Wearable Technology and the Internet of Things

Exploring threats to users' autonomy

Master's Thesis of

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Student number: 3656489

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Word count: 18.931

Utrecht University

June 21st, 2018

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Summary

This thesis explores the question whether personal technologies, in the context of the Internet of Things, pose a threat to users' autonomy. Analysing what services wearables offer, and how these services are offered, by means of nudging techniques and algorithmic profiling techniques, one significant threat is found. Wearables can pose a threat to the autonomy of users' by subtly mediating the users' process of identifying himself as an individual. Firstly, wearables emphasise and modulate certain practices with which the user comes to identify himself. Second, wearables approach users according to group characteristics instead of individual characteristics, thereby further mediating identity. Although the effects hereof are dependent on the effectiveness of wearables and the scale on which they are employed, it is a significant threat that cannot be overcome by means of practical solutions as it stems from inherent features of wearables without which the devices cannot offer value. Moreover, the increased use of or reliance on algorithmic profiling within society can exacerbate this threat.

Key words: The Internet of Things, Wearable Technology, Autonomy, Identity, Societies of Control

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Introduction

The fourth wave of digitisation

The Internet of Things (IoT) denotes a technological development that is expected to fundamentally alter how we arrange society and live our lives. This development is also called 'the fourth wave of digitisation', a more general description indicating the influence it is expected to hold for society, just as the previous three waves of digitisation have done. The first wave of digitisation arrived with the introduction of the computer in the 1980s. Followed by the creation of the Internet, the second wave of digitisation occurred in the 1990s. The third wave of digitisation set in with the introduction of 'mobile' Internet (Davidsson, Hajinasab, Holmgren, Jevinger & Persson, 2016). All these first three waves of digitisation raised new questions and challenges, such as the issue of a digital divide, cyber terrorism or the effects of social media on people's psychological health. Similarly, this fourth wave of digitisation is expected to bring forward new challenges and questions.

In the report 'Opwaarderen', which I translate into '*Upgrading'*, the fourth wave of digitisation is described as one enabling the creation of real-time, continuous virtual representations of the physical world on the basis of which one can inform and adapt products, services and behaviour (Kool, Timmer, Royakkers & van Est, 2017). As Kounelis et al. (2014) put it, the IoT allows for "pervasive connectivity and the integration of the digital and physical worlds" (p. 73). Once the IoT is realised, people will no longer have to insert or translate data. Each thing will be intelligent, or smart, in the sense that they will have the ability to autonomously monitor their surroundings, accrue data, share this data with other devices and things and translate this data into applicable information for people to consume. Ashton (2009), the man who coined the notion 'the Internet of Things', says that the data quantity and quality accumulated will no longer be constrained by human time limits, poor attention spans or inaccuracies of people. Hence, as Floridi (2013) says, this trend is about no longer needing, and thus removing human participation.

In the report '*Opwaarderen'* it is argued that this fourth wave of digitisation, that changes society, can challenge or put values, such as equal treatment, privacy, autonomy and human dignity, under pressure (Kool et al., 2017). To name one example, policy makers are currently exploring ways to use self-tracking devices, such as smart watches, to rearrange the management and provision of public health. The vision is that of empowering citizens to manage their own health with wearable technology. Here, scholars are worried for the effect of over-responsibilisation placed on citizens as the responsibility of traditional players, such

as national governments, is decreased (Sharon, 2017). Another example is the IoT development in supermarkets which Winter (2014) says, blurs the distinction between public and private life and thus raises privacy and power concerns.

Finding and using feedback in the form of digital visualisations to optimise services, products and systems is not new. What is new and characterises this development, is the increased speed, amount and way in which data is collected, i.e. mostly by things and devices instead of people, as well as the increasingly advanced tools, namely computationally complex algorithms, which are used to translate these large and continuous flows of data into value, i.e. feedback. What this development thus implies, is that the digital world will come to play an even bigger role in how society and our daily lives are shaped. Data, collected by things and devices, will become fundamental in how we perceive and shape our world.

The Position of Citizens in Society

Another crucial question that is being raised, that flows from the removal of people in knowledge acquisition through data, is how this development can influence the position of people in society. Popescul and Georgescu (2013), for example, argue that society only has the choice to adapt to and accept the situation that is brought forward by information and communication technologies, as they "explicitly or implicitly […] overtake some of our tasks and delicately induce certain moods or even force certain behaviour patterns, […] imperatively heading to maximum efficiency" (p. 208). This assertion suggests a loss of human control. Gill (2013) argues that critical attention ought to be paid to the surrounding context and "the discussion on what it is to be human in the era of ubiquitous computing" (p. 371). Similarly, Kounelis et al. (2014) say we should ask "why are we doing what we are doing?" (p. 76). In sum, scholars are raising awareness that we ought to think critically about what it is exactly that we are willing or wanting to give up to the IoT, and more importantly, what we do not. This question, how the IoT might influence the position of citizens, is arguably a fundamental starting point to judge the advantages and disadvantages of the IoT for society.

Wearable Technology

Trying to understand how this wave of digitisation might reshape areas in our lives and raise ethical questions is complex. Many developments, such as IoT uses for public health purposes, remain immature and involve various stakeholders. A development that is more mature and arguably involves fewer stakeholders is the use of personal devices in the private

domain. According to reports published by PricewaterhouseCoopers (PwC), the popularity of these devices amongst consumers within the market is substantial and the purchase hereof is expected to continue growing (PwC, 2015; PwC, 2016). Furthermore, public and private parties are starting to experiment with the use of such wearables in policies. As just mentioned, in Europe policy makers are thinking of ways to utilise wearables for public health purposes (European Commission, 2014). In the United States, health insurance companies such as Vitality are rewarding clients who successfully use wearables ("Compelling Rewards", 2018). Analysing wearables within the private domain could therefore inform how we should use wearables in policies as well.

As defined by PwC, "wearable technology refers to accessories and clothing incorporating computer and advanced electronic technologies" (2016). People use mobile applications, smart watches, smart glasses, smart clothing and other devices to track what they do on a daily basis, and to, through the digital displays, inform themselves on what they could do better. Whether this is to floss one's teeth more regularly, lose weight or manage one's time more efficiently. Wearable technology lends itself for any of these purposes and more. In a blog post Hans Stier (2016) argues that "by mixing the ability to save and store data with the ability to share and analyse it, this fourth wave allows us to use everything in our lives in a more productive, intentional way". This description denotes the positive manner in which wearables are typically framed, as tools that empower users.

It could be argued that consumers, as owners of these products, have most control over wearable technology when compared to, for example, an IoT bridge measuring the performance of a city. However, to what extent do users of wearables truly have control over personal devices in the context of IoT? Is it true that personal devices empower users? Various scholars have started to analyse the ethical implications arising with the use of personal technologies. To name two examples, Anaya, Alsadoon, Costadopoulos and Prasad (2017) have looked at users' perceptions on wearable devices in relation to privacy, security and user consent in the transferral of data and Owens and Cribb (2017) have argued why wearables might not promote autonomy and instead undermine users' decision-making processes.

