Worn out:

Exploring the Phenomenon

of Mental Health Wearable Devices

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Table of Contents

Abstract

"Worn out: Exploring the Phenomenon of Mental Health Wearable Devices" is a dissertation based on qualitative research that seeks to understand how the contemporary western understanding of mental well-being and mental ill health is forged through the use of technological interventions such as wearable devices. I attempt to untangle the complex interactions between researchers, device creators, devices, multi-national corporations, mental health practitioners and device users who inhabit a posthuman cyborg world where devices serve as prostheses for supposedly dysfunctional minds. I examine how users ascribe meaning to the physiological artefacts of emotion captured by wearable devices, to construct a sense of self, mediate a sense of control, agency and normativity based on their interaction with these devices. I also explore the influencing factors that drive the creation of algorithms that attempt to determine hitherto elusive objective baselines for states of being that were previously considered subjective and variable. Is the seeming reductionism of a range of meanings of the physiological signs of distress read by devices a cause for concern? Does the use of these devices prove therapeutic or are they being used as another means of socialization? These are the questions I seek to answer through the examination of the phenomenon of individual and corporate mental health wearable devices.

Declaration

This thesis is my own work and has not been submitted for a higher degree research to any other university or institution. All sources used have been acknowledged.

Ethics committee approval has been obtained from Macquarie University (Reference number: 5201700858)

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I'm grateful to all my interlocutors, particularly those who struggle with invisible mental health conditions, for agreeing to speak with me, and allowing me the privilege of witnessing their pain. Thank you, and I hope, alongside you, that diverse ways of experiencing the world will not come at the price of personal depletion in the future.

I'm grateful, most of all, to my friends and family who have listened to me for hours as I have processed the ideas that I have written about. Finally, I'd like to thank my daughter Anoushka who has tolerated a partially present mother during the time that I have worked on this project. Thank you for your sacrifice. I'm done, for now!

- Pavi

Introduction

> *One of the employees at the companies we trialled our device with had said in the screener that he wasn't stressed, but the device had flagged that he was. When we asked him later what was going on, he said he was afraid he would lose his job if he had been honest on the screener. So, we already have a bunch of clients using these with their employees. It's going to help these companies save thousands of dollars.*
>
> - *Ben, chief executive at a mental health wearable device company.*

Digital sensing and monitoring wearable devices are amongst the latest "hybrid" among technologies that are changing the way that the self is conceptualised for citizens in a digital world, where experience that was hitherto limited to internal and intangible human mental worlds has become mediated through instruments (Jadad, Fandino, & Lennox, 2015). The last few years have seen a marked increase in the marketing of wearable devices for improved fitness and health, including mental health. With over 450 million people suffering from anxiety or depressive disorders worldwide, mental health issues comprise 13% of the total disease burden worldwide (Tomlinson, 2013). The unequal global distribution of resources to adequately address the problem means that the quest for creative solutions to diagnose and treat mood disorders has become one of the main strategies of global mental health programmes led by governments and global health organisations (Donker and Kleiboer 2018, WHO 2013).

Within a global capitalist neoliberal economy, mental wellness and illness are frequently measured in monetary terms, whether in terms of lost productivity owing to a suboptimal mental state, associated higher medical costs, or reduced life span (Trautmann, Rehm, & Wittchen, 2016). Urban work environments trigger, and often require, employees to remain hyper-alert and function in a state of constant stress to be efficient and perform optimally. Riding on the popularity of wellness trends, the hashtag culture around mental health

awareness surrounding conditions such as anxiety and depression has created the perfect environment for the creation and marketing of tools that claim to alleviate a range of ailments of the mind, ranging from everyday stress to mental disorders such as schizophrenia. This presents an opportunity for corporatized solutions targeted at individuals seeking to improve their sense of mental wellbeing.

The increase in mental health challenges worldwide, the surveillance of mental ill health as a threat to capitalist productivity, and the continued failure of biomedical models of care have created the space for innovative solutions such as wearable devices for mental health interventions. A range of wearable devices is now available to allow individuals to track, measure and quantify a variety of experiences – from their food intake to the levels of stress they experience. The ubiquitous potential of wearable devices allows for unprecedented insight into bodily performance across a myriad of measures – from diet and sleep to movement and arousal states (Ruckenstein and Schüll 2017).

Mental health wearable devices are designed on the premise that physiological markers such as heart rhythms and breath rates can be used to map stress states as these physiological indicators of increased bodily stress responses are universal, and can therefore, be valuable in preventing increased levels of stress (Chandrashekar 2018). Some devices also integrate these physiological markers with data about environmental and emotional context and content that surround and evoke bodily responses at specific moments in time. Physiological markers such as increased heart rate, insomnia or chronic exhaustion, or behaviours such as reduced concentration and attention are often interpreted as symptoms of anxiety, depression or related mood disorders. The ability of technologies such as smartphone apps and wearable devices to provide useful information that might be integrated into a mental health treatment plan is an additional advantage for people who are seeking professional help as well as for their care providers.

In measuring physiological expressions of emotional experience, wearable mental health devices extend trends already well-established within clinical research and therapeutic practice. Psychotherapeutic practice over the last decade has primarily been structured around therapeutic models in which a person cognitises and then consciously reframes thought, as is evident within Cognitive Behaviour Therapy (CBT). These therapeutic models assume that undesirable behaviour can be shifted when the individual identifies the thought pattern that is at the root of the behaviour in question (Marzano, Bardill et al. 2015). CBT efficacy hinges on a person's ability to draw attention to their embodied experience of emotion on a visceral level, such as by identifying quickened breathing, palpitations or clenching fists. The practice of self-identifying these bodily responses to perceived threats or anxiety-provoking situations is aimed at making the experience of negative emotional experiences a cognitive task. In theory, this shifts how an individual's brain and by extension, their body is responding to a situation. This shift from redirecting stimulus from the parasympathetic nervous system to the sympathetic nervous system is the premise upon which mental health wearable devices that offer prompts to users based on increased stress are built.

The development of mass-scale wearable mental health devices raises a wide range of questions not only about the efficacy and desirability of such devices but also about the possible ways that such devices might transform the ways that society perceives and responds to mental health and ill health. My project employs ethnographic methods to investigate how mental health wearable devices help individuals to understand and navigate stress, anxiety and depression, and to analyse how these meanings are co-constructed by the corporations, scientists and other actors that create these devices. This research examines how wearable devices transform emotional experience into quantified data, and how we then ascribe meaning to the artefacts of emotion that are captured by wearable devices. It considers how we draw out the need for individual action or responsibility from these inputs, and what the

implications of wearable devices might be for surveillance, risk profiling, and clinical practice.

Background and approach

The world of wearable mental health devices piqued my curiosity when I saw an ad online for a device that claimed to assist people diagnosed with anxiety. In the world of algorithms, every thought as translated into a search query triggers a response from the online world within which people are continually mediating, negotiating and constructing their identities. I assumed there would be some regulation around the data I was generating when I spoke to a friend over my mobile phone about the help available to people who found traditional psychological services inadequate. Apparently not. I discovered that after I had that conversation, the ads that were promoted to me on social media ranged from services for private psychologists' practices in Sydney, to shopping, which if the algorithm's deduction was accurate, meant that shopping was a common coping mechanism adopted by people who fit my profile – the chronically anxious female adult in a big city.

None of these profile markers or virtual qualitative identifiers were protected by law (Wachter and Mittelstadt 2018). My social media profile, the apps I had integrated with it, the online support groups I was part of, the causes I supported, were all valuable data points which could be analysed by a system that was designed to sell, irrespective of whether the service being sold was retail therapy or psychological therapy. These markers could be accessed through the breadcrumbs and digital footprint I left, and through the things I spoke about, which were curated by my phone's microphone that was always tuned in, until I discovered this fact and turned it off. The places I visited tracked by the GPS tracker were an unmasked revelation of the details of my daily life that when pieced together offered up incredible potential to a marketing professional who had a product or service to sell, with the

promise of easing the discontent evident through the keywords I used in my conversations, searches and other virtual interactions (Krieg, Berning et al. 2017).

As someone who is autistic and has been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), and other secondary mental health mood disorder labels like anxiety and depression, I spend as much time finding and interacting with other sufferers online as I do navigating my responsibilities in the real world. I was keen to explore the option of devices that promised to improve my self-awareness and enable me to function better in social systems designed around productivity and profitability. The world of neurodiversity pride is a constant tightrope walk between two opposing narratives: one that is built around strengths, and the other, around deficits; while also inhabiting the role of performing one's disabilities to access support services. Within this context, online communities are alternative spaces where mental health sufferers often unmask themselves to assist each other in navigating real world situations that feel atypical and alien to neurodiverse sufferers (Ortega 2009). To neurodiverse individuals, and mental health sufferers, technological products such as mental health wearable devices present the promise of relief from the symptoms of the distractions and disabilities that impede optimal functionality in a neurotypical world.

What was curious to me was that the reviews of these products in the online communities that I was part of swung between one extreme and the other. Users either loved these devices or hated them; there was very little middle ground. Further, I discovered not just that there were a handful of devices available for sale to mental health consumers, but that there were also entire organisations using these devices with employees to aid them in their wellness journeys in the hope that the cumulative effect would translate into increased economic output and, therefore, improved profitability for organisations (Chisholm, Sweeny et al. 2016).

Early in my ethnographic research, I had a conversation with Ben, the CEO of a mental health technology company in Australia, who introduced me to a world where algorithms had transformed the concept of human resource management. Moving beyond electronic employee identity cards, in this world, wearable devices had come to occupy a gap that simpler tools could no longer fill for the bottom-line-driven organisation, where profitability was the ultimate measure of success. With increased pressure on higher management to ensure that company profitability remained high in the face of the shifting winds of global economics, organisations have been attempting to streamline their processes, and become leaner in the way they operate and utilise human resources (WHO, 2007). The weakest link has been the price that organisations pay by way of reduced reputation, increased legal liability and a lower financial profit resulting from human error and often by extension, the sociocultural factors that create conditions that reduce the quality of life enjoyed by workers.

Methodology and conceptual framework

This research studies multiple nodes in the system that makes up the increasingly popular phenomenon of wearable mental health devices. I used a combination of ethnographic and qualitative methods to address this topic. I conducted 20 semi-structured interviews with both creators and users of these devices. These included interviews with senior executives of the corporations that develop devices, the developers of the technology, the scientists who create these devices and validate the mechanisms that dictate how the devices collect and interpret data, the mental health practitioners who recommend the use of these devices, the individuals who use these devices, and individuals who are involved in informing government policy around the deployment and use of such devices in mental health initiatives.

I also carried out participant observation at an international conference where contemporary narratives around mental health technology are actively created. I carried out online participant observation and analysed over 5000 publicly-available online interactions within device user communities. Online ethnography allowed me to observe how users interact with one another, share their experiences as sufferers of mental illness and users of devices, exchange information about devices, and buy or opt-into or out-of the use of these devices. I carried out this observation with informed consent from the device manufacturers who run these closed online forums, and participants within these online forums were informed of my presence as a researcher. I have also been a participant observer within online groups in the public domain where device users congregate to discuss their usage patterns and challenges. I have employed "more-than-human ethnographic methods" to synthesize the discourses and narratives created by users online. I analysed the written and visual content generated online, the data maps around sentiment analysis and the data visualisation that was shared with me by users, and device creators (Kozinets, Scaraboto et al. 2018). I have also supplemented my fieldwork with discourse analysis applied to the marketing material and reports by the technology companies whose devices and user base I investigated.

The principal argument I present in my thesis is that the transformation of emotion and distress into a measurable artefact cements the biomedical reframing of human emotion and mental health as primarily a physical event, rather than a complex psychosocially mediated experience. I present how individuals and groups of users interact with their mental health wearable devices to generate these artefacts of emotion. I explore the phenomenon of the use of mental health wearable devices within the framework of Donna Haraway's conceptualisation of the cyborg as an entity manifested through a collective affinity by individuals to a system of ideas. Within the scope of this project, I have also integrated Andy Clark's theory of the extended mind where he argues that human beings use technologies to

extend their mental capacity. I propose the idea of a 'mentally-well digital cyborg,' defined as a person who mediates and modifies the experience of their inner world through the use of mental health wearable devices. Further, the usage of these devices is influenced by a shared collective understanding of mental wellness that is constructed through a performance of an ability to function within the material worlds that individuals inhabit.

