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Taming Cyborgs; Wearable Technology Growth in the EU

Understanding sociological catalysts of wearable technology and EU regulatory measures

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Abstract

This research paper explores potential reasoning behind regulatory responses filed and legislated by the European Union (EU) and its 28 member states in relation to wearable biosensor technology. The premise is that the growth in this type of technology is driven, or accompanied, by a host of sociological trends. In addition, this thesis explores consequent governmental and supranational responses taking shape to regulate this market shift. This premise is put to the test by applying three sociological developments to three case studies. The developments analyzed are: (1) self-surveillance, (2) quantified self and patient empowerment, and (3) neoliberal lifestyles. The three case studies presented are Muse, Fitbit Charge HR, and Google Glass, all of which differ in terms of purpose and data collection. The importance and relevance of this research is marked by the vast data collection enabled by these devices, and the consequent storage and treatment of data. Owing to the contemporary nature of this research the key objective is to discuss and analyze sociological developments that have contributed to this trend, and identify patterns within them.

The research question posed in this thesis is: What drives the growth of wearable (consumer) technology, and how are EU states trying to regulate this development?

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Introduction

Wearable biosensor technology is a phenomenon that began to rapidly take shape in the mid-2000's, and is likely to have a lasting impact. The term 'wearable' is primarily shaped by the idea of a "wearable computer". Examples of this are wristbands such as Nike+, Fitbit, Jawbone, etc., as well as ocular enhancements such as Google Glass. In other words, "wearable technologies" are clothing and accessories that incorporate computer and advanced electronic technologies (European Commission, 2014). The technology focused on within my study is available to individual consumers; thus, the research will not include technology that is produced and prescribed by hospitals or public heath institutions. This is due to the stark difference between regulation of publically health funded and distributed devices, and those produced by private firms (PWC, 2014).

The significance of this research lies in what it reveals about the sociological developments that fuel the growth of the use and production of wearable technology and how this topic is being treated in EU decision-making. The research will contribute to the field through the unique nature of empirical data collected, and the sociological analysis. The data aims to provide means to better understand this topic and will offer timely and contemporary research on the phenomenon. The data also aims to comparatively analyze similarities and differences between the regulations of the 28 EU individual member nations.

Wearable Biosensor Technology

For the purposes of this research paper, Wearable Biosensor Technology is defined thus: Wearable Biosensor Technology refers to a plethora of self-tracking devices designed to be worn upon the body that automatically collect data on bodily functions. The trend has been identified by a chorus of esteemed voices in academia, business and technology; following this, some of their definitions will be discussed and contrasted in order to underline the salience of my definition. In addition, this chapter aims to provide a better understanding of the variety of shapes and purposes of these devices, as well as provide evidence for user base growth.

Generally, the aforementioned technologies that are the objects of this study are fitted with biosensors, pedometers, accelerometers, and Global Positioning Satellite (GPS). In other words, these devices are able to track location, steps taken, bio data, and a variety of other lifestyle and activities data (PWC, 2014). Moreover, some of these wearable devices are also equipped with reactive biosensors that allow the device to respond to changes in bodily functions (Lupton, 2015, p. 17). An example of this would be an automatic insulin injector patch for diabetics,

actively monitoring blood sugar levels and reacting appropriately. Marketing and sales techniques of companies producing wearable devices, such as "Fitbit or Garmin", frame these devices as products that allow consumers to take a more personal grasp of their own health and wellness, by tracking quantifiable information and making it actionable through a better understanding of what the data implies. Additionally, these technologies are also commonly depicted as means of aggregating data, and creating patient or consumer communities (See Quantified Self & Patient Empowerment).

Through the rapid emergence of consumer wearables (See Figure 1 & 2), the growth and importance of wearable biosensor technology to consumers and society has spiraled (ASU, 2015). The Hanze University of Applied Sciences, in the Netherlands, has taken this topic to the forefront of higher education research and teaching by establishing a Quantified Self Institute (QSI). The QSI's mission is "to encourage a healthy lifestyle through technology, science, and fun". The scientific work of the QSI is based on measuring the so-called "Big Five for a Healthy Life": (1) physical activities and sport, (2) food and drinks, (3) sleep & rest, (4) stress, and (5) social interaction (QSI, 2016). Naturally, this relentless growth in terms of availability and usage has piqued the interest of the private sector, and led to a simultaneous surge in utilization thereof in business and organizations. This secondary development has been framed within a narrative of promoting employee wellness (this is discussed further in later chapters). The presumption here is that use will lead to healthier employees, and the corporate desired effect a happier, healthier workforce that takes fewer sick days. Concurrently, it has been observed that insurance companies provide lower healthcare premiums to companies that enforce or promote the use of wearable devices to employees.

Naturally, as the use of these devices increases, the producing companies are rapidly collecting more data. This development raises interesting questions concerning the subsequent storage and treatment of data—namely, regarding data privacy for the consumer, the society, and, in the case of the EU, the Union. As saliently observed within Paul Schwartz's paper, Property, Privacy, and Personal Data (2004), this creates a dangerous development of technology leading to a commodification of personal data. This type of development could be considered a market failure, and requiring regulation. To date, this issue is being loosely tackled on a supranational level by European Union regulation, specifically, by the EU DPD of 1995, a regulation that provides a baseline of data privacy within all member nations. Problematically, however, the regulation is vastly outdated, and does not cover the intricacies faced to date; however, it does set interesting base principles. To further convolute the matter, regulation varies between different member states as national laws differ; as outlined in the data compiled in the Regulatory Matrix enclosed in the appendix. The variation of the regulation and legislation is a

result of a multitude of factors, including industry pressure, political alignment, sociocultural differences, and the economic status quo. In some instances, this leads to national law taking precedence over the supranational (See Appendix). Despite the EU's adoption of a relatively general EU data protection directive (EC, 1995), also known as Directive 95/46/EC, there is still much room for improvement and more ubiquitous regulation that requires enhancing the security of data storage. Plainly put within a PwC research paper on wearable technology in 2014, "Privacy and security are consumer's main concerns regarding the impact of wearable technology" (PwC, 2014). However, as stated within the same research, consumer appetite is subject to constant change and increasingly we witness a growth in willingness to share personal data. We could surmise that this demonstrates a societal understanding of the trade-off (social capital for access to service), putting into question what is more valuable (PwC, 2014).

According to research conducted by reputable leading research companies (Forrester, 2013), consulting firms (PWC, 2014) and business periodicals (BI, MM); the wearable trend is showing a clear growth and forecasts have been excessively optimistic about the market's future. Figure slightly outdated.

[See Figure 1, Forecast Graph]

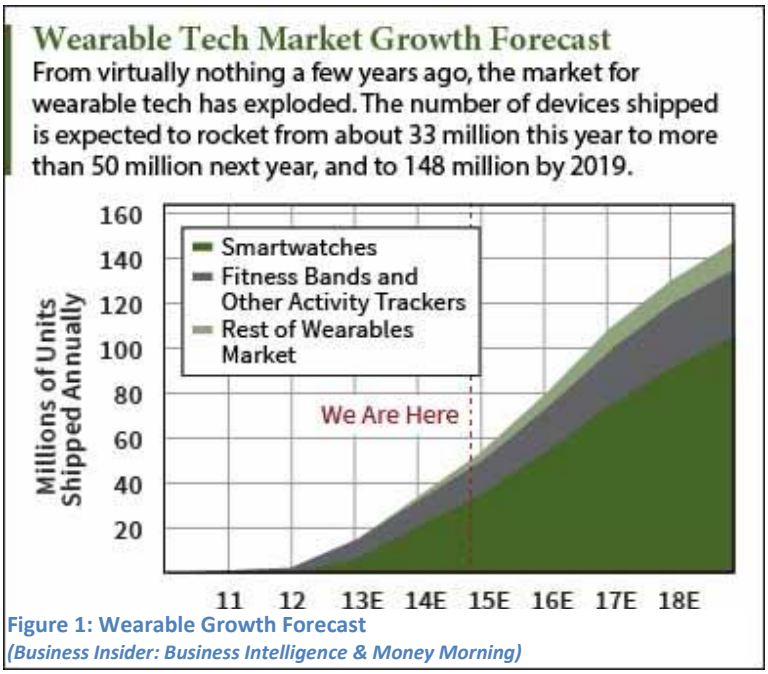

Figure 1: Wearable Growth Forecast
(Business Insider: Business Intelligence & Money Morning)

Contemporary Relevance

This topic boasts importance as its relevance transcends across all EU nations and the growth of the wearable technology trend has already impacted people across all member nations (McKinsey, 2014). Notably, despite the focus on the EU, this trend is not restricted to it, and surges in growth have also been monitored in Asia and North America. However, for the sake of brevity, proximity, and focus, this paper will primarily analyze the phenomenon as witnessed in the EU.