In sum, because of the relative maturity of wearable technology, it lends itself as an appropriate IoT application to critically examine how the IoT might influence the position of citizens. Moreover, the claim that wearable technology promises self-empowerment of users, which would imply a strengthening of these citizens' position in society, further begs validation. Finally, because public and private parties are starting to explore ways to incorporate wearables in policies, this question is even more urgent to address.

Research Question Thesis

In this thesis I thus aim to add understanding regarding the question of how wearable technology, in the context of the IoT, can influence the position of citizens that use these devices. A necessary requirement for increased self-empowerment is respect for users' autonomy. This brings me to my research question, *'Do personal technologies, in the context of the Internet of Things, pose a threat to users' autonomy?'* My intention is not to bring forward final conclusions, but to shed light on where, why and how users' autonomy might be undermined by wearable technology in the context of the IoT. With this exploration I hope to provide insights whether the overall concern for citizens' position in an IoT world is justified.

In order to answer this research question I will first provide a theoretical framework in Chapter 1. Using Gerald Dworkin's (1988) characterisation of autonomy as described in the first chapter of his book *The Theory and Practice of Autonomy*, supplemented by Isaiah Berlin's (2002) description of negative and positive freedom, a description of autonomy is explicated with which I later assess wearable technology. I then explain Gilles Deleuze framework of so called 'control societies'. In this framework for modern day societies, the autonomy of citizens is questioned. Chapter two serves to provide greater detail on the IoT, examples of wearable technologies discussed in this thesis and the empirical evidence regarding the effectiveness of wearables. I then show why wearable technologies are appropriately placed within the framework of Gilles Deleuze, constituting modulating mechanisms of control. I end this chapter with the core promise of wearables, which is for users to become more and better humans, and, subsequently formulate three autonomy conditions to later assess this claim.

In the last two chapters I will explore my research question and assess various arguments. As a departure point, I use Owens and Cribb's (2017) article "My Fitbit thinks I can do Better! Do Health Promoting Wearable Technologies support Personal Autonomy?" in which they argue that personal technologies might well challenge users' autonomy. In chapter three, I focus on the services that wearables offer. In chapter four, I focus on the technicalities behind wearables, namely algorithms and profiling techniques. In both chapters I identify one threat to users' autonomy, which is that wearable technologies mediate users' identity in a subtle, long-term fashion. Firstly, wearables emphasise and modulate certain practices with which the user comes to identify himself. Second, wearables approach users according to group characteristics instead of individual characteristics. This two-fold threat is significant as it stems from inherent features of wearables and illustrate Deleuze' warning that citizens' autonomy in control societies is under threat in an unnoticeable fashion.

Chapter 1: Autonomy and Control Societies

This chapter serves a three-fold purpose. The first is to show the importance of safeguarding autonomy in society. I do this by referring to a few segments of the Universal Declaration of Human Rights (UDHR) and the General Data Protection Regulation (GDPR), two important legal documents, which both show the importance of autonomy. The second is to provide a theoretical framework for this research. I use Gerald Dworkin's description of autonomy and to better explain which influences do and which do not challenge individuals' autonomy, I additionally use Isaiah Berlin's notions of positive and negative freedom. The third is to demonstrate that the respect for individuals' autonomy in so called 'control societies' is questioned by Gilles Deleuze.

Dworkin's characterisation of autonomy

The importance of autonomy is reflected in the introduction of the UDHR that was proclaimed and adopted by the United Nations General Assembly in 1949. In the introduction it states that since the drafting of this document "countless people have gained greater freedom […] independence and autonomy" (United Nations, 2015, pp. v-vi). Not only does this statement stress the weight attributed to protecting autonomy, it further shows how the notion of autonomy correlates with other ideals. At times, autonomy is equated with liberty, self-knowledge or independence. This is not strange, as autonomy is core to many, if not all, societal ideals such as justice, democracy or equality. This also partly explains why the exact contours and meaning of autonomy have been debated by philosophers for centuries. Gerald Dworkin (1988) argues that one of the few things people agree on is that "autonomy is a feature of persons and that it is a desirable quality to have" (p.6). Freedom is arguable another common feature in descriptions of autonomy because, even though freedom and autonomy are two separate notions, one cannot act autonomously if one was never free. I will elaborate on this later.

As I do not aim to critically analyse the notion of autonomy, but instead to formulate a description of autonomy that allows me to assess wearable technology, I have chosen to employ Gerald Dworkin's description of autonomy. Philosophical accounts of autonomy commonly distinguish between various levels of desires and associate autonomy with the coherence among these different levels (Frankfurt, 1971). Dworkin's characterisation of autonomy employs a similar approach but builds beyond coherence to include the actualisation of higher order desires. Although his approach cannot be said to be objective

and value-free, in the book *The Theory of Practice of Autonomy* Dworkin sets out to describe autonomy in a manner by which it can provide answers to moral, social and political problems. He thus also presents an account which is sufficiently broad and appropriate for the purpose of this thesis.

Autonomy

As argued by Dworkin (1988), "autonomy is conceived of as a second-order capacity of persons to reflect critically upon their first-order preferences, desires, wishes, and so forth and the capacity to accept or attempt to change these in light of higher-order preferences and values" (p. 20). An example of a first-order preference is to eat pizza. An example of a second-order preference is to be healthy. Generally speaking, eating pizza does not benefit one's health. The ability to cognitively evaluate both preferences and, through reason accept, reject or change these in order to shape one's life and who one wants to be, is what signifies autonomy. As such, Dworkin's description of autonomy is a procedural account of autonomy, because it employs a cognitive criterion to determine whether or not one is autonomous (Owens & Cribb, 2017).

To illustrate procedural autonomy more clearly, one can think of an alcoholic who does not want to be an alcoholic. Identifying oneself in a certain manner, for example as being an alcoholic, is not core to being autonomous. Indeed, many alcoholics know that they are alcoholics. Autonomy instead concerns the capacity to evaluate and then challenge, alter or accept one's reasons for acting (Dworkin, 1988). The first-order preference of an alcoholic is to drink and the second-order preference of an alcoholic is to *not* drink, or perhaps better formulated, to not have an urge to drink. Whereas non-alcoholics can reject pleasure as a reason to consume an alcoholic beverage, alcoholics cannot overrule urge as a reason for drinking. It is the inability of alcoholics to not be able to forgo their first-order preference for drinking that signifies their lack of autonomy. It is the ability of non-alcoholics to forgo the first-order preference to have one or several alcoholic beverages each day for the second-order preference of living, say, a healthier life that testifies to their capacity to act autonomously (Dworkin, 1988).

That being said, if a non-alcoholic, at times, decides to indulge in his first-order preference and has a glass of wine, this act does not signify a lack of autonomy. Autonomy is not something one can measure in short-time span, it "is a feature that evaluates a whole way of living one's life and can only be assessed over extended portions of a person's life"

(Dworkin, 1988, p. 16). However, if an alcoholic prefers to be motivated by first-order preferences to drink, whilst simultaneously not being able to change this first-order preference for drinking, it is too simple to say that the behaviour of drinking then signifies his autonomy. Autonomy "includes [the] ability both to alter one's preferences and to make them effective in one's actions and, indeed, to make them effective because one has reflected upon them and adopted them as one's own" (Dworkin, 1988, p. 17). As such, an individual who occasionally has an alcoholic beverage can be said to have autonomy whereas the alcoholic who is unable to challenge his first-order preference for drinking, and for example admit himself to a clinic, cannot be said to be autonomous. Thus, as argued by Dworkin (1988), autonomy is demonstrated when individuals attempt to change their habits, and when individuals express (dis)satisfaction about their lives. In short, autonomy is to be able to shape one's life through cognitive reflection and the ability to change it according to one's cognitive evaluation.