Qualitative research with researchers, data scientists, solution architects, corporate senior management, psychologists, patients, and device users has allowed me a glimpse into how the phenomenon of the digital cyborg is created, perpetuated and maintained consciously by individuals and intersubjectively as well (Lupton 2015). Witnessing the translation of the narrative of a mental health crisis broken down into action plans and algorithms located within human networks, government and corporate manifestos, has been enlightening. This thesis is the product of not just ethnography informed by direct observation and interviews but is also informed by the silences I have encountered while attempting to fill the gaps that I identified in existing knowledge. The executives and scientists who agreed to speak with me, and then didn't respond any more, the researchers who declined to speak with me citing protocol that protected proprietary technology, the individuals who were ambiguous about their experiences with the technology, have informed this thesis in equal measure as those who have let me witness the evolution of the idea of a new and improved mentally resilient cyborg – a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction (Haraway 2000) – superpowered to prevent it from breaking down and self-destructing.

In chapter one of my dissertation, I present the perspectives of organisation executives, researchers, data analysts, device developers and creators of mental health wearable devices. I aim to tease out the process and philosophies that drive the enterprise of encoding the digital sensing and calibration of mental health. Through this chapter, I build on

existing critiques of the neoliberalism capitalist influence on the medicalisation of health and offer vignettes of how the discourse of physiological mental health is co-constructed structurally. Through chapter two, I examine the experiences of individual and groups of users of mental health wearable devices, to understand their motivations, and how the use of these devices transform their ideas of selfhood, and their experience of mental distress, and wellbeing. I present the role that communities of users play in shaping a collective understanding of mental ill health and explore the impact that these dynamics have on care practices among individuals who use mental health wearable devices. In chapter three, I attempt to understand how the quantified-self movement extends to mental health wearable device users and the manner in which intangible and complex psycho-social phenomena of distress and mental illness are transformed into artefacts of emotion that can be measured, and at least re-framed, if not controlled. I consider the implications of the use of these devices for clinicians, and mental health practitioners, and attempt to understand how the use of mental health wearable devices might signal a distribution and democratisation of seemingly authoritative mental health care tools.

All my participants have been anonymised to protect their identities and the identities of the organisations they are employed by or represent. I have used pseudonyms for the names of the devices, organisations and the conference titles I refer to in this thesis. I declare that I have no conflict of interest in producing this thesis.

This dissertation is part of the requirements for a Master's by Research in Anthropology at Macquarie University and was funded by the Research Training Pathway Australian government scholarship. My project was based on five months of fieldwork and the thesis was written over a period of six months, and is limited in its scope because of the short timeframe allotted to the completion of this research project.

Literature Review

In this chapter, I review foundational ideas that form the scaffold for my arguments and findings around how mental health wearable devices play a role in aiding the disembodiment of distress. This review brings together theoretical contributions of several social scientists, psychologists, human-computer interaction experts, and philosophers. A wide range of studies explore the philosophy that undergirds the development of self-tracking technologies such as wearable devices, and the resultant human behavioural practices that these technologies give rise to. This body of research furthers ideas around the medicalisation of health and the human mind, and adds to the body of critical medical anthropological literature which has interrogated ideas of structural psychological categories (Scheper-Hughes, 1992). Minna Ruckenstein and Deborah Lupton have specifically examined the idea of medical consumerism and how the project of the "datafication" of health is a by-product of a larger neoliberal capitalist socio-economic environment where self-regulation is practiced as a social norm, and ideas of well-being and ill-health are composed within the "laboratory of the self" (Kristensen & Ruckenstein, 2018; Deborah Lupton, 2018; Ruckenstein & Schüll, 2017). Drawing on Foucault's framework of governmentality and control exercised through biopower wherein bodies are shaped and controlled through an internalisation of ideas of responsibility, Lupton (1997, 2015), Williamson (2015), and Ruckenstein and Schüll (2017) examine the process through which practices such as self-tracking and personal analytics aid the production of knowledge that eventuates in the phenomenon of an ideal, responsible and optimized citizen within a digital utopia. Henderson and Peterson (2002) discuss how market forces offer a further impetus for the solidification of notions of wellness beyond the subjective experience of individuals.

Roy D'Andrade and Strauss's (1992) seminal work on how cognition and human mental phenomena are culturally constituted posits the idea that human experience and

perception are shaped by cultural schemas and shared social understandings of notions of selfhood and experience. D'Andrade's arguments offer the lens through which I present my ideas through chapters One and Two around notions of self, and experience of the self and standards of achievement as transformed and experienced cognitively. Further, Donna Haraway's "cyborg manifesto" (2006) presents the idea that an assemblage of human and non-human entities, and a physical and intangible containment of consciousness, gives rise to a hybrid posthuman mind. Haraway's ideas are demonstrated in the blurring of experience of internal phenomena that several of my interlocutors displayed – where the wearables that they used mediated their sense of self, which provided a feedback that influenced how they understood and engaged with their own ideas of selfhood.

Literature around the Quantified Self and self-knowledge through measurement has been examined by social scientists such as Nikolas Rose (2018) within the paradigm of psychiatry. Ideas of human normality as defined through affect, whether positive or negative, and the implications that these notions have upon how individuals seek out mental health intervention forms the basis of my argument in chapter three. The rise of new diagnostic technologies that offer concrete and tangible images that externalise inner phenomena and attempt to identify markers of mental ill health has been problematised by the work of Rose and Joseph Dumit (2004). Further, the attempt to identify and anchor within the human brain a biological basis for non-conforming human behaviour and negative emotional events is explored by Rose and others to provide a contemporary comment on developments within psychiatry (Aicardi, Reinsborough, & Rose, 2018). The interplay of symptomatic or asymptomatic conditions writ upon the brain, as it were, are showcased within material culture and what the images borne of this specific culture such as PET scans and MRI imagery symbolises (Dumit, 2004). This process offers a parallel to my central argument around the construction of a therapeutic emotional alter – or "artefacts of emotion" – that

mental health wearable devices present to users. The role that material culture plays in the project of self-improvement and mental health and how notions of pathology, responsibility, and treatment play out for various individuals and groups is illustrated by the ethnographic case studies that I present in this thesis (McGrath, Reavey, & place, 2013; Tilley, Keane, Kuechler, Rowlands, & Spyer, 2006)

Rose's work also offers a scaffold to create a shift away from a binary argument that traditional critical medical anthropological approaches have presented, focusing on the governmentality of digital health technologies. The benefits that users of mental health wearable devices accrue from the integration of these devices into their lives, while impacting their ideas of self in profound ways, also presents options for the democratisation and personalisation of knowledge, hitherto contained and administered centrally, through bodies of authority and structural power. The adoption and transformation of psychological knowledge to create alternative or fluid understandings of selfhood mark the culture that is common to all the virtual mental health wearable user communities I engaged with (Bennett & Robards, 2014).

While this literature review is not exhaustive, I have attempted to offer a sketch of the primary theoretical pillars upon which I build the main arguments presented in the following chapters of my thesis.

Chapter 1: Producing artefacts of emotion: the production and regulation of mental health wearable devices

The WHO estimates that a quarter of the world's population struggles with mental health challenges (WHO, 2013). Medical anthropologists have examined this complex global health problem to analyse the intersections between socio-economic and cultural determinants of mental health outcomes across diverse population groups (J. J. G. h. a. Clark, 2014). The categories of mental health disorders set out in diagnostic manuals such as the DSM and ICD have come to inform not only therapeutic practice, but also the global urban public understanding of human behaviour mapped against ideas of typicality and atypicality (Bentall, 1999). The WHO guidelines define mental health as the ability of an individual to function within his or her social group in the face of daily stressors. The boundary that demarcates health from ill health is the use of the term "normal", which in the WHO guidelines indicates a broad definition that does not clarify what is considered normal stress. The mental health wellness wearables industry reflects these definitions of mental wellness and ill health and encodes categories such as stress into devices. The point of deviation, however, is the further delineation of disorders which are clinically diagnosed through subjective assessments. Mental health wearable devices, while avoiding clinical diagnostic labels to ensure that devices are classified and regulated as consumer devices rather than medical devices, reflect and extend the categories laid out by the ICD and DSM (Hiremath et al. 2014).

Within a social context that is shaped by discourses around normativity and optimally-functioning minds and bodies, the fourth industrial revolution has played a major role in the changing working and living conditions within urban environments that have in turn resulted in unprecedented levels of daily stress experienced by individuals (Donker & Kleiboer, 2018). The demands of earning a livelihood and sustaining one's health in order to

maintain a high degree of social and individual function and productivity has created an environment where notions of stress, anxiety and depression as pathologized conditions have entered everyday parlance (J. J. G. h. a. Clark, 2014). Within the last five years, workers health and safety regulations within most western nations reflect this sensibility by including mental health within the umbrella of health and wellbeing allowances extended to employees across several organisations governed by labour regulations (Burton & WHO, 2010). The industry that produces wearable mental health devices has emerged through this political economic context, in particular, the demand for consistent employee wellness.

In this chapter, I present how multiple actors approach the construction of categories of mental distress and, in doing so, assign value to a constellation of physiological symptoms that are taken as markers of mental health and ill health. As a result, these actors reframe how mental wellness has previously been understood and experienced within the collective imagination as a subjective experience linked to well-being. Mental wellness and distress are increasingly composed and presented in scientific and popular discourse as a purely biological phenomenon (Contrada & Baum, 2011). I consider the perspectives of organisation executives who are employed to sell, develop or integrate wearable technologies into employee wellness programs, as an extension and application of these biological discourses around wellbeing. I show how expectations of productivity within contemporary capitalist society shape the demand for wearable devices and influence the production of these devices and present the perspectives of device creators and researchers.

The chapter argues that the production of wearable devices involves the translation of the complex psychosocial phenomenon of stress into a measurable tangible factor – so that physiological markers become, what I term, artefacts of emotion. This process is driven by the influence and funding of corporations – whether large biotech companies or small start-ups. I study the process of the commercial and scientific development of mental health

wearable devices and examine how the development process shapes the manner of use and reach of the devices. I present a brief overview of how mental health wearable devices fit into the industry of wearable technology and discuss the degree to which industry regulations apply to these devices, and consequently, what this means for users and for device merchants.

In examining how multiple organisations and researchers develop wearable mental health devices, I demonstrate how the meaning of emotional experience becomes constructed and assigned to physiological markers vis-à-vis established biomedical mental health categories, and in line with consumer demands that are informed by norms around wellness as a social responsibility and socio-economic pressures created by a capitalist neo-liberal system. While historically, discourse around mental illness has been produced as a result of clinical research and therapeutic practice, I argue that the primary driving force behind the move towards a biological anchoring of mental health discourse within wearables industry is economic gain dependent on producing indefatigable humans who have been measured and tuned to deliver maximum efficiency, and who continue to be monitored and self-monitor towards this end. The ethnography below shows that although device manufacturers are motivated by diverse personal agendas and informed by varied scientific and professional backgrounds, that wellness culture and ideas about economic productivity have had a major impact on the development of wearable mental health devices and the shifting understandings of mental illness that are being generated as a result.

The Bioelectric Brain: the motivations and assumptions of device manufacturers

The delegates at the Brain Conglomerate conference in Australia as the year 2017 ended were a couple of hundred scientists, psychologists and government representatives working in the field of neurological and mental health research from around the developed world. This conference attempted to create a collaboration and single platform for individuals and private and public organisations interested in studying the human brain and was the latest

in a series of conferences over the last three years that attempted to create a coherent agenda and narrative surrounding the future of research related to the human brain. At the end of the conference, the scientists and government representatives present read out a document that was drawn up during the conference and named “the brain manifesto”. As part of this ceremony, the delegates chorused their collective intention to “measure, map, image, model, simulate, understand, imitate, diagnose and heal the brain”, which was part of the group’s larger manifesto around research around the human brain.