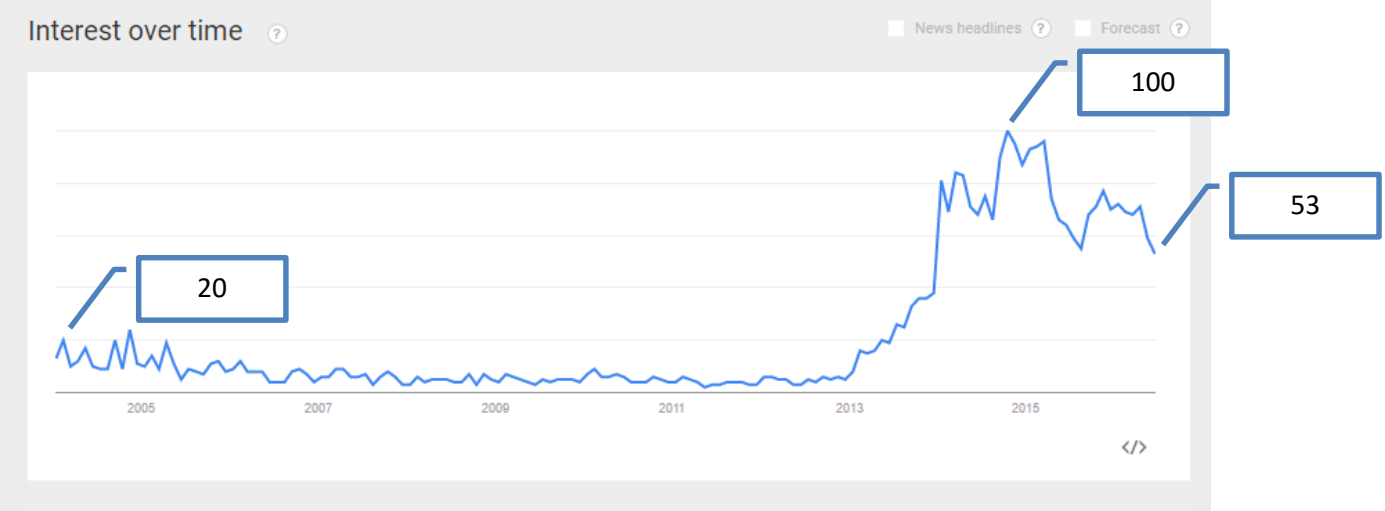

Figure 3: Interest over time – as presented per Google Trends
Data gathered from Google Trends Analysis of the terms "Wearable Technology"

Numbers represent search interest relative to the highest point on the chart. If at most 10% of searches for the given region and time frame were for "Wearable Technology"," Google considers this 100. This doesn't convey absolute search volume.

It is important to note that, if regulations in place will not prevent the data from being extracted and used for third-party purposes, then the future of health insurance premiums, as well as healthcare data is in jeopardy for all citizens, not just those using the wearable technology (Neff, 2013; Akrivopolou & Garipidis, 2012). The definition of healthcare data versus the data collected by wearable technology also needs to be clarified, as the implications and treatment of the data are very different. The gravity of the redefinition of the data protection acts, as well as a potential re-classification of the data is of urgent importance. The topic at hand is narrowly researched and discussed (Weber, 2014).

Finally, the wearable technology case studies juxtaposed with sociological developments should provide answer to the question posed, "What drives the growth of wearable technology, and how are EU states trying to regulate this development".

Research Design

The research of this thesis relies on qualitative study based on a mixed-method design, composed of three types of research. It is comprised of (1) a descriptive element, delving into sociology and philosophical contemporary developments; (2) a correlational element, using a case control study to compare the overlaps between the sociological developments and the device case studies; and (3) a review design, providing a de facto literature review within the discussion of the sociological developments types. The study is also exploratory in nature: the a priori assumption is that there are a set of sociological developments feeding into the explosion of wearable technology. The study contends that we should witness a regulatory response in the European Union in order to deal with these masses of personal data being stored by the companies producing the technology.

Sociological Developments

Accompanying the trends in consumer behavior, and technological progress, a host of sociological developments have driven the growth of wearable technology. The paper focuses on three: "Self-Surveillance", "Quantified Self & Patient Empowerment", and "Neoliberal Lifestyles". In the sections that follow, I discuss and contrast literature, theories, concepts, and research. These theories have been chosen as they pertain most closely to the presumption of overlap between both the growth in wearable technology, and changes in society/social behavior. The decisions made on the choice of sociological developments, as well as why others were excluded, were made as a result of browsing wearable technology community websites, e.g. Quantified self, discussions with experts, e.g. Bertalan Mesko in 2015, and clear indications for behavior altering features.

Self-Surveillance

Surveillance studies literature and research has enjoyed unwavering growth in the 21st century, and its relevance to Wearable Technology is nearly self-explanatory. Surveillance often brings to mind privacy, as this is generally what is feared to be lost if surveilled. Famously, Michel Foucault has spearheaded academic discussion on surveillance. In 1975, Foucault discussed his concept of the sociological 'Panopticon', a theory constructed in order to refer to a rigid power structure contained by a laboratory, that could ultimately alter behavior (p. 208). The conceptualization of a panopticon was designed as a blueprint for an institutional building much earlier by philosopher Jeremy Bentham. Bentham's structure was circular, with a guard tower ("inspection house") at its center, with a total overview of all cells. The overview was not reciprocated, so that only the guard could see the inmates, and not vice-versa. This essentially provided a system in which inmates would not know whether or not they were being watched, creating a system in which inmates would have to consistently behave as though they were being watched. Foucault viewed this as symbolic for the disciplinary nature that surveillance had on people and society.

Today, I contend that we find ourselves in the panopticon that is defined by our use of technology. The idea that the panopticon theory is no longer entirely accurate, due to structural, technological, and societal changes, was introduced by Roy Boyne, in his article on 'Post-Panopticism' (2000, p. 288). Peculiarly, the vogue of self-discipline through self-surveillance has shifted people's attitudes to voluntarily enabling software/technology to track information or data on our behavior. However, the guard watching from the tower is no longer just a stranger,

but rather the consumers of the technology, embodying the Foucauldian notion of neoliberal self-governance. Simultaneously, though, consumers are watched by the companies producing the technology. An example of this would be consumers purchasing the fitness tracker, 'Fitbit Charge', in order to monitor personal movement and sleep pattern, yet simultaneously Fitbit collecting the data as well. This development can be marked by the change of attitudes towards sharing personal information and data, also referred to as the social data revolution, that began in the early 2000s. The rise of social networks provided a fertile ground for this behavioral shift, as well as providing ample opportunity for people to share social data. This ongoing phenomenon has resulted in what experts have described as the aggregation of unprecedented amounts of public data (Weigend, 2009; Fuchs, 2013, p. 109).