The relation between autonomy and freedom

As said before, freedom is another common feature in accounts of autonomy. In order to act autonomously on must have (had) the freedom to act, however the ability to act freely does not signify the presence of autonomy. Autonomy and freedom are closely related yet two separate notions (Dworkin, 1988). A few examples will help demonstrate this.

Non-alcoholics, who pursue the second-order preference of health, need to have the freedom to act in ways supportive of this preference. If one is forced to drink, say at a student party, one cannot act autonomously. As such, one needs to have the freedom to act to act autonomously.

An alcoholic, if not admitted in a clinic, has the freedom to act and thus to drink. At the same time, the alcoholic cannot act autonomously in the sense that he cannot *not* drink. He cannot exercise cognitive control over his actions. As such, one can lack autonomy whilst having the freedom to act.

However, if an alcoholic chooses to admit himself to a rehabilitation centre, even though he no longer has the freedom to drink once admitted, his autonomy is not undermined. Once committed, "in limiting his liberty, in accordance with his wishes, we promote, not hinder, his efforts to define the contours of his life" (Dworkin, 1988, p. 14). This shows that if one has relinquished his freedom to act, one can still be autonomous and thus that mere

attention to the voluntariness of action insufficiently captures the capacity of autonomy (Dworkin, 1988).

Finally, one can think of the presentation of factually wrong information or acts of manipulation. Though both do not take away one's freedom to act, they do both challenge procedural autonomy. This shows that autonomy can be challenged by more than the absence or interference with freedom (Dworkin, 1988). In contrast, the presentation of correct information and the absence of manipulation, though not enlarging one's opportunity to act freely, do support one's procedural autonomy.

What these examples illustrate is that, in order to be autonomous, one must have, or at some point have had, the freedom to act; that one can have the freedom to act without having the capacity to act autonomously; that different factors, i.e. lack of freedom or lack of information, can influence one's ability to act autonomously.

Influences and autonomy

Dworkin (1988) adds that there is more to autonomy than reflection on second-order preferences, "for those reflections, the choice of the kind of person one wants to become, may be influenced by other persons or circumstances in such a fashion that we do not view those evaluations as being the person's own" (p. 18). This pertains to the final example, that other factors than one's ability to act freely, i.e. factually wrong information, can challenge one's ability to act autonomously. In this regard, it is crucial to distinguish between morally illegitimate influences that challenge individuals' autonomy and morally legitimate influences that do not (Dworkin, 1988). Explaining the difference between positive freedom and negative freedom, concepts coined by Isaiah Berlin, helps to explain this difference. Moreover, it helps to explain why influences, which present themselves throughout individuals' life, do not render autonomy conceptually impossible. As just explained, though the freedom to act is not equivalent to autonomy, one could say that positive freedom and negative freedom are additional layers of autonomy. That is to say, the presence of negative and positive freedom influences the extent to which one can exercise his autonomy.

Negative freedom

Morally illegitimate influences are best explained by referring to the concept of negative freedom. Examples of morally illegitimate influences could be racism, where one's opportunity to act according to one's second-order preferences in society becomes limited, or

the indoctrination of a certain religion at school, where one's cognitive processes are undermined. To reference Hildebrandt (2008), negative freedom is "the absence of unreasonable constraints imposed on a person" (p. 61). Such illegitimate influences or unreasonable constraints challenge individuals' ability to exercise one's autonomy. Coercion, a total lack of freedom, not only challenges but obstructs one's capacity to act autonomously. Dworkin (1988) emphasizes that for an individual to be autonomous the individual must be able to choose without being influenced by threats from others. As such, negative freedom, the absence of morally illegitimate influences, is a secondary requirement for autonomy. If personal devices have illegitimate influences on users', this would be a sign that they challenge the autonomy of users.

The 12th article of the UDHR reads "no one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation" (UN General Assembly, 1948, art. 4). The 29th Article, paragraph two, further elaborates on this, where it says "In the exercise of his rights and freedoms, everyone shall be subject only to such limitations as are determined by law" (UN General Assembly, 1948). These protections express negative freedom, the absence of unreasonable constraints to shape one's life, which in effect protect the autonomy of individuals. The recently enacted GDPR similarly protects autonomy with negative freedom. The right to access, for example, enables users to ask for explanation regarding what data is gathered and processed and to what end (Art. 15 GDPR, 2018). This right enables individuals to object to decisions, which they consider to form an illegitimate influence that others have made on the basis of their data.

Positive freedom

Morally legitimate influences are best explained by referring to positive freedom. Examples of instruments to create positive freedom could be anything from food labels to financial security. Each of these strengthens an individuals' opportunity to engage in critical cognitive deliberation and autonomous action. As such, positive freedom benefits autonomy. As explained by Isaiah Berlin (1969) positive freedom is what aids self-realisation. Positive freedom is the freedom to circumstances that beneficially influence or support individuals in becoming their 'real' selves, where "the 'real' self […] discerns the good" (Berlin, 2002, p. 180). It is to be influenced or supported in choices one might not make without this influence, because one does not have the necessary knowledge to do so, or because one is accustomed to another choice, but that one would want to choose, if one would have the required

knowledge. Positive freedom is to be influenced in such a fashion that would support and align with second-order preferences each individual arguable has, such as improved physical or cognitive health (Berlin, 2002). To reference Hildebrandt (2008), positive freedom is to have "the freedom to achieve one's personal objectives" (p. 61). Positive freedom is thus more demanding than negative freedom. Positive freedom only promotes autonomy yet, without it, people can still act autonomously. My aim is to investigate whether personal devices threaten autonomy. Signs of positive freedom within personal devices would indicate the contrary: that wearable technology promotes autonomy.

An example of positive freedom is the right to education as expressed in article 26 of the UDHR, where it reads "Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages" (UN General Assembly, 1948, art. 26). Making education free positively influences people's choice to be educated, and education benefits one's cognitive evaluation abilities. This example might not be the best as children do not autonomously decide whether they will or will not attend school. Parents and the legal system do this for them. However, it would be exceptional if an adolescent reflects back on his youth and says 'my autonomy was violated when I was sent to primary school to learn how to read and write'.

As such, the difference between negative freedom and positive freedom is that the former protects autonomy by *taking away* unreasonable constraints or immoral influences and the latter protects autonomy by *incorporating* morally legitimate influences into one's environment that are to the benefit of people's autonomy.

