that prioritize empathetic and user-informed interactions.

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