In addition, it can be argued that self-surveillance has been fueled by the use of gamification, in order to reframe the mundane daily activities and evoke behavioral change in users of said technology. Jennifer Whitson (2013) has asserted that "gamification is reliant on quantification", and that only by "everyday use, constant data collection and continuous feedback" does the data collected become increasingly refined and valuable (p. 167). A sentiment that we see being reflected by Foucault, who claimed that digitalization encourages, "care of the self", and Whitson (2013) echoed this as she argues that this caring of the self provides means to better participate in a community, and this community provides additional reason to share. The drive of this type of behavior is also linked to the reframing of narratives surrounding monotonous tasks (e.g. commute to work), or behaviors that are pursued as a playful exercise and providing means of achieving mastery, or to distance oneself from the masses. This can also be found in the workplace, as employees' competencies can be monitored in a corporate hierarchy, and efficiency can be increased (Whitson, 2013). Overall, as long as the framing of the activities conducted is performed in a playful manner, and the 'work' or activities performed do not come across as laborious this type of data collection and technology use can insidiously increase in years to come.

This effectively forecasts a continuous growth of both the gamification and self-surveillance trends. Critiques of the developments of self-surveillance generally point out the problematic dynamic between personal optimization and labor, the common claim being that, although enshrouded in an aura of self-help, self-surveillance is inherently in the interest of the companies and corporations producing them and collecting derived data.

Quantified Self & Patient Empowerment

The quantified self (QS) and quantified-self-movement (QSM) are comparable to the sociological development of self-surveillance. However, unlike the self-surveillance movement, QSM is a more recently coined term and concept describing the vogue of quantifying personal behavior through the use of technology (Wolf, 2007). In other words, one could describe the QSM as a movement that transforms people into numbers. More specifically, data collection and analysis offers insights into a variety of aspects of daily life:

> We tend to think of our physical selves as a system that's simply too complex to comprehend. (…) You can observe it all through the numbers. Everything is data. You are your data, and once you understand that data, you can act on it. (McClusky, 2009)

The founders of QSM claimed that the point of the movement "is to help people get meaning out of their personal data", as well as "to support new discoveries about ourselves and our communities that are grounded in accurate observation and enlivened by a spirit of friendship" (Wolf and Kelly, 2015) The type of activities monitored can be understood as a variety of inputs and outputs such as: food consumption, mood, blood pressure, distance/steps walked, geolocation, brainwave activity, insulin levels, and more. The shared belief of individuals involved in the QS movement is that data and knowledge collected by technology will result in a better understanding of one's personal health (mental, physical, or emotional). To date, the QS movement is internationally represented by thousands of members, and grouped together in hundreds of groups and communities (QS, 2016). The data collected is often analyzed in order to detect patterns. Data visualization is automatically provided (usually in the form of graphs) by much of the tech, as well as of the software provided in many of the cases. In contrast, a number of opponents of the QS movement believe it to be a dangerous fad, putting people at risk and wasting the time of doctors and patients. It is often argued that collecting the information is one thing, but understanding the data is another, creating a divergence between data and so-called 'actionable data' (Lupton, 2016, p. 91). The risks of acting on apparent causations in data that may just be correlations are often pointed out as dangers for the public by the opposition of the QSM.

Whether it is as a consequence of, or, occurring in parallel to the QS development, the patient empowerment vogue has grown exponentially. Amongst contemporary champions of the movement are medical futurists such as Dr. Eric Topol (2015, 2012), Dr. Rafael M. Grossman, and Dr. Bertalan Mesko (2015), who believe that patient empowerment provides people with the means to better equip themselves with knowledge, and break down the information

asymmetry between doctor and patient. Topol (2015) argues that smartphones are the most rapidly adopted technology in the history of man, and thus need to be heavily relied upon in this medical revolution that intends to shift the power dynamics of doctor visits, etc. This is directly reflected in the narrative created by medical futurists in books and articles that intend to shine a light on the paternalistic nature of healthcare, as well as the ingrained authoritarianism it carries (NYT, 2015). In line with QS, empowerment relies on technology and smartphones in particular. If used effectively, smartphones can remedy patient-doctor inequality and provide patients with access to personal medical records, and can be utilized in order to generate data and graphs (Topol, 2015). The argument for patient empowerment also draws legitimacy from the abundance of chronically ill patients that have been underutilized to provide feedback on the care techniques and models to which they are subjected. Accordingly, establishing more patient-centric care models would provide chronic patients with more involvement and create a more horizontal collaboration structure between the patient and doctor, in a development that has been referred to as 'healthcare democratization' (Lupton, 2016, p. 88). The empowerment movement's ethos often relies on the credibility and clout of the WHO, and the Alma Ata Declaration statement in 1978, stipulating that: "The people have the right and duty to participate individually and collectively in the planning and implementation of their healthcare". To date, it is argued by empowerment supporters, people are not provided this type of experience or treatment, and are heavily relying on the expertise of the practitioner (Lupton, 2016; Topol ,2015; Mesko, 2015).

Neoliberal Lifestyles

The third, and final, sociological development discussed in this paper is neoliberal lifestyles. As a whole, this is an umbrella concept, covering a range of different lifestyle trends. To further convolute things, the term neoliberal and its meaning has been obfuscated by decades of academic discourse, political rhetoric, and general misappropriation. Due to its ill-defined nature, neoliberalism is not clarified by a consensus definition. Nonetheless, it is generally marked by ideas pertaining to privatization, individual choice, deregulation of the private sector, and societal governance by means of market mechanisms or laissez-faire government (Mayes, 2015, p. 33). When discussing neoliberal lifestyles, it is near impossible to neglect Foucault, and how his thoughts and theories have increased academic awareness and pursuit of the understanding of biopolitics and bioethics. In the posthumously published lecture series based on audio recordings, 'The Birth of Biopolitics', Foucault develops this theory and traces its origins back to 18th century political economy, and the shift in government rationality (Foucault,

2008*). Neoliberal lifestyles could be considered a derivative of the more broadly categorized concept of biopolitics, and will be discussed in relation to the growth of wearable technology.

A neoliberal lifestyle, or neoliberal lifestyle choices discussed in this paper, are marked by the following: (1) striving for self-discipline through behavioral changes, (2) maximizing individual autonomy and decision making, (3) and extracting the most possible profit from a situation or a decision.

The modern workplace has witnessed trivial standards, such as dress codes, and protocols develop as a means of producing a cohesive and uniform workforce, in what the sociologist Richard Sennett has described as the "infantilization of the workers" (2004, p. 103). This could be considered to have been reflected in some of the technology, particularly in the gamification of health, as manifested by the setting of certain, seemingly trivial, targets.[1] An example of this would be receiving an award for having walked at night as well as daytime, within 24 hours, whilst wearing a fitness tracker, as well as the manner in which the technology positions itself as an authority by providing paternal information and behavior suggestions. The relationship of the consumer to the device could be compared to the manner that a child may consider the reign of the father as an unquestioned phenomenon, as the child's capacity for reason and think independently is underdeveloped, as discussed by John Locke in his critique of governmental paternalism (1689). In addition, people are becoming more willing to exchange personal data for experiences or services. This is reflected by Zygmunt Bauman (1999), in his statement that:

> It is not 'health' with its connotation of a steady state, of an immobile target on which all properly trained bodies converge – but 'fitness', implying being always on the move or ready to move, capacity for imbibing and digesting ever-greater volumes of stimuli, flexibility and resistance to all closure, that grasps the quality expected from the experience-collector, the quality that indeed she or he must possess to seek and absorb sensations. (Bauman, 1999, p. 23, as cited in Boyne, 2000)

Interestingly, this provides reason to believe that yet another reason for neoliberal behavior is an apparent drive for achieving freedom, freedom to experience. This tenet of the neoliberal self is interesting as it asserts that freedom is located in individual actions (mainly consumption) rather than provided by participation in formal politics (e.g. parliament, voting). Wearable technology conceives of the key to fitness, the ultimate goal, as consumption. The aforementioned consumption that Boyne (2000) refers to takes shape in the form of sensory stimulations. Thus, in a nutshell, the drive for fitness, and the subsequent drive for autonomy, could also be summed up as a mere behavioral proxy for acting in one's own self-interest. In

[1] As can be seen in the apps and on the user interfaces for Fitbit, Nike+, Garmin, Apple Watch, and others.

addition to this, Bauman (2000), alongside Giddens (1991) and Beck (1992), constructed a derivative of the theory of reflexivity, known as self-reflexivity (Lupton, 2015). The idea behind this social construct is to provide reason for the behavior of "seeking information and making choices about one's life in a context" (Bauman, Giddens, and Beck as cited in Lupton, 2015, p. 46). In the context of wearable technology, this can take the shape of changing habits, not just for personal reasons, but in order to remain timely and en-vogue; there's a societal aversion towards those who become developmentally complacent.