One of the highlights of the conference was a presentation by Dr Ethan Rogers, an American neuroscientist who was working on developing the brain-related equivalent to the human genome project. The objective of his endeavour was to map every human neuron as it was activated against its function, which Rogers described as “breaking the neural code”. Rogers theorises that this effort will help us understand the ability of every neuron in the brain, to provide a matrix of neural activity versus a matrix of muscle activity. Eventually, the objective of cracking the brain code is to provide a higher degree of predictability around human behaviour when acted upon by an individual’s neural circuitry. Rogers used the analogy of a moving image created on a computer screen:

> Can you figure out what is happening in a movie by looking at one pixel on the screen? The image you see is an emergent property that is dependent on how pixels interact in space and time. By definition, we cannot understand emergent properties. We cannot reduce behaviour to a single data measure, or by looking at individual units. If we are trying to understand emergent properties within neural circuits, we need to take a multidimensional approach and identify the patterns of activity between the units, which are individual neurons. Firstly, we need to develop methods that can measure the activity of every neuron. This will then allow us to alter the activity of every neuron and re-channel erroneous activity to help people overcome the limitations of their

> brains. Finally, we need a new theoretical approach to exploit the data that we generate so we can find the emergent property of this neuronal map, which is bound to be a multidimensional dataset.

I interviewed Rogers after his presentation, asking him whether the emergent properties that are the variations in emotional expression across human beings could be captured within a matrix of neuronal activity mapped against muscular activation. While acknowledging that the complexity of human experience and related emotional breadth and variation couldn't be simplified within the paradigms we currently utilise to understand the human mind, Rogers proposed that our as our technological ability to collate this data increases, our ability to model permutations and combinations of neuronal activation against affect or a range of human behaviour might not be a fantastical notion. Our conversation strayed into the realm of science fiction as we considered the computing power required to synthesize the data Rogers proposed to collect and code. Rogers explained to me:

> From my work, I believe that our ability to mimic human processes is limited by the material we use. If we are simulating the brain's functions using synthetic and not organic material that resembles the brain, we will not be able to fully replicate or create an autonomous system that can accurately mimic the varied possibilities in decision making that present to an individual.

In theory, collecting adequate data around neuronal information that considers individual variation and that is subsequently mapped against individual behaviour would provide a veritable manual of human behaviour, linked to the human body. The rhetoric of hardwiring and cracking the brain's code was prominent in the expressed goals of the scientists who had attended the conference. The senior government public health officers who were present also extended their support to a categorical shift away from subjective and self-assessed

questionnaires to a mode of measurement, diagnosis and possibly, intervention that was based on a framework that they understood to be inviolable, universal and objective. A collection of physiological factors presents a normative model that could be mapped if enough data were collected.

The device developers clearly saw their work as holding scientific, social and economic benefits. Tim, a government public health official, addressed the gathering as he spoke about the need for collaborative efforts focusing on understanding the human brain and related behaviour better. He remarked:

> You could speak with any number of psychologists and patients, and you are bound to find those many variations. If I'm administering and managing government funds that are allocated for treatment, we need results. That's not coming from someone seeing a psychologist for years and years and even after, having a relapse. With PTSD veterans, we pour in thousands of dollars over years, and nothing. It's just not reliable. We need something we can pinpoint, something scientific. Even self-reported data needs better measurement. If you can't measure it, it doesn't exist.

Deborah Lupton (2017: 2) a leading social scientist who studies the phenomenon of digitised self-tracking, argues that the practice of the quantification of the self:

> as a sociocultural set of practices (is) underpinned by dominant assumptions about selfhood, embodiment and social relations…popular discourses and practices represent digitised self-tracking as a mode for eliciting self-knowledge via digital datasets which is then used to optimise the self (Lupton, 2017).

When an individual's physiological profile deviates from these dominant profiles and this deviation can be proved statistically, a particular deviant physiological expression and sets of repetitive variances can be viewed as anomalous and eventually, as evidence for psychological disorders. The psychological element of behaviour becomes emergent, while

the physiological can be likened to building blocks of human consciousness and experience. The set of meanings that people attribute to how emotion is experienced and impacts an individual and the social group within which she belongs is eventually seen as a phenomenon that cannot necessarily be restructured or modified with a predictable degree of consistency and reliability owing to the variance in individual perception, experience and ability.

Despite the difference in methods and technology that various scientists at the conference were using to achieve the goal of mapping the human brain, they all agreed on the need for a reframing of our understanding of human mental health. They believed that the need of the hour was to move away from a focus on subjective measurement of human affect and emotion, which they saw as emergent properties of the human mind, to physiological responses that are quantifiable and easier to observe and control. Within this framework, the human mind is seen as the product of circuitry and bio-electrical activity, while the mediation of dysfunctions within this circuitry is viewed as easily measurable and eventually modifiable through bio-electrical stimulus (Helmreich, 2013).

Dr Fernandez, a researcher at a large multinational technology corporation, was presenting the journey that she had led at the company in attempting to predict the pattern of tonic-clonic seizures amongst sufferers of epilepsy, which is considered among the more debilitating physiological symptoms co-morbid in a range of neuropsychiatric conditions. Compared to some mental illnesses, epilepsy was seen to be relatively simple to identify externally as well as by the individual sufferers, implying a higher possibility of measurement, and intervention. Current clinical knowledge asserts that seizures are caused by abnormal electrical activity throughout the brain and result in the sufferer losing control over their motor functions and often, consciousness, too.

While Dr Fernandez presented her findings of being able to predict seizures with an over fifty percent chance of accuracy, she spoke of the limitations of a dataset riddled with

"false positives". Speaking with Dr Fernandez, I clarified how she had classified certain recordings of electrical activity as a false positive – which occurs when physiological indications of a seizure present but the actual seizure itself doesn't occur. My understanding was that an algorithm was an approximation at best around the rules that seemed to gird a phenomenon. Any variability needed to be understood relative to the larger data set (Cipresso, Matic, & Lopez, 2014). If an occurrence couldn't be classified relative to the norm, was it useless to understanding the phenomenon being studied? Fernandez shrugged, "It's a false positive. I need to keep trying till the pattern is more even."

Dr Fernandez' comments reflected the dilemma faced by several scientists who seek to curate a reliable mean of varied distressing human mental phenomena by finding averages in experience. Inadvertently, such an enterprise involved the elimination of data that created problematic anomalies within an otherwise similar collection of individual instances. The variability that these atypical experiences introduce into the exercise of datafication of mental phenomena is then eliminated to simplify and achieve a result that is not necessarily sensitive to variability but able to identify occurrences that are comparatively less subtle, and eventually, more common, in the interest of reaching a broader market of users.

Other device manufacturers had more personal motivations underpinning their work. Dr Christine Bell is a neuropsychologist whose child has been diagnosed with ADHD. Her psychological practice has grown from her desire to navigate her child's inner world and reduce the chasm between the ability of a neurodiverse child and her family, and the supports available to them. Dr Bell is the creator of a mental health wearable device, the X2, that provides an intervention in the form of vibration to an individual based on pre-selected modes of emotion states. She claims that her device can switch a person out of a high state of physiological stress arousal to a normal state in 30 seconds.

Dr Bell believes that her device works for people who because of their neurological differences are unable to be tuned into their bodies and minds as much as the average person. This leads to frequent overstimulation and an inability to cope with the competing demands on their bodies and minds. So, the X2 stops their flight, fight or freeze reaction to what they are perceiving as a threat. When they are in an environment or during a timeframe when they believe they will go into shutdown because it's too much, they can switch the device onto a frequency of buzzing that is designed to provide them with the frequency of vibration and stimulation that will force their brains to switch off the panic response. It's like short circuiting an oversensitive or misfiring system, or you can see it as a fuse in an electronic circuit that we are providing externally.

Dr Bell's product has been received well by thousands of users worldwide. The X2, like at least half the devices in the mental health wearables industry was crowdfunded by individuals online who contributed small amounts of money to reach a larger investment goal, which eventually gave birth to the product. The X2 does not measure any physiological indicators of stress but is activated by individuals themselves who identify as mental health sufferers, either clinically or self-diagnosed. Most users on the online forum where the X2 device users congregate report having been clinically diagnosed with a mental health condition or disorder and hope to find relief and control over the negative impact that their condition has on their ability to function.

As I discuss in more detail in chapter two, one of the major assumptions informing wearable devices is the understanding that negative affect, as measured through physiological symptoms, can be transferred onto a device. Negative affect has been pathologized into categories of abnormality within psychological practice for a few decades now (Bentall, 1999; Lupton, 1997). The translation of these categories into urban, popular modes of experience finds expression in technological artefacts of human experience as in mental

health wearable devices and how they are used to create normative ways of being. The X1 is a wearable device that like the X2, was also crowd funded. It was designed around the premise of providing a tool to users who wanted to break "unhealthy" habits, such as overeating, trichotillomania (hair pulling as a way of dealing with anxiety), smoking, repetitive negative thought patterns, or improving sleep habits. Unlike the X2 that is presented as a nervous system modulator, Ben, the creator of the X1, claims that the premise behind the X1 is "aversive conditioning" – breaking an undesirable pattern of behaviour through negative reinforcement.

Ben is not a psychologist, neither is he a mental health practitioner, but believes that the X1 achieves the goal of shifting negative moods and behaviour by allowing the user to administer a mild electric "shock" to themselves when they become aware of engaging in an undesirable thought or behaviour. The device demands a higher degree of self-awareness, like the X2, and offers the user complete control over the intensity and manner in which the device is used to provide the mediation required to shift behavioural and thought patterns. Unlike the X1, however, while the X2 does not claim to actively address mental health conditions, the device inventor, Ben, has actively cultivated relationships with user-ambassadors for his product many of who have diagnosed mental disorders, such as schizoaffective bipolar disorder and major depressive disorder.

Ben summarises the philosophy behind the diversity of users and how the X1 effects change in their habits, saying: "A lot of people that we helped, it was just voices in the brain. Everybody has voices and often, it's your own voice saying you're not good enough." Speaking with a homeless man, Bart, who suffered from schizoaffective bipolar disorder, Ben told him that the only difference in the voices Bart heard was that "it changed to someone else's voice". Bart had tried to commit suicide and has been admitted into hospital. Upon being discharged, he struggled with the constant barrage of messages

from voices telling him that he should kill himself. Giving Bart an X1 and providing him with shelter in his own home, Ben encouraged Bart to "shock" himself every time he had a self-deprecating thought or heard the voices prompting him to self-harm. Bart says, "I would tap, tap and it would, um, help me not think about things."

Ben was confident that Bart's mental illness resulted from his inability to change his thought patterns:

> The X1 showed Bart that there was nothing wrong with him, he only lacked the tools to change his thought patterns. Voices, delusions, whatever they are – whenever you catch yourself in a bad state – you press the button.

To Ben, the device serves as a mediator to moderate the negative experience that the user is navigating, but also transforms this experience into a positive behaviour that restores a sense of control over one's mind, circumstances and environment. Ben explained Bart's delusions as follows:

> After using mild electric shock for bad behaviours and a positive reminder for good habits, many of the symptoms went away, and most of the positive symptoms became more plausible.

Ben's interpretation of Bart's behaviour was that he was acting out a narrative that he was conscious of – that the delusions that Bart experienced were in fact constructed cognitively. His evidence for this deduction was that Bart would often "stim" by rocking from side to side when experiencing a delusion. Stimming is a term that is used to refer to repetitive physical movements that individuals suffering from neurodevelopmental or mental health conditions might engage in to self-soothe. Ben encouraged Bart to use the X1 to stop these "abnormal" expressions of what he saw as internalised negativity. The device became the receptacle onto which the "stim" was transferred. In so doing, Ben sees

the device as destigmatising ways of being that have been pathologized by containing them and moderating them using the X1.

Ben ran his organisation as a sole proprietor and the dynamics that this model of business dictated how he marketed the device, and the customers who bought his device reflected this dynamic. They were largely users who claimed that they needed help to shift their behaviours that they found problematic. Other device developers and companies who have investor funds backing the development and deployment of their technology take a more strategic approach to long term profitability rather than appealing to the individual western desire for self-help or self-improvement, which is the primary appeal of crowd funded devices like the X1.