Identity and autonomy

In sum, autonomy describes the capacity to reflect upon first- and second-order preferences and the ability to accept, reject or alter these according to one's cognitive evaluation. A second layer of autonomy is negative freedom, to be free from unreasonable constraints or coercion. These illegitimate influences threaten autonomy. A third layer of autonomy is positive freedom, freedom to circumstances that strengthen one's second-order capacity. These legitimate influences do not threaten autonomy but are in harmony with people's autonomy. As is implicit in Dworkin's description, autonomy is not binary: either one is autonomous or not. If one fails to do what one desires, this does not immediately demonstrate his lack of autonomy. Autonomy is better expressed on a continuum or scale. Derived from the Greek words *autos* and *nomos*, which translate into *self* and *rule or law*, autonomy quite

literally describes the capacity to rule over oneself and shape one's own life (Dworkin, 1988). Autonomy is what enables people to, over time, "define their nature, give meaning and coherence to their lives, and take responsibility for the kind of person they are" (Dworkin, 1988, p. 20).

Citizens' autonomy in Societies of Control

With this working definition of autonomy in mind, i.e. the capacity to reflect upon first- and second-order preferences and the ability to act on one's cognitive evaluation, it becomes clear how the final three sentences in "Postscript on the Societies of Control" written by Gilles Deleuze, suggest that citizen autonomy is threatened:

> Many young people strangely boast of being "motivated"; they re-request apprenticeships and permanent training. It's up to them to discover what they're being made to serve, just as their elders discovered, not without difficulty, the telos of the disciplines. The coils of a serpent are even more complex than the burrows of a molehill. (Deleuze, 1992, p. 7)

These sentences, in particular the part "it's up to them to discover what they're being made to serve" suggest that citizens are unaware of their current position, one described as servants. Without knowing the position one holds in society, one is incapable of reflecting upon this position and either endorse or challenge this position through action. As such, citizens' autonomy is challenged in what Deleuze calls 'control societies'.

In 1992, Gilles Deleuze argued that the disciplinary societies, as described by Michel Foucault, had evolved to societies of control. In these disciplinary societies, Foucault argued, a new right came to complement the former rights' of sovereigns. Previously, sovereigns exercised their power by either killing citizens or letting them live. During the nineteenth century "the right to make live and to let die" was added (Foucault, 2003, p. 241). Sovereigns started to focus on matters such as birth rate, life expectancy, illnesses and production processes to exercise control over individuals and the population at large. By doing so, they could optimise the population's strength, if you will. The sovereigns' management of the population, through disciplining techniques, is what is referred to as biopolitics. The disciplinary societies of the eighteenth and nineteenth century were societies demarcated by confined enclosures, such as the boundaries of a family, school, factory or prison. Each

confined enclosure disciplined the citizens, grouped together in one space, and together these disciplining enclosures had an effect "greater than the sum of its component", to create a strong and disciplined population, a "productive force" (Deleuze, 1992, p. 3).

What evolved from these disciplinary societies, gradually, after the Second World War, were the so called 'Societies of Control' (Deleuze, 1992). Whereas the disciplinary societies were demarcated by confined enclosures, societies of control are not. Discipline, which previously derived from the confined enclosures and which was interrupted when one moved from one space, such as from school, to another, such as the factory, is replaced by control that is omnipresent. The difference between disciplinary societies and control societies lies not in how harsh they are. The difference lies in the subtlety and greater effect that the mechanisms of control have in control societies to manage individuals and the population and promote capital aggregation, as opposed to disciplining techniques in disciplinary societies.

Deleuze illustrates this by showing how salary in corporations is a far more efficient modulating mechanism in today's corporations, than equal pay ever was in disciplining factories. Through competition, bonuses and "salary according to merit" we have increased the freedom of employees to pursue the career they want, whilst simultaneously effectuating greater productivity by opposing each employee against one another (Deleuze, 1992, p. 5). Another example that Deleuze mentions is how for example the hospital system has evolved to one where we no longer have doctors nor speak of patients, "without doctor or patient" (Deleuze, 1992, p. 7). This example is particularly topical considering today's debates on the reorganisation of public health. The advancements made in mobile health, which allow citizens to better manage their own health, are at once empowering and at the same exhibit a mechanism to better control the health of the population. The creation of societies that offer greater freedom are thus also societies that 'hide' the omnipresent mechanisms of control over the population. In control societies, an individual is controlled everywhere, and at all times by the various control mechanisms in society (Deleuze, 1992). It is the enlarged freedom, in part, that hides these modulating forces of control.

Deleuze says that we must find "new weapons" with which we can protect ourselves from these control mechanism (1988, p. 4). This is to say, that we must first identify, or dismantle the subtlety of the control mechanisms for otherwise we cannot escape their effects. In this thesis, I will argue that in this "progressive and dispersed installation of a new system of domination" that Deleuze describes, personal technologies present themselves as such modulating mechanisms of control (p. 7). I will moreover argue that wearables pose a subtle

and opaque threat, thus echoing Deleuze's final three sentences, to users' autonomy in how they mediate users' identity.

Conclusion Chapter 1

In this chapter I have provided a short description of Gilles Deleuze' claim that the disciplinary societies, as described by Michel Foucault, have evolved to societies of control. In these modern day societies, modulating mechanisms of control are omnipresent and no longer confined to enclosed spaces. Whilst simultaneously offering greater freedom to citizens, these mechanisms for governance to induce even greater effectiveness to mould the biological body and promote economic development, appear to threaten the autonomy of users in a subtle fashion. Autonomy, as characterised by Dworkin, signifies the second-order cognitive capacity of individuals to critically reflect upon first- and second order preferences, and upon evaluation, reject, accept or change these in the pursuit of higher order-preferences. It thus includes the ability to pursue these second-order preferences through action. As such, autonomy is fundamentally about the capacity for individuals' to shape their lives and who they are as a person. In order to exercise one's autonomy, and shape one's life, individuals must furthermore not be hindered by illegitimate moral influences, which I have tried to explicate more clearly using Berlin's distinction between positive freedom, which signify morally legitimate influences beneficial to citizens' autonomy, and negative freedom, which protects citizens from illegitimate influences that undermine autonomy.

Chapter 2: the Internet of Things and wearable technology

In this chapter I will firstly discuss the vision of the IoT with some more detail. Secondly, I will describe three examples of wearable technology, namely the mobile application MoodKit, the smart watch Versa and Vaunt glasses and illustrate what potential they have once the IoT is fully realised. Third, I describe why one can perceive wearable technologies as modulating mechanisms in the so called 'control societies'. Fourth, I briefly discuss the empirical evidence of these devices' effectiveness, to justify why it is reasonable to assume that these devices will, on the long-term, become increasingly effective. I end this chapter by describing the core promise that these devices offer to users, which is to become better and more human, and argue that for this to be true, devices must not threaten the autonomy of users. To clarify what this necessitates, I stipulate three conditions that are deduced from the explanation given in chapter 1.

The Internet of Things

In the introduction I already explained a bit about the IoT, otherwise referred to as the fourth wave of digitisation, which is expected to fundamentally alter the way citizens' experience and live their lives. Many technical challenges, social and political questions and ethical issues still need to be resolved before the IoT can be fully realised (Dutton, 2014). This means that the IoT, for now, is best described as a vision. This vision is thus one in which the physical world will be mirrored by digital representations, through the continuous and real-time monitoring of the world. The IoT turns the "offline world online" (Hildebrant, 2008, p. 60).