The aforementioned sociological developments and theories pertaining will serve to provide a backbone and substantiation for the overall growth of wearable technology throughout this research paper. On the basis of these three developments used as criteria, case studies will be gauged for their overlap or contrast, and conclusions will be drawn.

Regulation at the Nexus

With regard to the growth of wearable technology and a perceived loss in personal/data privacy, ample discussion erupted surrounding the blurred lines of data ownership. This chapter sheds light on the convoluted nexus between regulation and sociological developments feeding into the vogue of wearable technology. It provides a working definition of regulation, discusses alternatives and reasons for the definition utilized, and explains the implications that the growth of wearable technology has on data collection, and data privacy. This chapter demonstrates that, through an exponential growth in wearable technology use, societies are witnessing behavioral changes on a dramatic scale. In the wake of these changes we are witnessing unprecedented levels of personal and/or medical data being collected by private companies, which calls for governmental intervention and/or regulatory responses. Finally, this chapter provides a regulatory overview by referring to the regulatory mapping exercise conducted to offer a succinct overview of regulation and directives in place in the EU 28 (See Appendix).

Regulation

In this paper regulation is defined as setting reliable standards that provide mandated behavioral or market-related alterations, instated with an incorporated infringement mechanism (in the form of punishment, financial, legal, etc.).

The definition that this paper relies on is significantly shaped by Christopher Hood (1999), according to whom regulation exists in order to provide three necessary services: (1) standard setting, (2) behavior modification, and (3) information gathering. Through standard setting, the aim of regulation is to set direction by providing a target, objectives and means of compliance. Behavior modification can be enforced via advice, persuasion, or the threat of punishment as a regulatory mechanism (Hood et. Al, 1999). Finally, information gathering is conducted through elements of detection. This can arrive in the form of monitoring, requiring assessments, or self-assessments (Lodge & Wegrich, 2012, p. 116).

Sovereign entities, organizations, supranational systems, and federations regulate for a number of reasons, which may greatly differ from the perspective and theory substantiating the claim (Hood, 1991). Traditionally, and also in the case of standard economic theory, regulation has been conceptualized as a mechanism that overturns market failure, and alleviates imperfect conditions (Arnould & Grabowski, 1979). However, more recently this theory has been questioned, as a growing amount of regulatory actors are not associated with the state. This is also reflected in the Liesbet Hooghe and Gary Marks' conceptualization of multi-level-governance, which refers to the "entanglement between domestic and international levels of

authority", e.g., EU vs. national regulation (Hooghe and Marks, 2001). Moreover, within this paper the underlying theory behind the word regulation implies "intentional activity that seeks to alter the behavior of another party" (Lodge & Wegrich, 2012, pp. 96-102).

Critical standpoints on how regulation is enacted, as well as its purpose, differ greatly. Through comparisons and juxtapositions of various experts' points of view on the subject, as well as critical analysis of the status quo and developments, some assumptions and predictions can be made. At the forefront of useful scholarly discussions on regulation, Julia Black of the London School of Economics has established numerous striking arguments. In her literature she discusses a variety of angles from which regulation can be viewed and also a variety of angles on how it is manifested. Namely, she discusses the difference between authors who believe regulation to be central versus those who argue for the decentralized phenomenon of regulation. Black (2002) argues that "the role of technology in regulating is not yet part of the mainstream regulatory literature" (p. 16); I believe this to be a clear underpinning of the significance of the research conducted for this thesis. Stone, in, Critical Reflections on Regulation, discusses the definitional dispute by examining whether the forms of control resulting from new technologies constitute "regulation", or whether they are simply economic coping mechanisms (Stone as cited in Black, 2000, p.22). This thesis maintains that "the forms of control that arise through new technologies are a form of regulation".

As aforementioned, regulation, when approached from a standard economic theory perspective, can be seen as a market perfecting notion, in other words, regulation as a derivative of governance. The economic rationale is that the lack of information privacy and intellectual property rights is a market failure. Within the context of data and technology regulation, at the forefront of corrective legislation is the drive to reduce information asymmetry, in order to provide consumers with a more comprehensive understanding of what the data provided will be used for, and the consequences of stored data. This type of government enforced market perfecting activity, when viewed through a positivist lens, can also be considered a tool to overcome collective action problems (Schwartz, 2004, p. 2082-2083). The importance of data privacy within society has been outlined by scholars, such as Julie Cohen (2000), who argues that information privacy is a vital pillar of a civil society, and that it generates "concrete collective benefits" (p. 1426). Proponents of regulating information property rights, such as in the case of the wearable technology's resulting data collection, generally argue on the basis of bounded rationality (Schwartz, 2004, p. 208; Kahnemann, 2003). This theory holds that people are not necessarily acting in their own self-interest, or in that of society, but instead having their decision-making shaped by available information, cognitive limitations, and time restrictions (Simon, 1947, p. 198).

Data Collection & Implications Thereof

The contemporary willingness to use wearable technology is undisputable: from cell phones, to wristwatches, to eyeglasses, to fashion accessories, seemingly everything is collecting data. The vast range and ubiquity of objects collecting data was analyzed within the surveillance studies approach, as discussed in the Self-Surveillance chapter, as this plethora of consumer items is analyzing 'us' while we wear them for a personal understanding (Lyon et al, 2012). Wearables are primarily marketed as either lifestyle or wellness-themed products rather than health/medical products, in line with the drive of human efficiency previously discussed Foucauldian conception of Biopolitics (Mayes, 2015). This "lifestyle/wellness" classification is often also stipulated when these products are registered, in order to circumvent more stringent testing criteria, increased regulation, sales restrictions, and tightened data storage conventions (OECD, 2013). However, unlike in the EU, in the USA the FDA has just released a draft paper intending to rectify the thin line between the two different categories of products (FDA, 2015). According to the websites of several of the companies (Fitbit, Jawbone, Garmin) producing these products, the data for these devices is generally collected and aggregated within cloud-based storage platforms. In other words, the data is stored in user-friendly and easily accessible external servers. The technical specifications of how secure the data is stored are hard to come by as a consumer; Fitbit provides the following blurb on its website for concerned consumers:

"Fitbit uses a combination of technical and administrative security controls to maintain the security of your data. If you have a security-related concern, please contact Customer Support." (Fitbit Privacy Policy, August, 2014 – Accessed June, 2016)

Examples like this provide warrant for European citizens' concerns regarding the treatment of their personal data online. This has been made very clear in a number of opinion polls and research conducted in individual, EU level, and multi-nation polls and interviews. The pie chart on the right depicts the results of research conducted in all EU 28 member nations; see Figure 2 (European Commission, 2015; Barometer 431). In summation, the report begins by stating that, "more than 8 out of 10 respondents feel that they do not have complete control over their personal data". (EC, 2015) The entire report essentially articulates citizens' mistrust of the treatment of their data. This is also reflected within periodicals, newspapers and in academia, with experts claiming this has developed into an EU overarching trend (European Commission, 2015). Furthermore, individual and societal support of governmental increases in regulations protecting the rights of individuals has drastically increased in recent history (Akrivopolou & Garipidis, 2012).