The end goal of more sophisticated, data-driven mental health wearable devices, however, is predictability. Devices within this group use sensors that collect a continual stream of physiological dad which is then interpreted by software that deploys artificial intelligence systems that can identify patterns in sets of data. The data sets that are used to train these AI-systems and machine learning algorithms that power the more advanced mental health wearable devices are by no stretch comprehensive. However, the objective of creating these systems is largely to be able to predict patterns to hedge certain types of risk – whether that be risk to patients being treated by exhausted, overextended doctors on call in emergency wards, or shift workers operating heavy machinery.

Risk modelling and the surveillance of individual wellbeing and productivity

One of the major questions raised by the development of wearable mental health devices is the extent to which this technology might contribute to the risk modelling and surveillance of individuals. Towards the end of my fieldwork, I met Will, a data analyst and pattern recognition expert with a multinational technology major that builds artificial intelligence systems. He had been working on creating computing models using wearables that were able

to relay EEG data visualising electrical activity in the brain to demonstrate the degree of calm or hyperactivity an individual was experiencing. Will explained to me:

> Theoretically, we should be able to detect an event as it happens. With enough data and analysis, we should be able to see an emerging pattern that pre-empts an event condition. If someone experiences an internal negative event, what were the surrounding patterns that led to that event?

While the algorithm might help us identify "risk conditions", this model would be able to predict future events accurately if the person training the machine learning algorithm has already identified a risk profile and then, transfers that knowledge to the algorithm. There necessarily needs to be a degree of homogenization to arrive at any sort of profile that is useful to companies with the goal of increasing employee wellness and subsequently, productivity. Usefulness, Will continued, was decided based on the objectives of one's client. Was it a hospital monitoring its patients admitted into its mental health intensive care unit after an episode of self-harm? The algorithm would then need to identify if there was an anomaly in any physiological parameters that the device is measuring. The anomaly would be identified relative to an individual's "baseline" of vital statistics, collected over a period of days. The baseline is a derivative of a combination of statistics around heart rate, breath rhythms, sleep rhythms and perspiration. The goal of these devices is that if the hospital wanted to predict if the patient might have another episode of suicidal ideation, the data could point to a shift in any physiological parameters, just before an episode of self-harm.

The accuracy of the devices used is yet again inconsistent, Will noted, but seen as a valuable tool by staff employed within mental health intensive care wards, where constant surveillance is mandated. Short periods of stay are inadequate to gather enough data to generate personalised baselines. However, a larger data set that identifies a universal range of measurements might be used to create the digital base against which Individual data points

are mapped and interpreted. Will's understanding of the use of the devices within suicide prevention intervention in New South Wales, was that the trial was still in its early stages and the technology would likely undergo further refinement to achieve higher accuracy, in order to offer hospitals a compelling reason to invest in yet another tool within what is a highly stressful and volatile environment with multiple, continually changing variables. Will asserted that the modelling used within such environments could be seen as an isolated or opportunistic analytical model. He went on to explain that these models are generally popular with insurance companies or organisations. Will asserted that these corporations attempt to "price out a particular risk profile. Insurance companies are simply problematic, and organisations are sociopathic," he emphasized, as we talked about the implications of accurate predictive capability.

At the moment, the possibility of a dystopian digital panopticon that is able to discipline the bodies and minds of citizens to be productive workers based on their bodily and genetic makeup was still a fantastical notion (Foucault, 1977). The siloed nature of big data and its sheer magnitude confounds organisations. To scour through and render big data intelligible from a certain perspective when one is filtering for risk profiles, is a task that is beyond most organisations that own this data. There are multiple challenges that organisations must transcend in order to make the jump where, for instance, a person can be flagged as being at a high risk for depression, and that being proven as a pre-existing condition, based on his or her historical physiological vital statistics. The sheer work involved in standardizing and cleaning up the data, making multiple formats of data coherent and intelligible is something that organisations are simply incapable of taking on, given our limited technological abilities now and the administrative challenges that such an undertaking would involve. Will clarified that while it was possible in theory that an organisation might be able to do this to penalise an individual for "bad mental health", this was a highly simplistic notion that wasn't practical

and probably wouldn't be for the next decade, because our present computation capability is limited not only by the intention with which data is collected, stored, and processed but also the physical processing power available to us. Therefore, if a company had designed the collection of data from the point of view of analysing it to arrive at individual risk profiles, this task would be possible. However, to retrospectively wade through large amounts of data that have not necessarily been collected with this end goal in mind, might not be able to generate meaningful predictions. Will summed up the challenges of interpreting big data generated by devices such as mental health wearables:

> The gross and granular data reveal multiple actors about our underlying conscious and unconscious mental processes that determine human behaviour and modes of being. However, we are currently unable to make sense of all this data.

In other words, there are several data points that constant surveillance by mental health variables generates. While some of these data points reveal larger correlations, some others are relevant only when studying individual variation. The technological limitations that data analysts currently face dictate the degree and speed with which big data around mental health can be processed to extract meaningful results – whether those be individual mental health profiles or patterns around what might predispose an individual or a group to experiencing distress.

After Will had confirmed the current limits of wearable mental health devices in terms of surveillance, I wanted to learn more about what is currently possible with mental health wearables in terms of surveillance and prediction. While speaking to researchers across neuroscience, human-computer interaction, design, and psychology, working within this space at four Australian universities that are attempting to develop new mental health interventions using wearables, I enquired around the capacity of the technology that these experts were working with.

Dr Ross, a neuroscientist working on developing a wearable device to diagnose anxiety, explained the capacities of wearable devices as follows:

> Physiological stress is really the only reliable measure one can determine using these bodily markers such as heart rate, breath, sleep patterns and perspiration, among others. The problem in the research filed is that many companies monitor a test subject and ask the individual to subjectively report when they have an anxiety attack. The problem with that is that numbers for those events are very low because you can't really predict an anxiety attack. We are trying to ethically simulate a stress response within a laboratory, and then, measure over a period, to see whether we can predict whether there was a change in physiological response. The corporatisation of this space brings up a lot of ethical issues because the literature isn't peer reviewed and publicly available. The data as well as the algorithms are proprietary and protected. The claims made by these companies are wild, and impossible, given where we are at, technologically, now.

His primary challenge is achieving a diagnosis consistently based on similar physiological markers across different test subjects. Dr Ross explained:

> Variability is a problem, when you're trying to quantify something like mental health, that's where it gets complex, because every factor you add – age, nationality, gender, family background, it makes the algorithm that much harder.

Brains are increasingly seen as predictive organs whose primary function is to learn about typical patterns and predict future behaviour. The argument for a neurological model of the mind and consciousness is built on the premise that the physiological activity within the brain is responsible for all psychological phenomena. Andy Clark (2017: 727) argues for:

> "a new synthesis in which predictive brains act as entry-points for 'extended minds', and embodiment and action contribute constitutively to knowing contact with the world" (A. J. N. Clark, 2017).

The machine learning experts within corporations that I interviewed understood predictive algorithms as largely modelled on current frameworks of human cognition but assumed that devices that applied these algorithms to human mental health were merely transforming an unquantifiable experience into its natural corresponding quantifiable form. In conversation with Will, the commercial data analyst and pattern recognition expert, I proposed Clark's idea of a predictive extended mind where a wearable device might be able to not just read stress in real time, but also predict it based on an individual's baseline. In response, Will asserted:

> The eventual possibility of being able to predict an event is something we don't currently have the technological resources for. It'll be a few years before we can even work past siloed health records, let alone trying to piece together who is at risk given their other health and social conditions and then, up their premium if they pose a mental health risk. Unless this sort of data is collected intentionally within a coherent framework by a single entity, simply attempting to cleanse the datasets and render them usable or readable is a ridiculous task.

The multifaceted assemblage that mental health wearable devices are part of raise several questions around the ethics that surround the data generated, as well as the way in which e individual mental health data maps are used. Who owns the data generated by these devices and who determines how the data is used and mined, and unto what end?

Regulation and data ownership

A further ethical issue around the creation of wearable devices includes regulation and issues over data ownership. Regulations governing the mental health wearable devices that

are sold directly to consumers online are usually limited to safety regulations around the physical sensors and electronics that are used in the devices (SaMD, 2017). The data that devices collect, and the interventions activated by the devices are protected by user terms and conditions that are standard legal agreements that exempt the organisation that owns the technology from liability should users be harmed in any way by the device. The user data generated is protected if it is stored by the device manufacturer. However, a clause within the terms and conditions that govern the use of all devices allows for the data to be used by organisations that are affiliated or those that acquire the original device manufacturer. This leaves open the possibility of exchange of data for marketing or data mining by affiliated healthcare organisations or insurance providers who might see the potential that this data presents to increase profitability, by either increasing insurance premium payments for individuals who are identified as being at a high risk for mood disorders, or reducing the amount of healthcare costs covered for an individual who might have had a pre-existing mental health condition based on device data.

Many of the producers of wearable devices, or stakeholders who work in the industry are aware of these tensions around regulations. James, a data scientist working with citizen and government mental healthcare organisations, had a sobering evaluation of government will to regulate the mental health wearables industry. He spoke of the organisational reluctance and bureaucratic roadblocks that privileged narratives of productivity and healthy bodies independent of socio-economic inequalities that inevitably acted upon people's bodies and minds to feed the apparent mental health epidemic that was plaguing the developed world. Ruth, a mental health researcher among Culturally and Linguistically Diverse (CALD) communities, confirmed James' findings when she attempted to create a programme to understand maternal wellbeing using wearable devices in a non-English speaking group that she was working with. She found that educating new mothers around the basics of digital

literacy took precedence over the significance of what the wearables could help her achieve in terms of health outcomes in the community. James asserted that while communities such as this one were the ones that stood to gain the most in terms of self-determination and self-understanding from the use of such technologies, they were possibly the ones who will not be able to access the devices – primarily because of prohibitive pricing models as well as the fact that the data sets on which the artificial intelligence that the devices run are from privileged groups rather than marginalised groups, which he saw as skewing the baselines that are calibrated into many of the devices.

The devices that claim to offer dramatic mental health interventions are required to be classified as medical devices but often are introduced into the market as wellness consumer devices being exempted from the more stringent regulations and protocols that are to be followed before medical devices are typically introduced into markets for the use of individuals. Many of the device companies use initial sales and usage of the devices as public human trials to continue to improve their technology and algorithms. Combined with the fact that many of these devices are funded by the public through crowdsourced funding, the lack of accountability amongst these technology companies is worrying. Amy, an ex-employee of one such company that crowdsourced funds to create a mental health wearable device spoke to me about her assessment of the technology she helped market. The company she worked for eventually was acquired by a large technology company selling mental health technology solutions to employers, and therefore, never did launch the fledgling device leaving its public backers livid. Amy remarked, shrugging:

> In any case, the tech was immature and it's unrealistic to expect any impactful intervention or identifiable correlation to make any real dent in the mental health market at this point.

Amy's remark stands in stark contrast to the claims made by the companies selling these devices. One company claimed in their pitch to investors in 2017 that their device would render the DSM 5 standard of qualitative diagnosis irrelevant because their device was capable of quantitatively diagnosing a range of mental health conditions, ranging from anxiety to psychosis and schizophrenia based on biomarkers such as sleep rhythms. This claim shifted during a rebranding exercise in mid-2018 to take on a tone of caring about people's wellness in the company's marketing material, aimed not just as investors, but also consumers, as the company was making a foray into the consumer wellness wearables industry. The marketing material also dropped several conditions that the company previously claimed the device was capable of diagnosing – restricting the list to conditions where there was a direct correlation between stress states and sleep patterns – which brought the catalogue of diagnostic capabilities of the device down to three states – stress, depression and anxiety. The rapid evolution of claims versus actual technological capability of devices and the lack of accountability to the public or any other governing body around these claims is a worrying trend within the wearables industry.