According to Hildebrandt (2008), the core technologies enabling the creation of the IoT are "sensor technologies, RFID systems, nanotechnology and miniaturization" (p. 60). In the IoT world, everything will be tagged with sensor and networking technologies that allow these devices and things to continuously observe their surroundings, collect data and through IoT networks, share this data with other things and devices without any, or at least very minimal, human interference (Hildebrant, 2008; Ashton, 2009). The data that will be collected can be anything from human movement, physical reactions, people's habits, social interaction, to the temperature or humidity in any given area. Crucial to the vision of the IoT, is the removal of humans in data accumulation and processing (Ashton, 2009). The IoT is about empowering "computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory" (Ashton, 2009, p. 1).

With these capacities, devices and things can come to "identify and understand the world—without the limitations of human-entered data" (Ashton, 2009, p. 1). As said before, the digital representations created by the IoT technologies will show people how they can optimise products, services, behaviour and the environment at large (Kool et al., 2017).

Another concept important to address is Ambient Intelligence. Ambient Intelligence is the discipline which explores the technical possibility of environments to become capable of supporting, responding to and anticipating the needs of individuals (Cook, Augusto & Jakkula, 2009). Explained by Hildebrandt (2008), Ambient Intelligence has five key elements: "embeddedness", tagged devices and things are embedded within the environment; "context-awareness", these technologies are capable of recognising both people and their environment; "personalisation", they adjust to the individual and provide useful information specific to and for that individual; "adaptiveness", they can change the environment of that individual according to how an individual behaves; and "anticipatory", without the individuals input, the technology is capable of anticipating what the individuals needs (p. 60). Thus, wearable technologies are not only part of the larger vision of the IoT, they are ambient intelligence devices, which will become clear in the next section. One other fundamental technique in the IoT are profiling techniques. Profiling technologies translate the abundance of data, which would have little value independently, to applicable knowledge for people to consume on the basis of group characteristics (Hildebrandt, 2008, p. 60). I will further elaborate on the technique of profiling in chapter 4.

Three case studies: MoodKit, Versa and Vaunt

As implicit in the name and mentioned in the introduction, wearable technology refers to smart devices which one can wear that help users to track various items. I would argue that mobile applications are also appropriately classified as wearable technology as they are always with the user and equally serve to record and/or motivate certain behaviour. I will now illustrate three different types of wearable technologies that I will refer to in the remaining part of this thesis. The potential of these wearable technologies is best understood when one considers the envisioned context of the IoT I just described, which I will further demonstrate with some examples.

MoodKit is a mobile phone application based on scientifically supported principles and tools of psychology. Ultimately, MoodKit offers enlarged self-awareness and well-being. Some quotes promoting this application are "develop self-awareness and attitudes that

promote well-being" and "feel better, do better" ("MoodKit", 2018; ThriveportLLC, 2012). MoodKit's main slogan is "your gateway to a life better lived" ("MoodKit", 2018). It allows users to describe, track and rate productivity levels, moods, and social activity with diary reflections and questionnaires, and to share these with other MoodKit users (ThriveportLLC, 2012). It gives users tips such as, "Open up a little. Share what you've been up to or how you feel with someone you trust" (ThriveportLLC, 2012). MoodKit further provides information to users. For example, it explains the phenomena of catastrophising or downplaying positives ("MoodKit", 2018).

Versa is the newest smart watch brought to the market by FitBit. It is sold as an intuitive and empowering device, a "daily health & fitness companion" (Fitbit, 2018). It allows wearers to measure and track daily health and fitness activities, sleeping patterns, menstrual cycles and is equipped with many other applications. The device motivates the wearer to engage in specific behaviour through notifications. The slogan embodying this device is "to live your best life with Fitbit Versa" ("Fitbit Versa™ Watch", 2018**).**

A third device is one of the latest set of smart glasses, Vaunt, that are currently being developed by Intel. They have one purpose, which is to show the wearer contextually relevant information (The Verge, 2018). With the informational display shown in the lower left corner, Vaunt allows users to consume data. In a video, developers say these Vaunt glasses are "meant to be non-intrusive, not annoying in social situations, but [..][they] can do little subtle things" (The Verge, 2018**)**. For example, the glasses show the wearer messages, incoming calls, shopping lists, or restaurants in close proximity. Which restaurant, the one to your left or right, has the best review? Or, "when you're in the kitchen, and you go, Alexa [which is another smart home device], I need that recipe for cookies, and it just appears on your glasses" (The Verge, 2018). Designers say that their purpose is to show you want you want, when you want it (The Verge, 2018). As such, this device promises greater ease for wearers to manage daily activities.

Just as these case studies, the devices I discuss in this thesis are limited to those that are always worn, or are permanently with the user. They are either bought for the purpose of measuring certain mental or physical activities or to help the user in accomplishing a specific objective, a second-order preference. The Vaunt glasses illustration to recall a recipe instantaneously, most clearly illustrates the vision of IoT. An example that illustrates the current potential when devices become interconnected is when, for example, a music installation starts playing classical music when a wearable technology detects rising stress levels (TEDx Talks, 2014). To mention another example that illustrates the potential of

wearable technology in the envisioned context of the IoT, Vaunt glasses will be able to suggest restaurants that are in line with the wearers' fitness and diet, i.e. second-order preferences, with the help of Versa who monitors physical activity. These examples moreover illustrate why these devices are ambient intelligence devices. They are capable of observing their user, providing personalised information and anticipating needs. As devices become more capable of exchanging data with each other, without human interference, and translating this data into valuable information they will likely become more capable of supporting users. By feeding into one another they can generate even more accurate and personalised advice and information for the wearer to consume.

Wearable technologies as modulating mechanisms of control

With these three case studies in mind, one can start to see in what ways they have the same features that are characteristic of the Societies of Control, which has moreover been clearly explained by Brett Nicholls. Biopower, as discussed by Foucault, had always been about improving the biological whilst simultaneously stimulating capitalist development through networks of knowledge and power (Yu & Liu, 2009). Wearable technology firstly illustrates biopower, because, without complicating the governance of bodies, they provide means to optimise this biological body and thus promote the economy (Nicholls, 2016). Personal devices can thus be interpreted as a body political technique, improving at once the biological individual as well as pushing the development of capitalism through more productive, happier and healthier masses. Yu and Liu (2009) say that the commodity of life remains as fundamental in the Societies of Control. Indeed, to recall chapter 1, whilst modulating mechanisms offer greater freedom to individuals such as managing one's own health with wearables, they simultaneously offer an even more efficient way to modulate bodies for biological improvement and capitalist aggregation in modern day society.

Indeed, as Nichols (2016) explains "at the most basic level, the user engages with a health app that manifests the central features of control societies", and the same can be said for wearable technology at large (p. 109). As explained previously, control societies are societies in which control is continuous, dispersed over separable spaces. Similarly, these devices modulate practices persistently, as wearable technologies are *always* worn. Moreover, they modulate a wide range of practices, such as sleeping, eating, drinking, exercising, socialising, etc. Modulation through wearable technology is largely dependent on the ideology of dataism, a term coined by José van Dijck. This ideology describes the belief

that data offers insight into how one can improve his suboptimal performances and life. On the basis of this belief, wearable technology can exercise control over the biological body (Nichols, 2016). By means of measuring the human body and translating this data into informative displays, which people trust, users come to modulate those practices monitored to improve one's overall performance (Nichols, 2016). The combination of this established ideology and the popularisation of wearable technology are placing the "selves, technology, and data" in an ever more personalised relationship (Nicholls, 2016, p. 103).