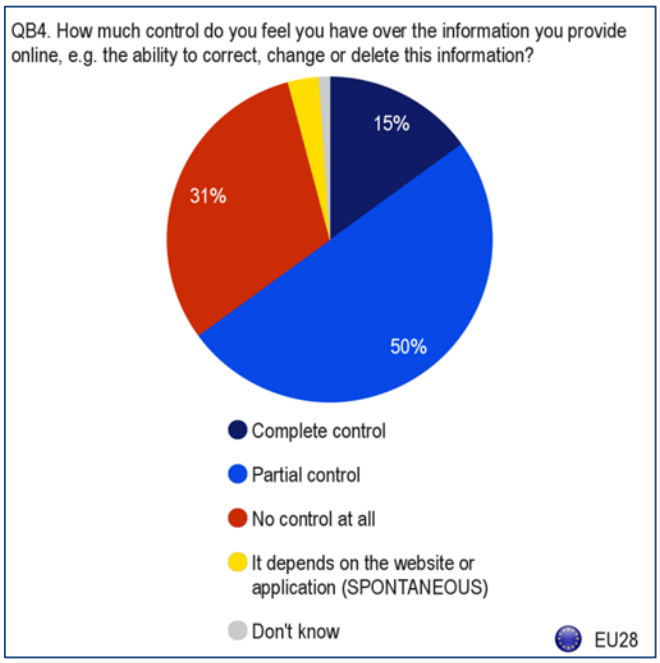

Figure 2: Information Control & Data Privacy
Research conducted on all EU 28-member nation basis
Source: Euro barometer

Data Protection Regulation Matrix & Wearable Technology

To date, there is no aggregate compilation that compares all EU 28 member nations' data protection regulation through a side-by-side matrix. Thus, as an initial step towards comprehending the variation in legislation and regulation, this paper provides a 'working matrix' (See Appendix). The matrix is highly time-sensitive as data protection laws and regulation are constantly being shifted, updated, and changed. This mapping exercise serves to visualize the contrasts and similarities between countries. The matrix is accurate as of May 2016. All information reflected in the matrix was derived from the European Union, European

Commission and European Parliament websites and white papers. Additionally, the information is also derived from the DLA Piper, Data Protection Laws of the World. [2] [3]

The matrix provides an overview that transcends across all 28 EU member nations. It clearly demonstrates that although the Directive 95/46/EC is (certainly) in place in 25 of the 28, there is an obvious variance with other national legislation and regulation. This additional variance within the regulation, and the exact implication of the different supplementary directives and regulations merits further analysis of the countries' given stance on data protection. This table offers a sound foundation and cornerstone for further academic development and research regarding differences between EU member nation legislation.

The EU'S data protection directive adopted in 1995 was revolutionary for its time—it led to a mechanism that intended to create clear boundaries for the handling of all data in the member nations. The directive is based on the 1980 OECD privacy protection guidelines, entitled "Recommendation of the council concerning guidelines governing the protection of privacy and trans-border flows of personal data" (OECD, 1980). Fast-forward to 2016, it has by now aged several decades and through its age become outdated and obsolete. However, as with all directives in the EU, the directive has been renewed and revamped on several occasions in order to ensure its contemporary relevance. Thus, the directive currently ensuring the safety and regulation of our personal data is now 20 years old, and the recommendation that this directive is based on is now well in its 30s. This directive is primarily made up of three points: (1) privacy, protection of all personal data collected for or about citizens, (2) (any type of) exchange of this data, (3) has key elements of article 8 of the EU convention on human rights concerning the protection of rights to privacy in personal life. Naturally, the European Union updated its directive in 2000 and created a timelier response. Later, the OECD guidelines were updated in 2013 in order to offer more comprehensive and timely guidelines.

The data protection reform that, in theory, intended to provide a bolstered and improved method of providing citizens of the European Union with certainty about the safety of their personal data was composed of eight changes. These were: (1) **right to be forgotten**; when you no longer want your data to be processed and there are no legitimate grounds for retaining it, it will be deleted; (2) **easier and improved access to your own data;** (3) **right** to **transfer** personal **data** from **one service provider** to **another**; (4) when **consent is required**, you must be **asked to give it explicitly**; (5) **increased transparency** in terms of **how personal data is handled**, more **easy-to-understand information**, particularly **for children;** (6) **businesses**

[2] DLA Piper: www.dlapiperdataprotection.com | Version 2015.
[3] European Commission, European Parliament and European Union: www.europa.Eu, www.ec.europa.eu, and www.europarl.europa.eu

and **organizations** will be **required to disclose data breaches with users** without undue delay; (7) **improved administrative and judicial remedies** in cases of violation of data protection rights; (8) **increased responsibility and accountability for those processing personal data**—this should be done **by means of data protection risk assessments**, **data protection officers**, and the principles of '**privacy by design'** and **'privacy by default'** [4] Despite the reform, it is notable that in actuality many of these changes were watered down in the European Parliament version that was voted on a year after the commission released its communication (C-131/12).

However, the European Commission's Business Innovation Observatory released a case study in February, 2015, entitled, "Internet of Things", with a focus on "Wearable Technology". The study argues that the European Regulatory Framework "may not be adequately geared to deal with the complex privacy issues that result from this development" (European Commission, 2015). It specifically mentions that the Directive 95/46/EC should be reviewed and edited, in order to verify that all data covered by said wearable technology is also properly handled and adequately covered by the directive. This gives an interesting indication of what the discourse surrounding this topic seems to be circulating within the European Commission.

In conclusion, the regulatory responses provided by EU countries, as well as federally legislated by the EU, may not adequately address the concerns that have arisen as result of the growth in wearable technology. As outlined by the sociological developments discussed, these trends do not seem to be dying down, and arguably are here to stay; thus, as forecasted by the trends identified and outlined by 'working matrix', the reality is pointing at a contemporary disconnect between data privacy, sociological developments, and regulation. EU regulation is currently highly permissive of the extraction, storage, and fluidity of personal data.

Case Studies

The case studies in this paper aim to cover a wide spectrum of wearable technology in order to provide a snapshot of a large variety of respective data collection techniques. The research and evidence presented is primarily based on desk research, and in some cases also on personal use. In order to account for limitations that would result from looking at similar wearables, the studies focus on a three significantly different types of wearables: Muse – mental health and brainwaves; Fitbit – physical health and fitness; and Google Glass – augmented reality and ocular

[4] European Commission, Document, How does the data protection reform strengthen citizens' rights?

enhancement. The case studies are analyzed and compared to the sociological developments discussed earlier, with overlap indicating a potential match in the assumption that the sociological developments have driven the growth of these devices. In addition, they are discussed in relation to the data collection, and the triggered regulatory responses (or lack thereof).

Case Study A: Interaxon, "Muse"

The first case study this paper will cover 'Muse', a wireless brain sensing headband, measuring electrical activity produced (electroencephalography) and distributed by its parent company, Canada based, Interaxon. Muse intends to provide the user meditation assistance, via real time feedback (Muse, 2016).

The headband itself measures brain signals utilizing 7 calibrated sensors (see figure 3). It is advertised as being "Safe, Trusted, and Verified", for having been tested in accordance with "Canadian, USA, and European regulatory standards" (Muse, 2016; What does it measure?). The headband is worn in a similar manner to glasses, resting on one's ears, with the difference being that the frontal strap can be adjusted to fit tightly around the forehead. The product is marketed as a type of focus building, mental health improvement, and cognitively optimizing wearable technology (Muse, 2016). The direct feedback loop that the Muse offers is rendered through audio cues, providing the soundscape of a beach, rainforest, desert, etc. The more brainwave activity the device registers, the louder and more violent the soundscape becomes, and the same applies in reverse as brainwave activity becomes more placid and focused.