Many device manufacturers get around the stringent regulations surrounding the deployment and use of medical devices by classifying these mental health wearables as consumer electronics (Anand, Venkatesh, & Kumar, 2016). This creates the impetus for technology organisations to reverse engineer the lowest common denominator of the results – the ability to predict physiological stress – and extend the messaging that is promoted to consumers to encompass other key triggers within the collective contemporary imagination to evoke ideas of compulsive bad habits, anxiety or depression, therefore, attracting sufferers of a range of conditions while not overtly claiming to address anything other than stress reduction and improved wellness. For instance, while device makers might market the device to employees claiming that it is a tool that improves productivity and mental health, and

reduces absenteeism, I identified a clinical study being run at a university using the company's technology that is unconnected to these claims, but instead seeks to validate the mechanics of the technology and the correlation between the markers that it measures and their connection with arousal states. While this could obliquely be interpreted as translating into productivity measures, researchers within universities validating these studies may be unaware of the implications of their studies upon the marketability of the technology or the factors that are extrapolated by correlation that they might be endorsing. Dr Sanders was a case in point as she had no idea that the study she was heading was funded by the technology major that was deploying devices at the organisational level amongst thousands of employees worldwide at multiple organisations, was engaged in making ethically concerning plans built around the capability of this technology to diagnose human error and reducing absenteeism among staff because of mental health issues (Bauer et al., 2017). Her understanding of the technology was that it demonstrated a correlation between sleep patterns and error rates amongst shift workers, and the link between these factors and depression (Wirz-Justice, 2008). The construction of the narrative around the technology and its use - whether that be to reduce absenteeism or improve productivity – is driven by increasing profits, while reducing the individual cost paid by workers contributing towards building those profits.

The myriad approaches that creators of devices adopt revolve around the capabilities of the technology that they deploy and modify. While some device creators view mental illness as resulting from an underdeveloped ability to cognitise and therefore shift negative affect, others eliminate the instances that they encounter that do not fit the mould of mindful and cognitive modification, where emotions are tamed into anchors in the human body, and therefore seen as modifiable. As technology that measures physiological signs of distress, wearable mental health devices have extended assumptions of mental illness as a purely physiological phenomenon and transformed physiological

symptoms into artefacts of emotion. The overarching goal that underscored the attempts of all device creators was to extend a technological tool to individuals who would apply increasing amounts of time and effort into understanding themselves and their bodies during distress, in the hope that quantified, intensive and consistent self-surveillance would lead to improved regulation of distress. This process is informed by norms of self-responsibility in contemporary wellness culture and is underpinned by a demand for economic productivity. Although the current surveillance and risk modelling capacity of these devices is limited, the emphasis on the responsibility of the individual to observe and monitor their own condition also raises questions about the future capacity of wearable devices to contribute to broader surveillance and risk modelling for the purposes of collective or corporate profitability and improvement.

Chapter 2: Embodied Emotion and Mood Engineering

In this chapter, I shift from analysing the production of wearable mental health devices to analyse the experiences of users of these devices. The chapter examines how users of mental health wearable devices use their wearables to mediate their embodied experience of mental health, mood and emotion. I attempt to understand the mechanism of the devices vis-à-vis psychotherapeutic practices aimed at cognitising emotion that have been adopted into the popular, western contemporary collective understanding of mental health self-improvement. The chapter draws upon ethnographic case studies with device users and considers the extent to which users mediate ideas of self and a sense of wellbeing through the use of their wearable devices. The chapter also discusses the online communities of wearable device users and considers how these communities might transform users' experiences of their own mental ill health. How do the use of these devices, and the theory of mind that the users embrace inform their conceptualisations of mental health and ill health? Towards this end, I interrogate notions of well-being and the pursuit of users in achieving what is considered positive optimal mood states, while negotiating the tensions of bodily manifestations of emotional distress.

The overarching argument of this chapter is that mental health wearable devices are developed upon frameworks that extend assumptions that cognitising emotion is an ideal means to alleviate suffering and stop undesired behaviour that might perpetuate suffering. This model of interaction between individuals and the therapeutic device, builds upon and extends established therapeutic practices that use a similar logic, such as cognitive behavioural therapy (CBT) and acknowledgement and commitment therapy (ACT). However, unlike mainstream psychotherapeutic techniques, wearable devices primarily use physiological symptoms as the sole and key indicators of negative emotional experience, and

as a mechanism through which the body of the user can be interacted with to help cognitise and thereby, modify emotional experience.

I argue that mental health wearable devices that are sold direct-to-consumer also offer users a sense of community with other users and sufferers where individuals often seek solidarity with others who share similar experiences and understandings of mental wellness, and the associated struggle to achieve a collectively accepted ideal of socially constructed normative performance of mental wellness. Unlike the struggle to conquer mental illness through regular psychotherapeutic intervention that is often marked by isolation and stigma, the journey within these communities towards achieving wellness is often characterised by a collective pursuit for refinement and control of physical effectiveness of devices, not just individual bodies and mental ailments, with the goal of achieving increased self-awareness of the embodiment of mental distress. Peer ambassadors and the collective sense of vulnerability, anonymity, and support differentiate users who actively benefit from the use of these devices from users who have been encouraged towards the use of these devices by their affiliation with a larger authoritative entity. While sometimes such an organisation can be an individual's employer, oftentimes, it might be a healthcare provider. These entities who hold social and economic power are markedly absent within online communities and in this absence, represent an extension of the complex enactment of mental suffering and power dynamics involved in how identity and healing practices are intertwined. Eventually, wearable devices seem to offer a tangible tool for self-regulation of distress with the promise of a high degree of control by the individual user, thereby representing an act of individual agency, as opposed to working with an external practitioner to achieve results that might come at an exponential price tag in comparison to the cost of devices.

Cognitising emotion and mood engineering

Psychotherapeutic practice over the last decade has largely been structured around therapeutic models that aim to build the capacity of an individual to consciously reframe thought. The premise that versions of this tradition of this practice are built on is that undesirable behaviour can be identified before they occur by tuning into bodily identifiers such as an increased heart rate, breath rate etc. Psychologists and mental health practitioners coach individuals to anchor themselves in these sensations and develop the practice of shifting away from an intangible world held within their thoughts and involuntary bodily sensations. The goal that patients are urged to work towards is identifying the thought pattern that is at the root of the undesirable behaviour in question, and shift it through practice and cognitive effort (Marzano et al., 2015). This shift hinges on a person's ability to draw the emotions that she might be experiencing and locate them in the body – whether by means of increased self-awareness of autonomic functions such as breathing by identifying quickened breathing or palpitations moments before an emotional outburst triggered by distress. The practice of identifying these bodily responses to threats triggered by one's psycho-social environment is aimed at making the experience of negative emotional experiences a cognitive task, which in theory transforms how an individual responds to a situation by beginning with shifting behaviours. This shift from redirecting stimulus from the parasympathetic nervous system to the sympathetic nervous system is the premise upon which wearable devices that offer prompts to users based on increased stress are built.

Therapeutic models centred on the cognitisation of emotion, especially negative affect, strongly inform the technology of wearable devices. Mental health wearable devices are developed on the premise that physiological markers such as heart rhythms and breath rate can be used to map stress states, and can be valuable in preventing increased levels of stress (Chandrashekar, 2018). This premise rests on the ability of the device to measure and

accurately interpret physiological markers of stress (Muaremi, 2014). The electronic sensors that are currently used can measure an individual's physical movement and activity, social encounters as understood through speech, blood pressure and sleep patterns. Further, an algorithm interprets these physiological data points based on sets that have been collected to indicate what is considered normative and what isn't, for each of these parameters (Matthews, Abdullah, Gay, & Choudhury, 2014). Thus, the diagnosis of normativity that was hitherto subjectively administered, through device usage, is turned into a technology that offers a dislocated positioning of knowledge which, by virtue of being outside the human body, takes on a veneer of scientific objectivity. The authority that is assigned to a machine such as a mental health wearable device validates emotional turbulence and mental ill health experienced by individuals. Further, not only does a device seem to provide legitimacy to the suffering experienced by individuals, but also serves to place itself being the sufferer and her experience, thereby increasing her ability to cognitively frame her suffering.

This knowledge then, for individual users seems to represent improvement and control through the interaction with micro-indicators that do not carry the same degree of social stigma as psychological labels of mental disorders, but instead become indicators for a type of suffering that can be improved simply through interaction with a morally-inert device. Behind this interpretation of physiological data are clear moral discourses about what constitutes good and bad experience, and ways of being and functioning in the world. The discourse that surrounds the marketing of the wearable devices fits into a framework of good versus bad, where one's ability to self-regulate and perform was good, and the inability to control one's anxiety, irrespective of the circumstances around that anxiety was bad. The translation of motion through algorithms into cognitive states that are at the best of times inaccurately self-assessed by the people experiencing them, are seen as reliable artefacts of the experience rather than the subjective experience of the user (Bentall, 1999). Wearable

devices build upon the medicalisation of misery to further reclassify the experience of negative emotion as a cognitive experience, rather than a feeling, controllable through conscious mindfulness, breathing and the active refocusing of one's attention (Bentall 1999, Van Dam et al., 2018). Therefore, rather than a response to an external event, emotion is framed as a habitual response that is seen to be situated in the brain and the body, rather than as an intersubjective experience.

Types of devices that users choose

In order to better understand how users engage with devices in attempting to cognitise their emotional experience, it is important to first describe the three main categories of devices. The three main categories of mental health wearable devices can currently be broadly categorised into passive monitors, active monitors, and intervention devices.

Passive monitors passively collect physiological data based on skin response, perspiration, respiration and heart rate. The device's algorithm then analyses the data against a baseline and alerts the user when any markers of stress rise above a pre-set threshold. These devices also allow for subjective data, by way of making notes of the stressors that may have caused a spike. As a result, over time, a user can, in theory understand any significant patterns and co-relations between daily events and their mood. The alert mechanism on most of these devices provides a physical stimulus to users that in theory shifts their awareness onto their body, however briefly. This alert or behavioural activation is intended to pre-empt or reduce the intensity of stress events by aiding the user in focusing their attention on their bodies and stabilising factors such as breath that might be indicative of increased anxiety.

Users of passive monitors refer to their wearable device readings for insight into their ongoing physiological or emotional states. They may or may not seek to intervene in the patterns recorded by the device. For example, a 36-year-old shift worker, remarked on

how his sleep patterns impacted his daily life and how his device has afforded him the insight around the impact of his sleep on his mental health:

> My sleep has been so fucked. Sometimes, I can't get to sleep, even though I need to wake up by midnight to leave for work. I feel so irritable when that happens. I'm looking at these blue spikes, you know, my deep sleep, like, and I'm, like, no wonder I nearly ran that kid off the road the other day when I was driving the truck. Yeah, it doesn't really fix my sleep, but at least I know how I'm going, you know? It feels like I can fiddle with shit like my exercise, how many more laps am I going to do today, will that make me pass out, should I be drinking less beer, you know? That kind of thing, yeah, it helps to know.

While passive monitors record data over an extended period, active monitors require users to actively record discrete "stress events", usually through an analogous input like pressing a physical button. This activates a signal to be uploaded onto a cloud-based repository of data that maps a stress point rather than correlating an individual's stress data with specific events. Such applications make it possible to see a stress map of a group across a location, such as stress in traffic, or in a user towards the end of the workday. These monitors are used primarily within research settings to understand the movement and behaviour of groups. Applications could range from improved spatial or organisational design to enable lower stress levels among social groups and improve overall wellbeing by reducing or managing external stressors. But individual users also use active monitors to observe their responses to stress. Rita, a 41-year-old user of an active monitoring device, said:

> Look, I found that every time there were holidays, even like the weekend, just before my daughter's ballet class and son's soccer, trying to get everyone out the door was a nightmare. Having the band for me to press so I could record that I was getting out of touch helped a bit. Understanding that maybe if I started half an hour

> earlier or even went and watered my plants outside would help me not feel so antsy. Seeing that pattern is helpful.