The persistent direction provided by these 'somatechnologies', regardless of where a user finds himself, can be described as modulating mechanisms of control. For an individual to accrue data on the practice promoted by the device, one must "reconfigure their practices in relation to the technology", or, in other words, one must modulate his body and daily activities to accrue data, in a certain manner, to satisfy that practice and optimise it (Nicholls, 2016, p. 110). To become happier using MoodKit, one must write diary-like reflections, spend time reading the presented information and rate one's mood each consecutive day.

Wearable technology has another effect, which is to emphasize those practices integrated within the devices, over other daily practices which are not integrated within the devices. The explicit norms and values, such as 'exercise is good', embodied by such devices have the effect of certain behaviours being emphasized on a daily basis, overshadowing other activities. The result hereof, as argued by Nicholls, is that certain practices attain greater focus than other daily aspects of life. Other aspects of life become "subordinated within a hierarchical relationship to the key aspects" wearable technology supports (Nicholls, 2016, p. 110). Those practices accentuated all contribute to the optimisation of the individual, benefiting either their mental or physical health or efficiency to manage daily routines.

This hierarchical structure of "work practices, beliefs, narratives, and organisational routines" which users are exposed to, has further consequences (Bowker & Leigh Star qtd. in Nicholls, 2016, p. 110). The stimulation to gather data on pre-selected practices over time, and to compete with others or share one's results with others, transforms a practice into "a goal and an object of accumulation" (Nicholls, 2016, p. 110). Yu and Liu (2009) say, who focus on other technologies promoting the biological human, life becomes increasingly fixed, "a cultural or artificial construct open to calculative and regulative interventions of administration" (p. 289). Through the objectification of practices, such as walking, sleeping, eating, being productive or becoming stress-free, human practices are medicalised, or turned into instruments (Nicholls, 2016). "Walking is no longer simply for walking, it is reconfigured as an activity for something else, for enhanced performance" (Nicholls, 2016, p.

110). Similarly, eating becomes a calculable practice, instead of a pleasurable activity and signifier of culture (Nicholls, 2016). Nutritional content becomes the signifier of truth within the relationship that exists between body and health. Well-being tips, such as engage in more social activities, would be another example of the modulation and conversion of practices into instruments. By presenting information to the user why social activity is beneficial, the activity of socialising, formerly just a pleasurable activity, becomes medicalised and turned into a scientific instrument with which one can optimise his biological life.

As such, wearable technologies can be identified within the characteristics of control societies. Whilst simultaneously offering freedom for users to improve objectives they have, they are mechanisms with which pre-selected practices are modulated, and in turn governed, to improve the biological body and benefit the growth of the economy. Wearable technologies effectuate a certain hierarchy of everyday practices, and instrumentalise those which they support. This by itself however, the modulating effects of wearable technology and hierarchisation and instrumentalisation of daily practices, does not prove that wearable technologies pose a threat to autonomy. Thus, the question remains whether this modulation is one that threatens autonomy or strengthens autonomy.

Empirical evidence of personal devices' effectiveness

In order to claim that wearable technologies modulate practices of users, there needs to be some proof indicating that these devices are effective tools. Research shows that such devices *can* be effective. Stephenson, McDonough, Murphy, Nugent and Mair (2017) conclude that wearables can reduce sedentary behaviour, though the effectiveness hereof weakens over time. Jakicic et al., (2016) conclude that wearable technology provides no additional advantages for weight loss, which implies that wearable technology is not ineffective but merely that they are no more effective than other approaches are to manage one's weight. Wac and Rivas (2018) focus on the Quantified Self movement and the effectiveness of this trend to attain greater wellness and health (including physical states, psychological states, social interactions and the environmental context). This paper concludes that the effectiveness of self-tracking still needs greater research, and that some domains are particularly under researched.

Even though these articles mainly focus on the application of personal technologies for health purposes, they provide evidence that it is best to understand the effectiveness of personal technologies as being dependent upon the specific device, the design hereof and the

domain in which they are employed. This evidence moreover suggests that it is reasonable to assume that, as our understanding of these devices (in)effectiveness increases and the technologies advance, personal technologies will likely become increasingly effective in supporting users' to achieve their goals, i.e. second-order preferences.

The core promise of wearables

In a Ted Talk, Lauran Constantini argues that we should perceive wearable technology as tools with which we can expand our human potential by making us more self-aware, efficient, healthier or happier (TEDx Talks, 2014). Through the real-time continuous collection of data and translation hereof into informational, digital displays by personal technologies we can optimise our performances at any moment and even anticipate suboptimal states, such as stress or a disease. Notwithstanding the dependence on the third parties who create and offer these technologies, these wearable technologies also allow us to become less dependent on third parties such as health professionals or psychologists. Lauran Constantini mentions an example of a man that uses more than 20 devices that he either wears on his body or has installed in his home. This man, called Chris, lost 120 pounds not by dieting, but by using these devices to inform him on matters that correlate with him overeating. Constantini adds that this man "is of course trying to find a better version of himself, which we all are" (TEDx Talks, 2014). Once we have become more aware of ourselves, learnt about harmful triggers and altered behaviour we can stop using these devices, Constantini says. This is why Constantini says we should perceive these devices as training wheels. With time, we no longer need to wear the devices yet we "maintain that rich life that that technology enabled […] [us] to have" (TEDx Talks, 2014).

The promise of these devices is thus that they allow us to optimise our lives: to attain greater awareness of how we behave, feel and think to effectuate behavioural or cognitive change. This general promise is echoed in the descriptions of what MoodKit, Versa and Vaunt can be used for. Owens and Cribb argue that the central claim of health promoting devices is that "the information and motivation they provide will grant people greater autonomy over their health, enabling people to become fitter, healthier and happier" (2017, Introduction, para. 1). Constantini ends her Ted Talk by saying "technology is allowing us to become more human in these ways […] [and] better humans" (TEDx Talks, 2014).

For the claim of personal devices providing the opportunity to become more and better humans to be true, it is necessary that they do not at the same time deprive us of our

autonomy. This is because, as just explained in Chapter 1, autonomy is core to being human as it is the capacity that allows us to reflect on what we do, who we are and the lives we want to shape for ourselves. In the next two chapters I will assess whether this core promise of personal devices is true: do personal devices, in the context of the IoT pose a threat to our autonomy?

Three conditions of autonomy

I will briefly sum up what three conditions personal devices must satisfy, according to Dworkin's characterisation of autonomy described in the previous chapter before I start my analysis. Although my research question is to explore whether or not personal devices pose a threat to autonomy in the context of the IoT, for the purpose of expressing myself more clearly, I will both indicate when personal devices can be said to promote autonomy and when personal devices can be said to threaten autonomy.