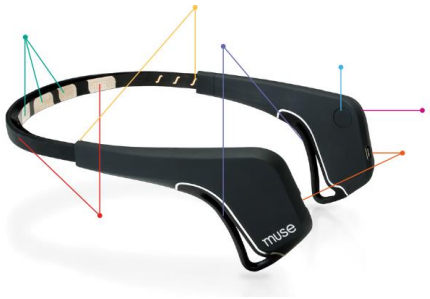

Figure 3: CGI of the 'Muse', derived from the Muse website

The narrative used by Interaxon to discuss the implications that Muse has on a person's life are in many ways replicating the discussion points in the Sociological Developments chapter. As discussed in the Self-Surveillance chapter, Muse provides the people with opportunity to more profoundly and consistently monitor their activities, in this case cranial activity, that pertain directly to emotion and focus. This directly conforms the conceptualization that Roy Boyne discusses in his social theory of the post-panopticism, in this case placing the muse at the center as a proverbial guard tower, and replacing the guard with the user (2000, p. 288). The dovetailed characteristics of technology and the Foucauldian concept of "care of self" could be identified as an underlying sales driver. Consequently, this could also be categorized under the

ideas posed by Whitson (2013) that, as users begin working on improving themselves, they become more likely to share progress and participate in a community.

This overlap is continued in all other areas of the Muse's utility, and its corporate communications. The software that provides a visual and data driven overview of one's progress during the meditation sessions, provides a host of user incentives for sustained use of the Muse. These incentives come in the form of gamified user badges, challenges, and "chirps"[5] that as the Muse website claims motivate beginners and challenge those with more experience in mindfulness exercises and meditation (Muse, 2016). The necessity to spend more time meditating and to improve overall mental health, focus, and physical wellbeing is a behavioral model identified as neoliberal in the sociological developments chapter. In the case of Muse this urge for personal efficiency is enshrouded in rhetoric that exceeds the individual, but instead hints at the subsequent efficacy of labor; Co-Founder of Muse, Ariel Garten claims in TechCrunch interview (2014) that after a meditation session she finds it much easier to focus on work. Yet, it certainly corresponds to all three markers (1-3) identified earlier, as Muse does foster an (1) individual pursuit of self-discipline through user incentivizing for continuous and daily meditation, (2) maximizing individual autonomy, by allowing users to use it at their own choice of time and place and extracting the most possible profit, per providing meditation sessions that demand low time yet promise effective meditation with immediate feedback, and (3) provide data that can be used to quantify behavior.

The benefits of what wearable devices such as the Muse are also accompanied by a host of risks and threats. It has been argued by authors and experts in the field of biopolitics, technology, and sociology that developments in social behavior catalyzed by wearable technology should be critically viewed (Foucault, 1975; Fuchs, 2013; McClusky, 2009). The arguments stated generally lean on the premise that overreliance on the data is risky in the sense that it provides only a window into a much bigger picture that is the human body, and that the data may not be entirely accurate, as well as strong resistance to the idea that an average person is able to discern and evaluate the data. In the case of the Muse, this is hotly debated, as the measurements come in the form of brainwave activity aggregated by seven individual sensors portrayed in a line graph. This results in visually depicting peaks and troughs of activity segregated in three different levels of cranial activity, which provides a glimpse but offers no help in understanding why and where this excitement is stimulated within the brain. Connected to this risk is the danger of people who should rely on the support and help of psychologists and psychiatrists utilizing Muse as a substitute. This could potentially put public, mental, health at risk. Popular periodicals

[5] 'Chirps', is a form of reactive audio feedback. If the user is able to maintain a certain level of calm, as measured per EEG, ambience noise is silenced and a chirp emulating the noise of a bird chirping and landing in the users 'vicinity' can be heard.

covering technology and sociology have also covered this phenomenon, and discussed the risk of a loss of self-reliance in society, resulting in a society that is reliant on technology for relaxation, meditation, and mental relief, and, consequently, a loss of behavior that calms us down, something that we as humans have always known how to do (Wearable, 2015: Muse Review).

Finally, as with the other sociological developments covered, Muse also seems to be in line with the Quantified Self Movement. The data collected provides graphs for analysis, the device itself a tool for empowerment, and it immerses the user in a community, again covering all aspects of the definition of quantified self in this paper. In addition to the risks associated to an overreliance on this type of technology detailed in the prior paragraph, Muse provides similar opportunities and threats to society as discussed in the sociological developments chapter.

Case Study B: Fitbit, "Charge HR"

The second case analyzes 'Charge HR', a wireless wrist worn biosensor, which provides information on movement by GPS and pedometer, sleep pattern, caloric output and input, and heart rate. It is produced and distributed by Fitbit, a San Francisco based American company (Fitbit, 2016). The evidence provided was gathered through desk research, from the corporate website, reading through corporate communications, interviews, newspapers and periodicals, and personal use and data collection[6].

Figure 4: Fitbit Charge HR, image derived from www.fitbit.com

The Charge HR, when worn, primarily acts as a static collector of data, such as calories burnt, heart rate, steps taken, and distance covered, as well as providing time, alarm, and stopwatch functions. These functions can be optimized and adjusted to each individual user, and when calibrating the Charge, there is great scope for personalization. For example, the alarm function can be adjusted to the information gathered by monitoring sleep patterns in order to be woken up during light sleep and not in REM (deep) sleep. The heart rate monitor can actively be used to understand the resting versus active rates, however its accuracy has come under severe scrutiny (Consumer Reports, 2016). In addition to these passive activities tracked, the Fitbit Charge also vibrates when the user has reached the daily 'goal' of 10,000 steps, a number that has been deemed as physically and emotionally beneficial by a California State University study (CSU, 2005). This intends to provide a feeling of accomplishment, and a daily benchmark, and could be considered a gamification technique, as

[6] From August 2015 – June 2016

the steps may have been taken regardless of wearing the Fitbit or not. In January 2016, a class action lawsuit was filed against Fitbit, specifically the Fibtit Charge HR, and Fitbit Surge, claiming that the devices "misread heartrate by a very significant margin, particularly during exercise" (McLellan et Al, 2016). In the case of Fitbit, we see as legacy of devices produced from 2008 onwards, and, as the name suggests, according to Fibit's corporate communication, all aim to incentivize a physically active lifestyle, improve user health and wellbeing. In the case of the Fitbit Charge HR, I personally used it in order to collect data on myself from August, 2015 to June, 2016. This personal use allowed for a more in-depth understanding of the user interface provided to the user, via the Fitbit Android Application, as well as the structure of the data provided.

In comparison to the sociological developments discussed, as with the Muse, the Fitbit Charge HR provides ample overlap, as its purpose is surveilling oneself. With the Fitbit Charge HR this is done in a number of ways; the surveillance ranges from steps taken, calories burnt, heart rate, geolocation services (via GPS), and a range of other activities that can be manually logged. This clearly echoes the sentiment of Boyne's post-panopticism, as consumers are treating the data they provide to the devices, and parent companies, with a cavalier attitude (2008). As with the self-surveillance development, this also would be an example that is in direct consonance with that of the QSM, as it drives the user to quantify his actions, behavior, and health (Wolf and Kelly, 2015). The Fitbit's description of use through corporate communication, as well as periodicals reporting on it, exhibit a close connection to Foucauldian biopolitics, specifically the care of self, as well as the principle that digitalization encourages the care of self (Whiston, 2013).

The communities that the use of Fitbit encourage are also a thriving example of self-surveillance growing user bases, customers, and consequently leading to an overall growth in market share of wearable technology like the Fitbit. The playful manner in which Fibtit awards 'badges', that indicate such things as the cumulative distance covered, e.g. "Italy Badge – 1,184 lifetime kilometers covered", and the vibration alerts that mark the culmination of the daily recommended 10,000 steps covered, are physically interrupting the days of consumers wearing Fitbits, and indicative of catalyzing increases in personal and corporate efficiency (Whitson, 2013; Foucault, 1975). All things considered, this provides reason to believe that overall the Fitbit is a highly neoliberal tool, aiming to drive efficiency and allowing for maximizing user autonomy and decision-making. There is an apparent trend of users trading personal data for services (Mayes, 2015; Bauman, 1999), and we see fitness being presented as yet another form of consumption in the communication being used and marketing strategies. I contend that regulators should critically eye the rate at which these are being worn in corporate environments, and whether private companies are gathering this data, and to what purpose.