The third category of devices, intervention devices**,** allow the user to initiate an intervention when they feel agitated. As opposed to passive monitors that might suggest low intensity action such as increasing the number of breaths taken, or actively slowing down one's breath rate, intervention devices necessitate a removal of oneself from routine activities and engaging with the device's input. Here the device plays the role of a coach while also serving as an extension of the individual's mind – thus being perceived as internal and external simultaneously. The ability to see a visual representation of one's "calm" states seems to aid developing the practice of meditation that then might over a period of time increase a sense of wellbeing among users. Another form of intervention device does not actively measure biological markers but instead allows the user to select their mood state from a set of pre-existing conditions such as angry, calm, sleep or focus. Depending on the result the user wants to achieve, the device provides a physical stimulus that functions based on a similar premise to the passive monitors. The device switches the user's attention by introducing a bodily stimulus that users believe switches their anxiety off, because it either provides a rhythmic stimulus that calms down the body, anchoring it to the present, and therefore claims to disrupt the "flight, freeze or fight" impulse.

Gretel, the user of an intervention device employs the device to break and change her anxiety, which she sees as a habitual internal behaviour, rather than a disorder:

> I bought it for a specific habit which I actually haven't used it for yet ... But, I am struggling with getting very worked up with the kids. It's wrapped up in anxiety, tiredness, just a lot of stuff. Anyway, every time I feel overwhelmed and I feel like I'm going to lose my temper, zap. The angry mood I'm in is switched 180 degrees and I relax and smile. It's amazing. The stressy moments are getting fewer. Just

wanted to share this as I kind of discovered it by accident. I didn't really think of my feelings of stress and anger as being a bad habit. Or that zapping myself could make me feel happy in an instant! But I do!

All three categories of devices require contact with a user's skin. While most devices can be worn as pendants, clip-ons or are strapped onto an individual's wrist, some intervention devices are worn on an individual's forehead. The efficacy of devices does seem to vary based on placement or the narrative surrounding the mechanism by which the device works. Devices that have a visual representation of biological activity while demanding active action such as meditation increase the degree of involvement that the user invests in the device and in their own self-awareness.

The common thread that runs across the mechanism of all these devices is the provision of an external bodily symbol of stress management. Users come to view the devices as a receptacle for stress when the devices do work. Subsequently, for many users, the devices irrespective of whether they seemed to be active, passive or intervention devices, and even irrespective of whether the devices worked, served as anchors, to draw the attention of users to their body, and the physical manifestation of emotional distress.

"Short circuiting the misfiring brain", and other understandings of users

As discussed earlier, wearable mental health devices build on therapeutic models of cognitising emotion through drawing awareness to the body. Biofeedback as a strategy for building self-awareness of physiological functions in order to build the capacity to control these functions, has been around since the late 1950s, and operates around the idea of monitoring and providing physiological stimulus in connection with a particular physiological operation for an individual. With the anchoring of mental health within neurological and by extension, physiological frameworks, biofeedback practices have gained

popularity among psychologists using neurofeedback techniques within their clinical practices (Millings et al., 2015).

While users who choose to use devices such as the X1 and X2 use these wearables as means of understanding and controlling undesirable emotional states that they experience, the users who abandon these devices (about 40% of users) tend to find that the devices introduce a layer of complexity into an internal phenomenon that they consider perplexing. Carla, an X2 user, asserts:

> The idea of responsibility and the general belief of psychologists that everything is controllable and understandable is so stupid. But the reality is that there is a level of functioning that I cannot control and am not aware of.

I asked her if she felt like the device increased her capacity to feel like a free agent, in control of her "self" and her body and mind? She replied:

> Look, half the time, I'm either PMSy or have my period, or I'm anxious, or just plain tired. What freedom is there? I'm always waiting for the next drop, y'know? This thing helps me feel like at least I can see what is happening a bit, maybe if I understood it, then, it can get better, y'know?

The idea of understanding and controlling one's internal world and struggles with emotional regulation is a recurring theme for other mental health device users as well, such as Max, a man who has autism and co-morbid anxiety. His lifelong struggle with anxiety limits his ability to function socially on par with other adults his age with regard to holding down a job and being part of a peer group, and managing daily tasks independently, such as taking public transport and paying bills on time. He uses a combination of two devices, one to measure his vital signs such as heart rate and breath, and another device, in response to irregular readings from the first. This second device provides a mechanical buzzing stimulus, and Max uses it for about ten minutes whenever he feels overwhelmed. He believes that this

short circuits his anxiety attacks by shifting his brain's focus onto his body and engaging his 'non-emotional' brain as he calls it. These devices are like other popular wellness wearables such as the Fitbit. However, these devices come with additional algorithms that interpret the emotion states of the wearer based on psychophysiological markers such as heart rate, breath rhythms and skin temperature among others. Among the range of devices available, each running proprietary algorithms, some devices skip the monitoring and move directly into intervention, based on psychotherapeutic practices, and offer the user the autonomy to choose the intensity of intervention they need based on self-assessment.

Max has often felt like everything, from getting out of bed to going to work, triggers extreme anxiety. He stays home with his father and works at a firm that allows him the flexibility of working from home. Given the degree of physical distress that he regularly experiences from sensory overstimulation, his current therapist has been working with him on autogenic training, which involves helping him relax and develop higher levels of tolerance to triggering circumstances. One of the biggest challenges Max has faced has been building his self-awareness to a degree where he is able to identify the effect his environment has on him. When Max's therapist attempted to get him to practice cognitive behavioural therapy, Max was encouraged to consciously focus on the negative thoughts or sensations he was experiencing. Given his profound visceral response to stressors that were sometimes not even physically present in his environment, Max's anxiety got worse.

He had better success with the Acknowledgement and Commitment Therapy protocols (ACT), an approach that has been gaining popularity among psychologists working with treatment-resistant and chronic mental health mood disorders such as depression and anxiety (Hofmann, Sawyer, & Fang, 2010). ACT comprises practices that are rooted in mindfulness, and it allows people to simply acknowledge their own distress rather than try to actively and consciously replace the behaviours that spring from this distress. The ACT

model lends itself to being incorporated into a range of interventions for improved mental health – from clinical role playing with therapists to wearable-led prompts that are activated when individuals are experiencing increased levels of stress, anxiety or panic. Many of the wearable devices for mental health improvise off an ACT model to improve the user's ability to be mindful of their body and the impact of their emotions on their body. Some devices also integrate the information around the psychophysiological markers with subjective input from individuals about environmental and emotional context and content that predicate bodily responses, therefore, allowing for increased self-awareness over a period of time (Rapp & Tirassa, 2017). In interacting with mental health wearable devices, users often hope to relearn what they consider are healthier ways of responding to stressful situations in their lives, or even simply, use the devices as a self-improvement tool to increase awareness around their thought patterns that they feel impede their ability to reach their potential in terms of productivity at work or in academics.

Taylah, an 18-year-old user of the X4, describes how she feels she is "teaching her brain" through her use of her device:

> I am teaching my brain through positive reinforcement, the X4 helps me reduce my heart rate noticeably and I am sure it isn't a placebo. I can now sit still for twenty minutes at least and do my homework. I used to lose my focus a lot and didn't realise when I was daydreaming. The X4 buzzes me because it senses that my breathing changes when I'm daydreaming.

Some users, such as Sen, a 38-year-old user of an intervention device, are less convinced by the impact of the device itself to cognitise their experience:

> I might as well use a rubber band on my wrist to snap myself. This thing stops working. It's cheap plastic that cost me more than a hundred bucks. If I'm doing all the work, what is the point?

Mia, another user of the device on the same online community countered Sen:

> Well, it did make you wanna snap yourself. The point is you have started doing the work. Don't hate on them!

Riding on the wave of an increase in women seeking devices not simply to improve mental health, but to also track their workplace stress levels and other wellness and fitness indicators, two companies launched mental health devices specifically targeted at women users, who until recently were an ignored demographic (Lupton, 2018). One of these devices attempts to predict the user's susceptibility to stress based on a combination of meditation practice, exercise, water and nutrition intake and a woman's menstrual cycle.

22-year-old Meg is a user of one of these devices:

> It isn't accurate, but it forces me to stay on top of things. Makes it easier, for sure, to know what's going on. Who has the time to keep track of all this shit?

Meg finds the pendant styling of the X4 far more unobtrusive compared to other wearable devices available:

> I work in retail, I'm not going to walk around with this fugly black thing in my arm. At least this way, nobody else knows I'm spazzing out when I lose my shit on the inside.

Designed to be worn on charm bracelets, along with meditation beads, or to be used as a "zen anchor", as Meg called it, the X3 and X4 take on the material symbolism of an amulet that not only materially represents an internal reality, but that also allows for a self-understanding that is transformed through the medium of charts, guided visualisation, mediation and numbers. Meg reflected on how the X4 helps her feels more empowered, in control of her emotions and like a "responsible adult":

> It helps me feel superhuman, like, I know that even if I'm not going to be able to deal with something, like, I have something else, like, a part of me that extends my battery life.

Meg demonstrates how some users internalise the idea that exercising self-regulation of their mental health is part of responsible adulthood. Her use of the world “my” while referring to “battery life” is revealing in how she believes that the device is indeed a part of her bodily and mental mechanism. In this regard, the wearable is the ultimate self-monitoring and disciplining tool that transforms the mind and bodies of users wherein an external narrative of ideal ways of being are willingly internalised and embodied by the users of these devices (Csordas, 1990). Consumer wearable devices involve a prominent element of self-monitoring that is among the primary focus of discussions on online communities of users. These communities encourage self-regulation, but also create experiences of support, solidarity and the normalisation of not only the experience of the various categories of negative emotional experience, but also provide validation of efforts towards controlling and transcending the limitations imposed on individuals by their emotional distress.

Online communities of mental health suffering and healing

Although mental health wearable devices could have highly individuating effects, as users monitor and attempt to regulate their bodily experiences, this potential impact is significantly mediated by the online communities that have developed around wearable devices. In exploring whether mental health wearable devices are being used to mediate and frame or reinforce ideas about users’ inner worlds, I encountered groups of users who form communities not just around their mental states of perceived dysfunction, but also around the project of mediating these states using devices. The users active in these online communities were predominantly consumers who had purchased these devices online for personal use. Users within companies that were deploying devices among their employees were not granted permission to discuss their experiences outside of employee-prescribed channels, and so I cannot include these perspectives in this thesis.

Discussing the challenge of resolving various approaches to developing a single contemporary theory of mind, Tanya Luhrmann (2011) proposes an anthropological theory of mind, arguing that:

> The way we imagine our minds shapes our mental experience: the way a social group implicitly models/theorizes mental process (imagination, perception, thought) will affect the way people draw inferences about their own minds and the minds of others. This theory of mind will involve different dimensions, among them: 1. the senses, 2. how bounded the mind is, 3. whether interiority matters: whether inner thoughts/voice/dreams etc are given significance [and] 4. epistemic stance: what counts as real?

Communities of mental health wearable device users develop a theory of mind that, while reflecting popular interpretations of psychological discourses around emotional regulation and dysregulation, also delves into individual interpretations and discussions around the relevance and validity of these discourses. Indeed, online communities reflect the process that Luhrmann refers to as the process of developing a coherent theory of mind that is often unique to these groups.

On an online group for X1 users, the users often discuss not just their device and hardware issues and communicate with the company, but also their mental health conditions, and the groups often end up being support groups for users. Bharat, an X1 ambassador says:

> I think one thing…is the sense of community we have in this group, I owe a lot to my X1 (and team) but also get 25% of my growth from the inspiration of this group and my fellow X1ateers... When I see someone on the same road with the same habits it is inspirational.

The tone of the exchanges across these forums often takes on the tone of spiritual evangelism, with followers appending an “er” to the device name to take on an identity

attached to their device of choice. That is, many users in online communities enthusiastically refer to themselves as an X1er, or an X2er. Their exchanges typically discuss ways to improve device functionality or are centred around discussions of the mental health conditions that drove them to integrate devices into the management of their maladies. Many users wholeheartedly advocate for their device with a near-religious fervour once the device has worked for them. Christopher, an X1er who used the device to help "break" his anxiety said in one post:

> I knocked out the last of my anxiety VERY quickly. Like, as in, I get absolutely ZERO anxiety now. I've conditioned myself to go the other way with my thoughts/emotions. X1 removed anxiety that I had for nearly the entirety of my almost 40 years on this planet. So, yes...it'll work for that. Changed my life.