If personal devices benefit users' critical reflection on first- and second-order preferences they can be said to benefit autonomy. Examples of this might be that devices provide greater understanding over users' reflection processes, or that personal devices offer novel information that inform users' reasons to accept, reject or alter preferences. If, in contrast, personal devices offer false information, this would limit the users' ability to critically reflect and thus be a sign that personal devices challenge autonomy. I will call this condition *respect for users' cognitive reflection processes.*

Beyond strengthening or undermining cognitive processes of users, for devices to benefit autonomy, they must enlarge one's ability to forgo first-order preferences and pursue second-order preferences. However, these influences must be morally legitimate. If wearable technology presents morally legitimate influences, one could argue that personal devices benefit autonomy on this level. For example, if Vaunt first suggests restaurants serving healthy meals instead of fast food restaurants when the user is pursuing the second-order preference of health, this could be a sign that wearables promote autonomy without illegitimately influencing the users' choices. If wearable technology presents unreasonable constraints or morally illegitimate influences, to first show fast food restaurants instead of healthy restaurants, one could argue that personal devices threaten autonomy. I will call this condition *respect for users' choices.*

As autonomy is about shaping one's life and moulding one's individuality according to how one wants to be, a device that supports one in discovering how one wants to shape his life would be a sign that wearable technology supports autonomy. The reverse, where

personal technologies come to shape users' life and identity would be a sign that personal devices threaten the autonomy of users. I will call this condition *respect for users' identity.*

Conclusion Chapter 2

This chapter has provided greater detail on the vision of the IoT and described three examples of wearables. I then argued that it is reasonable to assume that wearables will be effective in the future. This is because there is evidence that suggests that they *can* be effective in the short-run today, and great efforts and substantial investments are made to further improve these technologies. I then argued why it is appropriate to classify wearables as modulating mechanisms in societies of control. Directing multiple practices persistently and throughout the whole day with notifications, information and motivational strategies, the bodies and minds' of users are moulded with the intent of improvement. Finally, after describing the core promise of these devices, to empower users with tools to become more and better humans, I argued that this claim cannot be valid if wearables pose a threat to the autonomy of users. Translating Dworkin's characterisation of autonomy into three separate conditions, this entails that wearables must demonstrate respect for users' cognitive reflection processes, respect for users' choices and respect for users' identity. In the following two chapters I will categorise each potential threat that wearables can pose to users' autonomy under one of these three conditions, and assess the gravity of these threats.

Chapter 3: The services of personal devices an autonomy

In this third chapter I will explore in what ways the services that personal devices offer can influence autonomy, using the three conditions of autonomy just formulated. To build my argument, I will primarily critically analyse the arguments presented by Owens and Cribb. They discuss the relation between autonomy and self-tracking devices used for the purpose of promoting health. This is a more restricted focus of devices than those discussed in this thesis. However, the same arguments can be applied to a broader range of devices. I will also refer to Peter Paul Verbeek's work, who discusses ambient intelligence and persuasive technology at large in light of agency and freedom and other articles where appropriate to strengthen my arguments.

Comparing two conceptions of autonomy

As I mainly critically analyse Owens and Cribb's argumentations, it is important to first compare their conception of autonomy with that of Dworkin's characterisation on autonomy. Owens and Cribb draw a distinction between procedural autonomy and substantive relational autonomy. Both these elements are arguably included in Dworkin's characterisation of autonomy. The definition of procedural autonomy that Owens and Cribb employ corresponds to the characterisation of autonomy provided by Dworkin. Owens and Cribb (2017) explain that "procedural accounts of autonomy […] emphasise the importance of freedom of will and the capacity to engage in processes of independent deliberation about the course of one's life" (Section 3, para. 2.). Owens and Cribb (2017) conclude that procedural autonomy "refers to processes of psychological deliberation" (Abstract**).** Both accounts thus use a cognitive criterion to determine whether or not an individual has autonomy. Substantive relational autonomy, Owens and Cribb (2017) say, "refers to the opportunities people have for exercising potential actions" (Abstract). By considering the societal influences on individuals, those which challenge autonomy and those which do not, Dworkin addresses people's opportunities for exercising their autonomy as well. Because these two conceptions of autonomy are similar, one can justify critically analysing Owens and Cribb's argumentation with Dworkin's account of autonomy.

Wearables and respect for users' cognitive reflection processes and choices

At first glance, Owens and Cribb argue that "there is good reason to think these technologies can support processes of deliberation about health that enhance their users' procedural autonomy" (Section 3, para. 4.). This is, as said by Owens and Cribb, because they inform wearers with informational displays, create better awareness of habits and weaken traditional asymmetries, for example between doctors and patients.

At first glance, I agree that all three cases appear to enable larger opportunity to achieve second-order preferences through the display of useful, personalised information that informs, and might motivate, the user regarding his first- and second-order preferences. Versa offers informative displays on matters such as activity levels and calories burnt, and correlations between these. By encouraging user to write diary-like reflections and rating moods and portraying the results hereof in a graph over time MoodKit, for example, can help show the wearer which activities are correlated to higher stress levels. These displays thereby inform users on how they behave and how this behaviour correlates with other factors. One could say that incorrect information interferes with cognitive deliberation. However, since the assumption is that wearables *can* already be effective and additionally that the technologies will be improved upon, the portrayal of incorrect information is not a significant threat. As such, this information and increased awareness of one's habits does not present a threat to autonomy but might instead be beneficial to users in cognitive reflection processes and decision-making of preferences. Thus, wearables appear to satisfy the condition *respect for users' cognitive reflection processes* by providing (more) information and greater self-awareness, thus not posing a threat to users' autonomy.

Vaunt is slightly different from both Versa and MoodKit. Vaunt does not generate awareness of wearers' habits nor does it inform wearers on personal metrics. Vaunt does however offer contextually relevant information, such as auto routes or nearby restaurants. At first glance, this would equally not pose a threat to users' autonomy but instead favour the individuals' deliberation processes by providing them with relevant information that they can thereafter consider in processes of cognitive deliberation. Only if the information shown is one-sided or biased to favour a third party, one might have reason to believe that users' autonomy is challenged in some way as this would imply that certain information is prioritised over other, thereby complicating the potential for well informed cognitive deliberation. In general, then, it appears that Vaunt equally respects users' cognitive reflection processes and thus does not pose a threat to users' autonomy.

Versa and MoodKit further use motivational strategies through notifications such as 'don't forget your run today' or 'share your experience with a close friend'. Such notifications and other motivational elements of wearable technology, Owens and Crib (2017) argue, potentially enhances wearers' ability to achieve their "genuine volitions", or second-order preferences as Gerald Dworkin would say (Section 3, para. 4). If such motivational notifications are in line with the second-order preferences of users, and they are effective, one could classify these motivational strategies under positive freedom. This is because they purport to influence the users in a manner that accords with his second-order preferences. If competition with friends or strangers incurs the opposite effect of de-motivation users can reflect on this effect, and decide to no longer share experiences or compete with others. Thus, the motivational elements of wearables also appear to satisfy condition two. They do not constitute illegitimate influences and as such motivational strategies equally do not pose a threat to users' autonomy.