Although personal health and fitness are objectively longevity-building pursuits, the paradox of gaining more life to spend on more work is a notion that should be scrutinized as, again, it lifts the importance of the market above that of the human.

Conclusively, the Fibit Charge HR is yet another wearable device that is congruent with all sociological developments discussed earlier, and that also raises concerns surrounding the corporate treatment of data, and thus spells out a larger risk of market failure and the necessity to regulate.

Case Study C: "Google Glass"

Figure 5: Google Glass | Image derived from Edinburgh Robotics Website

The third and final case study will focus on the ocular enhancement known as "Google Glass", or simply "Glass", designed in the shape of eye glasses, produced by Google X, an Alphabet subsidiary. The wireless device provides the user with an augmented reality, via a small screen in the top left or right hand corner of the user's vision and includes sensory inputs via Bluetooth capabilities, microphone, accelerometer, gyroscope, magnetometer, ambient light sensor, and a proximity sensor. The Glass is a unique case study, as it has been in production, in alpha and beta phases, with prototypes sold from April, 2013 onwards until May, 2014 when it became available to the public. Since January 2015 Google has announced a stop in the production, yet proclaimed continuous development on the product. As of December 2016, Google has filed a new application with the Federal Communications Commission for a new version of the Google Glass.

In terms of usability, as with the aforementioned devices, Google Glass brings to mind personal and physical enhancements. This is made visible in the marketing provided in the Google Glass Commercial[7], primarily depicting people multitasking in their daily lives ranging from mundane tasks to exciting hobbies or work, with emphasis on hands-free usability. In parallel to Google Glass being sold, communities emerged online. This was reflected by many tech-focused periodicals reporting that the purpose of these communities seem to be sharing and developing new uses for Glass (Forbes, 2014; Wired, 2015; Technology Review, 2014). Consonant with the discussed trend of self-surveillance and Foucauldian theory this indicates effort to allow people to further understand their surroundings, personal movement, and potential for altering personal behavior (Foucault, 1975, p. 208). Additionally, as with Self-Surveillance, we see a clear indicator of gamification of daily life, as indicated in the corporate communication provided by Google in its marketing and advertising campaigns; what was once a regular commute to work could become a time to film, research, and all the while not obstructing either hand.

This freedom of movement, and essentially, what is being framed as a time-saving activity provides a way into the discussion surrounding the Quantified Self & Patient Empowerment movement. Not only can the information acquired be dissected and provide data sets, in a similar manner to the Fitbit Charge HR, but it also provides means to use the data on the spot or allow for personalized suggestions. Behavioral patterns can become actionable, as the wearer could ask the Google Glass to provide restaurant suggestions, that become custom tailored to

[7] Google Glass Commercial – Accessed in June, 2016: https://www.youtube.com/watch?v=Q-Gwb61aAq4

suit personal preferences, dietary requirements, also geographic location, and much more. Chronically ill patients, people confined to wheelchairs or their beds (as long as not visually impaired) could utilize this type of technology to easily communicate with friends and family, significantly regaining lost autonomy. In addition, doctors can (and some already do) use Google Glass to receive live surgery assistance, assist autistic children with socializing, and use Glass' visual aids that augment and improve medical processes (Topol, 2015).

Critiques, point out the dilemma of having people being filmed, recorded, and photographed unnoticed, as this would provide a massive breach of personal privacy (See TechCrunch, The Economist, Time Magazine, Guardian, CNN). Journalists and civilians alike were quick to refer to the wearers of Google Glass, as 'Glassholes', feeling that the bearers of this device are deliberately infringing on their personal privacy. It is notable also that as this device is not operated by hand motion, it becomes unclear to people when the device is being actively operated or just passively worn. Again, we see parallels to the Foucault (1975), Boyne (2000) and Bentham (1786) conceptualizations of the panopticon, as this may lead to a society that finds itself perpetually behaving as though it was being monitored.

To conclude, Glass, as presented in this chapter, is yet another wearable device that provides steady data collection derived from a variety of sensors and sources. It also allows users to become more independent, and reclaim autonomy in actions that would otherwise require assistance. It is marketed as device that allows you to get things done, without the hassle of having to use your hands, and without being cognitively demanding; improving personal efficiency. All of these factors could be considered strongly related to neoliberalism as defined earlier, and are on par with definitions and descriptors provided by Bauman (1999) and Boyne (2000). This is crystalized in the framing of seeking increased freedom, which leaves the consumer with more time to consume, be it by direct consumption, labor, or in pursuit of sensory stimulation. All the while, Google Glass allows users to act on urges guided by what would be framed as the helpful hand of wearable technology and reflexivity (Bauman, Giddens and Beck as cited in Lupton, 2015, p. 46).

Conclusion

There is ample evidence that the discussed sociological trends - self-surveillance, QSM & Patient Empowerment, and Neoliberal Lifestyles - are highly conducive to the growth in wearable technology. Within all the sociological developments discussed, there is an overarching inclination towards driving efficiency. This can also be identified in the case studies, as this drive is directly addressed by the incorporated features, promised outcomes, and types of sensors. The importance of quantifying personal activities was also emphasized in all three cases, with focus on data empowering people. Finally, all three markedly different case studies provide evidence that the corporate communication advertises the user's potential for reclaiming autonomy or freedom, a decisively neoliberal pursuit.

Furthermore, all of the discussed devices are both statically, and actively able to collect data, and it is notable, that, as this trend continues to grow, so will the amount of personal data stored in the clouds. Yet, the evidence presented points out that the EU populace is riddled with a mistrust of the handling of personal and online data. As supported by the working matrix, the regulatory measures taken by the EU on a supranational level have been feeble and ineffective in facing the realities. It also becomes apparent by the analysis of regulation that this type of technology-driven personal data flood can be considered a market failure, requiring governmental intervention.

Problematically, the notion of neoliberalism discussed in the context of wearable technology and the pursuit for autonomy has left people feeling empowered to the point that they no longer require experts. This could be considered a slippery slope in healthcare, as the immediate consequences of this could lead to people not seeking the medical attention they need. This risk would be heightened by two factors: (1) the fact that people are not necessarily able to understand the data collected, or act upon its implications, and (2) technical inaccuracies, as with the flawed heart rate monitor on the Fitbit Charge HR. The final, and most insidious repercussion is that it contributes to a culture that invests responsibility for health and wellbeing in individuals and not in the state.

It has become apparent that people have heightened sensitivity when it comes to their data, and that although daily lives are shared through various social media channels, people are still gravely suspicious of organizational and governmental treatment of personal data. Thus, this thesis outlines a significant convergence of developments that, if left unattended, will lead to questionable storage and data treatment, as a result of societal paradigm shifts and lack of robust government intervention. Policy intervention is required in order to alter the collision course that the European Union currently finds itself in.

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Appendix

EU Data Protection Matrix

1. Austria	2. Beligum	3. Bulgaria	4. Croatia
Austria implemented the EU Data Protection **Directive 95/46/EC** with the Data Protection Act, Federal Law Gazette part I No. 165/1999 as amended ('Act').	Belgium implemented the EU Data Protection **Directive 95/46/EC** with the Data Protection Act dated 8 December 1992 as amended in 1998 (Act). Enforcement is through the Belgian Data Protection Authority (DPA), called the Commission for the Protection of Privacy.	Bulgaria implemented the EU Data Protection **Directive 95/46/EC** with the Personal Data Protection Act, promulgated in the State Gazette No. 1 of 4 January 2002, as amended periodically ('Act'). The Act came into force on1 January 2002. .	Croatia implemented the EU Data Protection **Directive 95/46/EC** by the Personal Data Protection Law ('Official Gazette of the Republic of Croatia', nos. 103/2003, 118/2006, 41/2008 and 130/2011) ('DP Law'). The DP Law is in force as of 4 July 2003.