Shanaya shared a similar tale of support but added the extended credibility around the fact that the device had the approval of her therapist. The idea that she was using this device in conjunction with traditional psychotherapy made her a favourite self-appointed X1 ambassador. She shared with the online group:

> I saw my therapist today and showed her my X1. I told her how I was able to break my mindless eating habit and she was very impressed. Next time I see her, she wants to talk about how we can utilize the X1 in conjunction with therapy to break me of my negative/self-destructing thoughts (which has been inhibiting my confidence and motivation). Long story short: My own mother has been emotionally abusive to me all my life... 30 years now. I'm a failure in her eyes because I have not lived up to her expectations. She still has a hold on me, despite me being over 30, having two kids, a college degree, a husband and a job. I want to break free. Her words have been ingrained into my soul and it's not like turning off a light switch. Therapy has been helping, but I think the X1 will give me a boost to overcoming this.

However, not all users have positive experiences to share online. One user, Telulah, posted a note on an X1 forum calling the device possessed and evil, urging other users to "get out as fast as possible". Her comment sparked a flurry of activity with her erstwhile support group banding together against her and cautioning her to follow group guidelines that were built around positivity and a spirit of learning. The next morning, Telulah, posted an apology to the group saying:

> Yes, I am crazy, unfortunately. I was diagnosed with Bipolar 5 years ago and my diagnosis changed to Schizoaffective about 9 months ago. I have paranoid thoughts that are incessant and plaguing and persuasive. Unfortunately, I acted on them last night… I said shit to you guys about this device being possessed and evil. It felt evil. I woke up saying "I didn't really say that did I?" I called my support worker and got my 2 weekly dose and talked to her about what I can do to stay well. I'm going to go device free for a while and go to a respite centre for a couple of days. Also, I'm going to stay away from Cannabis as it makes me nuts. I'm sorry for the things I have said... You deserve better than that.

After posting this message, Telulah deleted her profile from the group. Once Telulah had left the group, there were exchanges between members enquiring after her. One member commented:

> She needs help. This here, is low grade. This isn't a medical device after all … Shame about her leaving though. Does anyone have her deets? Sounded dire.

While some users embraced their diagnosis or medicalised their experiences, others rejected these labels. For instance, Ben, the device creator encouraged Bart, who had been diagnosed with schizoaffective paranoia to consider his experiences as normal, saying: "These are just voices. We all have them. Nothing is wrong with you." Within this community of followers, there is the occasional tale of levity linked with an X1, such as the

experience of Ash who used the device to prompt himself to work up the courage to ask women out on dates when he passed attractive women on the street or at a bar. Yet others were promptly shut down by the community as abusers for misusing the device by choosing to use it on children or as pranks.

Eventually, the spirit of collective recovery that pervaded these groups served to crystallize around ideas of similar experiences of suffering scaffolded by mental health labels, whose sting was dulled by the device. Rather than experiencing their suffering as an internal or private sensation, these communities of suffering aligned along the fault lines of technology, consumption and ideas of normative inner worlds to collectively construct and transform affect into a more positive experience (Stephens, 2015). Melissa, a 27-year-old woman who uses the X1 to manage her anxiety, summed up in an online forum:

> The premise of this device is that the solution to "stress" is for the individual to work on themselves to be better able to tolerate the stress of their present familial-socio-political-cultural situation. The underside of this approach is that the person does not feel stressed enough to do something to change their external situation. Perhaps life could become better if more people became empowered and were actively creating positive changes in their relationships and even in their society, government and cultural worldview. At least this device appears to not have the physically damaging effects of many other methods of obtaining numbed passivity (such as bingeing, alcohol, illegal drugs and pharmaceuticals).

A separation and categorisation of their labels and conditions vis-à-vis their identity as individuals was a recurrent theme among users with diagnosed mental health conditions. While their conditions seem to dictate how they viewed themselves and their interactions in the real world, the device allowed users to bracket and choose to distance themselves from their conditions when the sensory experience provoked by the device “kicked in”.

After analysing the experiences of users, I propose that mental health wearable devices present an attractive tool for self-disciplining what is often perceived by users as an unruly and distressing inner world. This inner world, however, is shaped by social norms that define wellness as an ability to function as responsible and well-regulated individuals within society. While users adopt these devices for a range of reasons, the primary goal of self-improvement is seen as an extension of self-responsibility for one's own well-being. Communities of users often take on the dimensions of a sympathetic and supportive community of sufferers. To some extent, these communities draw their group and individual identity from belonging to a group that is in pursuit of an improved self and that seeks to gain control over their challenging inner worlds. Eventually, by interacting with both these communities and their devices, users seek relief that hitherto had only been available through psychotherapeutic or coaching sessions with other qualified professionals, which are often stigmatised owing to the social narrative of deficit that frames mental health struggles. Psychologist of even emotional coaching sessions can be expensive as well, at an average of 100AUD per session. Within this context, devices and user communities develop an authority that was previously earned through rigorous training and professional membership to psychological practitioner groups that are recognised and regulated by governments and clinical bodies. In the next chapter, I present ethnographic data that shows how the process of self-quantification is enacted by users and discuss the implications of self-quantification for what has hitherto been the domain of qualified mental health practitioners.

Chapter 3: I measure; therefore, I am: regulating the quantified self

In this final chapter, I examine the phenomenon of wearable mental health devices in relation to the idea of the quantified self. I enquire whether the transformation of embodied experience into quantified data influences the experience of device users, and examine whether devices aid users in creating a coherent understanding of themselves and their circumstances (Sharon, 2017). I argue that users' reframing of their self-perception in response to quantifiable parameters and data indicators creates a richer dynamic within the space of mental health discourses and practice for device users. The mass development of wearable mental health devices means that the authority previously accorded only to licensed practitioners is extended to individuals, who now have an increased ability to interpret their own mental health experience in relation to psychological frameworks.

At least in the perception of users, devices become material representations of authoritative medical knowledge that is configured within numbers and visualisations of internal intangible processes. This perceived authority in some cases enables users to develop self-care routines that integrate other medical interventions, such as taking sleep medication or behavioural modification that is informed by popular trends such as mindfulness, breathing techniques or group therapeutic practices. Additionally, this chapter presents a comment on the views of a mental health practitioner, in order to place the use of these devices within the context of contemporary mental health practice. While users integrate their efforts to quantify their minds into everyday practice of other self-care routines such as exercise, they communicate ideas drawn from their self-quantification to their medical practitioners. In certain cases, practitioners themselves recommend the use of devices to better understand and aid patient self-care. The chapter concludes by attempting to understand whether wearable mental health devices might bring about a shift

in the way mental health interventions are designed and deployed currently, and in the future.

I measure, therefore, I am

Hannah is a 49-year-old Welsh woman who had moved to Sydney six years ago and had been going through a trying time with her personal life, because she is a recovering alcoholic and she had been contemplating ending her marriage. Amid her struggles to cope with her circumstances, Hannah has also been attempting to work through her anxiety that is exacerbated by daily events. Hannah and I were driving from the central business district in Sydney towards the school that her daughter attended. She had said we could talk about her device usage while I chauffeured her there from an afternoon tea that had been organised by other school mums. Hannah's six-year-old daughter also wore a device that allowed Hannah to measure the amount of sleep her daughter was getting. Hannah said to me, laughing:

> She gets super cranky with me when she hasn't slept enough. She looks at the images around her sleep on my phone now and knows when she needs to be in bed. It makes it more concrete, reduces the intensity of the bedtime battles. Sometimes, I think of it as the judge and jury.

As I sped towards an amber light to avoid being held up by a red light during the school pickup rush hour traffic, I kept an eye on my speedometer to make sure I was driving within the speed limit. Hannah gripped the edge of her seat. "What's wrong?" I said, "we'll make it in time, don't worry, I'm going as fast as I can, about as safely as I can," I attempted to reassure her. "Oh, I usually take the bus. This is too fast - look", she showed me the interface of her wearable control on her mobile phone. "My BP's going up. I can't handle it. My heart!" she smiled nervously. "Cars really make my anxiety so much worse." I pulled into the slow lane and dropped my speed to ten kilometres under the

speed limit. “That’s a little better,” she said, as a bus overtook us. “Look, it’s even dropped a bit,” she added, showing me the live reading of her blood pressure as we drove into Sydney’s lower north shore over the harbour bridge.

Hannah hasn’t sought any medical advice or psychological support for her anxiety because of the associated cost and because she wishes to feel she is in control of her own recovery. As we talked about her struggles with daily tasks, and how the device she uses helped her navigate her experience of stress, Hannah elaborated:

> I can work through this stuff myself. What are they going to tell me? I need to stop drinking? I know I’m shit when I’m drunk. I know I’m kind of stuck. But I need to work through my shit myself. Nobody else can help me with that. I know I’m stressed out. I know I self-medicate my pain and my shit life with alcohol. I hate the AA meetings. Makes me feel even more hopeless with all these people moping about their lives. I don’t want to go whinge to a shrink about my life. I’m going to sort shit out myself. I walk five kilometres every day. I try to drink only when I’m out with friends or family. Knowing how my body is coping helps me feel like I have micro control, you know. I can’t change the big things. I can change how much I walk. I can change how I’m breathing to control my heart rate. I’m in control of myself. Not my husband. Not alcohol. Not my shitty job. Just me, you know?

Hannah was not my only interlocutor who validated stress as she experienced it with a machine-sensed and interpreted visual map. Tony, another informant, met me on a hot summer day after he had been out walking. Perspiration was dripping down his brow. As he mopped it up with a large white handkerchief, he said to me: “Fuckin’ heat really kills me. I’m on my feet all day.” Tony worked as a bartender. Owing to the hours he worked, maintaining good sleep hygiene was his biggest challenge. Tony informed me that he

regulated his use of sleeping tablets based on his sleep maps to ensure he is rested enough to be able to function adequately at work:

> I know that if my sleep is off, if I'm not getting' enough REM sleep, I'm gonna be tired all day, like, I'm pourin' drinks, like, chatting these fellas up, but I can't wait to be done, yeah? Sure, my X3 doesn't cure how grumpy I can be, doesn't make me sleep better, but it makes me more aware, like, I know I haven't slept well. I also know that without any effort, I been walking more than 15000 steps most days – that's a lot, like, I exercise. That helps. I just gotta find more ways to get better sleep. I know that if I'm not getting good sleep, when I can't see that REM sleep there, like, it's not gonna be a good day. You get all kinds of people at the bar, like, if fights break out, or some bloke's being smart, I gotta be able to think on my feet, yeah? How can I do that then? Yeah? If my sleep is fuckin' all over the place, yeah? So maybe I'll take some Seroquel the next night that I don't have good sleep. That helps keep things down, like.

The embodiment of mental distress presents a base physical factor upon which many users understand their emotional states (Lock, 1993). However, a paradox that is presented by mental health wearable devices is that while urging users to be constantly observant of their experience and behaviour, the device offers itself up as the receptacle for transference of embodiment rather than the user's body itself. Gail, a 24-year-old X2 device use, commented:

> I think of it as transmuting energy. Think about it – it's all energy, yeah? We are all energy. So, when I look at my screen and see my breath, and when I use my X5, along with the X3, I see my brain waves too, not just my breath – it's all right there. I can see it happening. But it's more real outside me on the screen than inside, you know? I feel the difference, when I see the waves change, when I see

> my breath steady and moving in time with what I'm being guided to do. When I'm driving and it's buzzing me telling me I'm too tense, it's fucking annoying, but it's outside me, and not a person I can scream at, but it kind of is. Like, an extension of me. So, it kind of connects my energy with the rest of the world and others around me better than I can.