5. Cyprus	6. Czech Republic	7. Denmark	8. Estonia
Cyprus implemented the **EU Data Protection Directive 95/46/EC** in November 2001 with the Processing of Personal Data (Protection of the Individual) Law of 2001 and its amendments (Law No. 37(I)/2003, 105(I)/2012)).	The regulation of personal data protection in the Czech Republic is based on **Directive 95/46/EC** on the protection of individuals with regard to the processing of personal data and on the free movement of such data (the 'Data Protection Directive'). The main provisions are contained in the Act no. 101/2000 Coll., on the Protection of Personal Data, as amended (Act).	Denmark implemented the EU Data Protection **Directive 95/46/EC** in June 2000 with the Act on Processing of Personal Data ('Act').	Estonia implemented the Personal Data Protection Act **Directive 95/46/EC** in June 2000 with the Act on Processing of Personal Data ('Act').

9. Finland	10. France	11. Germany	12. Greece
A member of the European Union, Finland implemented the EU Data Protection **Directive 95/46/EC** in June 1999 with the Personal Data Act 523/1999 ('Act')	Law No. 78 17 of 6 January 1978 on 'Information Technology, Data Files and Civil Liberty' ('Law') is the principal law regulating data protection in France. The EU Data Protection **Directive 95/46/EC** was implemented via Law No. 2004-801 of 6 August 2004 which amended the Law.	The main legal source of data protection in Germany is the Federal Data Protection Act (Bundesdatenschutzgesetz in German) ('BDSG') which implements the European data protection **directive 95/46/EC.**	Greece implemented the EU Data Protection **Directive 95/46/EC** in October 1997 by Law 2472/1997 on the Protection of Individuals with regard to the Processing of Personal Data, as amended ('Law'). Such law is currently in force as amended by Laws 3471/2006, 3783/2009, 3947/2011, 4024/2011 and 4070/2012, and 4139/2013. Enforcement is through the Data Protection Authority ('DPA')

13. Hungary	14. Ireland	15. Italy	16. Latvia
The EU Data Protection **Directive 95/46/EC** is currently implemented in Hungary by Act No. CXII of 2011 on Informational Self Determination and Freedom of Information which came into force on 1 January 2012 ('Act'). Enforcement is through the National Authority for Data Protection and Freedom of Information ('Authority').	The core Irish data protection law is comprised in the Data Protection Act 1988 ('1988 Act') as amended by the Data Protection (Amendment) Act 2003 ('2003 Act') (together the Data Protection Acts (DPA)). The 2003 Act implemented the EU Data Protection **Directive (95/46/EC)**. In addition to the DPA, the European Communities (Electronic Communications Networks and Services) (Privacy and Electronic Communications) Regulations 2011 ('ePrivacy Regulations') set out data protection rules in relation to direct marketing and electronic networks and services, including location data and cookies. The irish council for bioethics was also quite prevalent and active in Ireland, regarding the storage and utilization of data, until shut down in 2010.	The Italian law applicable on privacy issues is the Legislative Decree no. 196 of 30 June 2003. The Privacy Code Implements **Directives 95/46/EC** and **2002/58/EC.**	Latvia adopted the law on protection of personal data of natural persons (DPA) in 2000. The DPA incorporates the principles of the **Directive95/46&EC.** Enforcement is through the National regulatory authority. (SDI)

17. Lithuania	18. Luxembourg	19. Malta	20. Netherlands
As a member of the European Union, Lithuania has implemented the EU Data **Protection Directive 95/46/EC**. Lithuania passed the Law on Legal Protection of Personal Data on 11 June 1996 ('Data Protection Law'), which has been amended on 17 July 2000, 22 January 2002 and 21 January 2003 in order to transpose the provisions from the Directive. The latest modifications to the Data Protection Law came into force on 1 September 2011. They include amendments and new regulations on public polls, credit referencing agencies and public governance of data protection. Enforcement is carried out by the State Data Protection Inspectorate.	The law dated 2 August 2002 protection of persons with regard to the processing of personal data as amended from time to time ('Law'). The law dated 30 May 2005 laying down specific provisions for the protection of persons with regard to the processing of personal data in the electronic communications sector amended from time to time ('Law of 30 May 2005').	The relevant law is the Data Protection Act (Act) (Chapter 440 of the Laws of Malta) and the Regulations (at present eight in number) issued under it	The Netherlands implemented the EU Data Protection **Directive 95/46/EC** on 1 September 2001 with the Dutch Personal Data Protection Act ('Wbp'). Enforcement is through the Dutch Data Protection Authority ('College Bescherming Persoonsgegevens')

21. Poland	22. Portugal	23. Romania	24. Slovakia
As a member of European Union, Poland implemented EU Data Protection **Directive 95/46/ EC** in the Personal Data Protection Act of 29 August 1997. The implementation was introduced by the Amendment of Certain Laws in Connection with Membership of the Republic of Poland in the European Union of 24 August 2007 (Journal of laws of 2007, No 176, item 1238).	Portuguese Data Protection Law – Law nº. 67/98, of October 26th – was enacted pursuant to **Directive 95/46/EC**.	Even though Romania has only been a member of the European Union since 1 January 2007, the EU Data Protection **Directive 95/46/EC** was implemented into national legislation in November 2001 through Law no 677/2001 on the protection of individuals with regards to the processing of personal data and the free movement of such data ('Data Protection Law').	As a member of the European Union, Slovakia implemented the EU Data Protection **Directive 95/46/EC** in September 2002 with Act No. 428/2002 Coll., the Data Protection Act, as amended. In order to solve some application problems of Act No. 428/2002 Coll. resulting from the non-uniform interpretation of the definitions under this Act, the new Act No. 122/2013 Coll., the Data Protection Act ('DPA'), substituting Act No. 428/2002 Coll., has been adopted and is effective as of 1 July 2013 which has been further amended by the Act No. 84/2014 Coll. that is effective as of 15 April 2014.

25. Slovenia	26. Spain	27. Sweden	28. U.K.
As a member of the European Union, Slovenia formally implemented the **EU Data Protection Directive 95/46/EC** as well as the Data Protection act of the republic of Slovenia in 2013. The Ministry of justice of the republic of slovenia	As a member of the European Union, Spain formally implemented the **EU Data Protection Directive 95/46/EC in November 1999** with the Special Data Protection Act 1999 (the 'Act', also known as the 'LOPD' in Spain). Nevertheless, from 1992, Spain already had a Data Protection Act ('LORTAD') that was fully consistent with most of the contents of the EU Data Protection Directive 95/46/EC.	Being a member of the European Union, Sweden implemented the EU Data Protection Directive 95/46/EC in 1998 with the Personal Data Act (Sw.personuppgiftslagen, SFS 1998:204, below 'the Act'). The previous Swedish Data Act enacted in 1973 had by then already been considered to be outdated for many years.	As a member of the European Union, the United Kingdom implemented the EU Data Protection Directive 95/46/EC in March 2000 with the Data Protection Act 1998 ('Act'). Enforcement is through the Information Commissioner's Office ('ICO').

The data and information represented in the matrix was derived from: The European Union, European Commission and European Parliament websites and white papers. Additionally, the information is also derived from the DLA Piper, Data Protection Laws of the World. [8] [9]

niversity. Consumer Wearables: Biosensors and Healthcare. Accessed in July, 2015

[8] DLA Piper: www.dlapiperdataprotection.com | Version 2015.

[9] European Commission, European Parliament and European Union: www.europa.Eu, www.ec.europa.eu, and www.europarl.europa.eu