The constant, quantified feedback that some of these devices provide raises questions about whether a device can actually allow a user to become aware of their embodied experience. In therapeutic approaches such as ACT, such practice of bodily awareness and integration of emotion as manifested bodily is considered the first step towards attempting to shift distress. Using one's body as an anchor is among the more popular modalities of therapy that is encouraged amongst clients seeking psychological help, to enable them to transform a distressing event in their minds into a bodily event. Simply by virtue of being a visible and tangible counter-point to the invisible turbulence experienced by an individual in mental distress, the body presents an anchor that draws the sufferer into the physical world where there might, in fact, be no turmoil. The stillness and comfort of being contained within one's body forms the base upon which the user can re-frame her reality cognitively rather than just experience it viscerally. Indeed, devices might distract from an internal experience that might need considered approaches, such as trauma or unhealthy thought or behaviour patterns that stem from deeper unresolved emotional or even physiological issues. Attempting to shift bodily responses from moment to moment may not be enough for reliable and lasting recovery from distress that might stem from circumstantial or other factors. However, the experiences of users I have presented in this chapter demonstrates how users look to their devices and the data that these devices present to self-regulate and change their behaviour, ranging from micro-changes such as breathing more deeply to larger routine modifications such as changing their sleep habits. The propensity of users to choose devices seems to be

impacted by the allure of the narrative of being self-reliant, which is a quality that is frequently valorised within western society. The convenience of instant bio-feedback that the devices offer, as opposed to group sharing and reflective practices with human-centred support groups such as Alcoholics Anonymous, sometimes results in a distancing of emotion from the experience of selfhood to a degree where disembodiment and dissociation from distress is held up as a preferred way of being in the world.

Wearable devices are relatively new technological innovations. Therefore, there is limited data to indicate the long-term impact and effect of device usage within health, much less, mental health contexts. However, my research indicates that mental health wearable devices might serve as signposts to individuals seeking relief from varying degrees of distress. Further, there are many ways that users take up and engage with their devices, and these carry different social and therapeutic implications. With the development and refinement of the technologies to improve the functionality of these devices, mental health wearables might indeed provide a veritable alternative to clinical psychotherapeutic modalities of treatment and offer an alternative, or at the very least, a useful supplement to understand and improve individuals' experience of mental ill health.

Potential impact on clinical practice

The dramatic shift toward self-regulation of physiological experience as prompted by mental health wearables raises questions about whether these devices will significantly shape clinical practice. While it is still too early to comment on how devices might shape clinical practice, several major hospitals and government-funded studies within the mental health space are moving towards an active and enthusiastic attempt towards integrating and embracing mental health quantification technologies (IRPWC, 2018: 9). Some therapists encourage their patients to regulate their own behaviour using devices as an aid, encouraged by the fact that many of these devices are developed as an extension of

existing treatment protocols such as CBT and ACT. Some other therapists express concerns about safety, including the ways that some might use these devices to avoid therapy in attempting to manage their own mental health independently. This may carry ramifications on the internalisation and isolation that device use might perpetuate in individuals who might already be pre-disposed to unhealthy ways of relating with community and self. Some therapists argue for the value of interacting and working through challenges in interaction with another human being rather than with a faceless non-human device.

Dr Jeremy Benedict, a neuropsychologist who specialises in treating neurodiverse clients, explained:

> Some of my patients complained that they had crushing headaches, or their vision was blurred after using an EEG based headset in my practice. I use it with my patients with ADHD for neurofeedback. Some of them order these devices online and use it at home. That sort of thing is totally unsupervised. At least here, I have protocol, should something go wrong. And if I think it isn't working, it isn't working. It also helps to make sure they are coming in for treatments. Compliance is a problem with medication or even regular therapy. But these sessions are different, so there are fewer cancellations, and people will adhere to the course of treatment. The continuous monitoring while they are in my clinic is helpful. Sometimes, if they are using other devices, they will often show me their charts too, so I know how they are progressing over time. I think it's incredibly helpful.

Despite the positive feedback that most devices within the industry have received, the negative experiences point to the need for stringent advocacy, transparency and improved ethical guidelines and the enforcing of these regulatory standards. While some users complained of physical side effects such as sensitivity to materials used, other users complained of being electrocuted by their devices. Some others with diagnosed mental health

conditions found that the devices presented a tempting treatment option – something that they could control, that promised no side effects unlike pharmaceutical treatments, and that presented a possible permanent solution. We saw this in the experiences of Telulah and Hannah, while others, such as Tony, looked to their devices to monitor their symptoms and self-medicate.

Dr Benedict insists that the patients who use these devices do so only under his supervision for the first few weeks when the technology is introduced alongside the talk therapy he provides them with. He explained that mental health devices will not, or should not, replace clinical therapeutic practice:

> You can't just vanish on your therapist and start treating yourself with these things. Companies will claim a bunch of things. If you have a mental health issue, you need treatment within a practice. It's that simple. We aren't at a point where technology allows us to heal in isolation, to do anything in isolation. That's counterproductive. You just can't do that. That's the danger when you just market these things ahead of the curve. If you've got 10,000 users, you've got those many interpretations of how the device is working. I think there needs to be a new way in how we think about these types of devices. We've been throwing more money at the technology, because it's expensive to treat sick people, when you can't see how they are sick. So, this isn't a silver bullet. No amount of chat bots or virtual reality or apps or wearables will make that all go away. There really is no shortcut, and the danger is that sometimes, these devices can seem like a magical shortcut.

The impact these devices will have on therapeutic practice is still unclear. There is an increasing trend towards using devices instead of clinical practice within western contexts where wellness devices are popular. This might very well indicate another form of medication used to self-medicate, in this case, self-mediate, in order to improve one's

sense of wellness. Instances of devices being integrated into clinical practice are not just growing but being encouraged by a systemic drive towards increasing the reach of mental health support within areas where the ratio of mental health practitioners to patients is low (Falconer, Kho, & Docherty, 2018). This technology builds upon, but significantly extends the emphasis on the physiology of mental illness established by biomedical psychiatry. It also develops the practices popularised within psychological practice such as CBT and ACT through moving emotion into the realm of cognition, integrating these practices with popular trends around meditation and mindfulness as efforts towards self-actualisation and good health, eventually, indicating the pinnacle of self-responsibility and therefore, moral and civil achievement in a western context.

Conclusion

In attempting to examine the major nodes in the phenomenon of mental health wearable device creation and use, I have interviewed and engaged with multiple researchers, device creators, users and community groups. The experiences and profiles of usage and development agendas that I present are varied but point to some overarching ideas. Mental health wearable devices advance the idea of interiorization of self-regulation among individuals who use these devices and promise the possibility of achieving higher productivity within organisations where these devices are promoted. Secondly, these devices are being used to co-construct and reframe understandings of mental health and mental illness through the framework of medicalisation, further reduced to autonomic and involuntary bodily function. I call this signposting of affect into measurable and tangible digital signals "artefacts of emotion". While this process of digitisation of emotions might seem to disable the individual as an active agent in her wellness, wearable devices for many users play an important role in validating and offering a sense of coherence and authority to the individual around her suffering, thereby increasing a sense of agency, owing to the fact that the user feels exempt from taking recourse to more traditional means of seeking psychological help. The implications around the future use of devices in mental health care are largely only surmisable currently since the mental health wearables phenomenon is still relatively new and inexpensive, consumer technology and algorithms are still in development. Technology that is more reliable and enabled by more sophisticated artificial intelligence is expensive for individual users, and primarily used by organisations and within centralised healthcare settings. Eventually, mental health wearable devices transform mental and internal, personal experiences of distress and mental illness into artefacts that can be tangibly observed, and even manipulated through simple bodily and conscious practice of particular habits of mindfulness and change in breathing patterns. In this regard, the movement towards adoption

of measuring mental health through wearable devices is a demonstrations of cyborg beings in practice, extended and attempting to be optimised through devices that are integrated into their daily lives.

I would like to draw my reader's attention to the fact that my experience within this world and perception of this phenomenon has been coloured by Foucault's ideas on biopower. While I have attempted to remained self-reflexive around this, and moderate my personal preconceptions around governmentality, I have invariably seen this phenomenon through the lens of the panopticon where continual surveillance eventually leads to self-regulation and internalised practices of disciplining the self (Foucault, 1977). While surveillance and the governing of bodies is intricately linked, in philosophy, this isn't necessarily a new phenomenon; however, the deployment through this family of technologies is. The shift in the manner of surveillance and granular detail available to individuals and organisations has been augmented through the use of wearable devices. The imperative to map human bodies against ideas of optimal functioning and narratives of normativity, driven by neoliberal capitalist framework of selfhood and productivity has merely found another register of expression through mental health wearable devices.

The unprecedented potential that these devices offer to the project of producing and disciplining bodies and minds warrants more interdisciplinary attention – not just from scientists, but also ethicists, ethnographers, and regulators across academia, industry as well as citizens who use these devices (Nebeker et al., 2016).

The democratisation of technology as a result of wide wearable device use, easier access to open access and crowd-funded and crowd-sourced technology, the accountability demanded of larger organisations because of the ability of populations to exercise bottom-up surveillance of institutions are all manifestations of power exchanges in practice. Further, the stark differentiation between subjects and objects within power exchanges is no longer as

evident within the realm of consumer users of mental health wearables. This is a result of the interchangeability of the subject and object position of users who inform how technology is developed and used upon them, particularly within the consumer market for these devices. The ability of the user to stop use at any time, and manipulate data is also an expression of closer integration and authority exercised by the user within the assemblage constructed around devices.

The move to increase public involvement and transparency while working towards collaborative science and a call to ethical design amongst academics, researchers and developers bodes well for individuals hoping to benefit personally from the use of wearable technology to improve their sense of wellbeing (Mittelstadt, 2017). The need for improved regulation, might lie, therefore, not so much around the technology itself, neither the hardware, nor the software, as much as for the organisations that may profit financially from the interpretation of data generated by this family of technology. The "unholy nexus of insurance providers and employers", as one of my participants, James, called it, is a critical node within this system that needs further examination and transparency, rendering it visible to users, citizen scientists, and user groups who desire increased accountability and a redistribution of power hitherto accumulated by and concentrated within traditional institutions.

No amount of regulation of the sensors, of usability restrictions surrounding the artificial intelligence machine learning algorithms, of increasing the diversity of the training data sets employed or even improving accessibility to beneficial precision mental health technology will shift the location of power that drives the larger enterprise that I discuss within this project – the use of mental health precision technology to form and re-form individual ways of being an optimal citizen. The power held by the large multinational corporations that buy and sell the technology and data generated by individuals is protected

behind proprietary software terms and conditions of use, and a non-democratic opaque organisational vision driven primarily by investor wealth and profits, not necessarily alleviating the suffering or distress of individuals or necessarily even workers impacted by "unnatural" or stressful working conditions. Therefore, the premise of the devices is really – when the environment cannot be modified, shift the internal environment of the lowest common denominator – the workers – to create an internal landscape that enables the larger project of neoliberalisation.

As our ability to process big data and make meaningful links between user behaviour and user profile maps increases with technological development, profitability is the key driver around where and how this technology is developed further. The push for accountability and transparency from private organisations who fund, develop and own these AI-driven technologies is a gap that researchers, citizen scientists and policy makers need to pay immediate attention to. Limiting the liability that people, and not organisations, are exposed to by improving the governance of private organisations owning and accessing device-generated data is an also an area that requires consideration from citizen-run advocacy groups focusing on the ethics that govern data science practices.

My hope for this research project is that it will offer a critical overview and map to people who envision a better individual and collective future through the creation, use and regulation of artificial-intelligence enabled precision technology, aimed at mental health users. In interacting with users of these technologies, I have not found a single model of use but multiple ways in which people engage with devices. Further, vibrant communities of users that several individuals find incredibly helpful in their recovery journeys are formed around the epicentre that devices provide, that externalise a hitherto hidden struggle. Future research that explores in greater detail some of these aspects will be incredibly beneficial to the users as well as developers of these technologies.

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Appendix: Human Research Ethics Approval

Office of the Deputy Vice-Chancellor
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13 December 2017

Dear Dr Groark,

Reference No: 5201700858

Title: *Wear Your Heart on Your Sleeve: How mental health wearables devices are changing the experience of stress, anxiety and depression among urban individuals*

Thank you for submitting the above application for ethical and scientific review. Your application was considered by the Macquarie University Human Research Ethics Committee (HREC (Human Sciences & Humanities).

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted by:

- Macquarie University

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007 – Updated May 2015) (the *National Statement*).

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement*, which is available at the following website:

http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All adverse events, including events which might affect the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol and associated documents must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au