Nudging and respect for users' choices

The third condition I deduced is that devices should have respect for users' choices. For this condition not be violated, the influences that personal devices have on users must be morally legitimate. If wearable technologies present unreasonable constraints, or immoral influences, the autonomy of users in coming to choices with cognitive evaluation would be challenged. In the previous section I discussed the display of information and motivational elements, and focused on the question of *what*. I will now analyse *how* this information and motivation, which can influence the user in his choices, is presented, namely through the use of certain choice-architectures and nudges. Owens and Cribb (2017) argue these nudges and choice architectures challenge autonomy, arguing that "whether adopted voluntarily or otherwise, health promoting wearable technologies cannot be seen as simply embodying or supporting the autonomy of users" (Section 3, para. 4). This is because they encourage the subscription of users to particular norms and values. Thus, at deeper inspection Owens and Cribb (2017) argue, on the basis of Sunstein and Thaler's theory on nudging, that personal devices threaten autonomous deliberation by motivating users' to subscribe to certain values, norms and behavioural practices. Both Mood-Kit and Versa would classify as health promoting wearables, one focusing on physical health and the other on mental health. I here examine this claim and thus pose the question 'in what way do the influences of wearables leave room for the wearer to choose?'

There are several counter-arguments to refute this claim. First of all, devices are not meant to be neutral. Their purpose is to provide directions and this automatically implies that devices mediate how we perceive our surrounding world. "Technological mediation can […] be seen as a specific, material form of intentionality" (Verbeek, 2009, p. 235). However, as Verbeek argues, and I agree with, this does not imply that users are at the mercy of these devices as it necessitates "the intentionality of human beings" (Verbeek, 2009, p. 235). Thaler and Sunstein's account of libertarian paternalism further explains why users are not at the mercy of such devices, and provides moral justification for the value-laden nudging techniques integrated into wearables, showing that wearables do not undermine users' autonomy.

Although at first seemingly conceptually impossible, Thaler and Sunstein (2003) explain why libertarian paternalism is possible and a morally justifiable account in "Libertarian Paternalism is not an Oxymoron". Where libertarians stress freedom of choice, paternalists advocate techniques to influence people's behaviour in morally desirable directions. Libertarian paternalism combines both attitudes, showing how one can morally justify paternalist influences to promote the welfare of individuals whilst maintaining freedom of choice (Thaler & Sunstein, 2003). First, Thaler and Sunstein explain that paternalism is impossible to avoid. Every choice exerts an influence. Whether one places fruit or chocolate at the front of the line in a canteen, both choices will influence the behaviour of the consumers. Hence, wearables cannot be value-neutral in the first place. Thaler and Sunstein (2003) further add that often times people do not have fixed preferences about what they want, a claim they support with economic and psychological studies. They then go on to defend the claim that it is reasonable to assume that people generally value their own welfare. Consumers would prefer to be healthy, happy and efficient to being unhealthy, unhappy and inefficient. As such, there are certain norms and values we can reasonably expect people, or at least the majority of people, to have. By changing choice architectures in a way that they encourage choices in line with individuals' welfare, which would be in line with individuals' preferences, whilst not removing any choices, the freedom of choice of individuals is still respected (Thaler & Sunstein, 2003). What libertarian paternalism thus supports is that the nudging techniques of personal devices are morally justified because they (generally) encourage behaviour which is beneficial to users' welfare whilst respecting users' freedom of choice. When one's Versa says 'go for a walk', the user still has the choice to stay sedentary. As personal devices can be said to promote the welfare of users', whilst respecting the

freedom of choice, there is no reason why these nudging appliances are morally immoral, even if they are not value-neutral which Owens and Cribb find problematic.

Moreover, although Owens and Cribb (2017) argue that the voluntariness of using wearables is irrelevant, I instead would argue that the place of choice architectures seems particularly relevant to consider and that is provides additional justification for the nudging techniques in wearables. There is a moral difference between changing the choice architecture in a canteen at work to one promoting healthy choices, to the choice architectures in wearables. Employees might not have consented to the alteration in choice architecture of the canteen, whereas wearers of personal devices, in a way, do consent to the choice architectures presented by personal devices. PwC's (2016) research shows that many people purchase such devices for the purpose of accomplishing certain behaviour they feel such devices might help with. People feel that these devices create a feeling of accountability and motivation towards one's personal goals. According to PwC's research, "since 2014, consumers agree that wearable technology helps us exercise smarter (82%), […] improves personal accountability (69%), and makes us more efficient at home (65%)" (2016, p. 5). Thus, people willingly and with reason subject themselves to nudges that motivate certain behaviour as they find this helps them to accomplish second-order preferences, those preferences they have difficulty to accomplish without the nudges of wearables. This pertains to Verbeek's (2019) statement, namely that the influence of technologies on users can only come into force once users decide to employ these devices and introduce them as part of their lifestyles. In other words, one could say people purchase these devices to be nudged. Nudging the behaviour of employees in a canteen is a whole different ball game than nudging a citizen who bought a personal device to measure behaviour and/or strive to improve certain elements of one's life. As such, the voluntariness to use wearables further legitimises the nudging techniques.

On a critical note, I say that users have consented to the choice architectures *in a way*, as it is unlikely that all people fully understand how choice architectures in personal devices operate and what kind of effect they induce. To further strengthen the legitimacy of these devices' nudging techniques, users should be able to retrieve information explaining this. *In a way* is further necessary to add due to the fact that individuals, though described as rational beings, are not simply rational in how they behave and make choices, such as to buy a personal device. Many philosophers have indeed criticised rational choice theory, a theory that treats individual and the choices and behaviour they engage in as something that can be explained economically (Simon, 1990). Instead, as economic and psychological studies on

human decision-making have proven, the cognitive abilities of individuals are limited, or as Herbert Simon said, individuals have "bounded rationality" (Simon, 1990, p. 15). Moreover, people's choices are influenced by social, historical, and cultural factors (Hodgson, 2012). It is worth investigating whether one can truly speak of an autonomous choice to purchase such devices, considering these influences. This is what Owens and Cribb (2017) explicitly refer to when they argue that wearables form part of wider discourses and "consumerist cultures which supply strong signals and messages that may further compromise users' procedural autonomy" (Section 5, para. 7). This issue however, although I admit that it deserves attention and may well be a valid claim, says something about the consumerist society and vulnerability of consumers and nothing about wearables. In other words, it does not suggest that personal devices undermine autonomy but that consumers' choices might be interfered with when deciding to purchase these devices.

I would like to add that the choice to use persuasive technologies ought to be an autonomous choice. If the choice to purchase is influenced by the wider consumerist culture, this would be a morally illegitimate influence. However, if not, it would be paternalistic to argue that consumers should not expose themselves to nudges from personal devices. This would infringe upon individuals' autonomy in cognitively evaluating the choice to use or not use a device and come to a decision. Moreover, one can wonder why consumers may not be exposed to nudges of wearable technology, that they willingly expose themselves to and are to the benefit of their welfare, if they live in a society laden with choice architectures (Thaler & Sunstein, 2003). Supermarkets place chocolates at the counter and Netflix shows a button with which you can skip the intro tune making it more likely for the watcher to engage in binge watching. Surely the nudges of wearables are no more harmful than many other nudges we face in our everyday practices.

On a second critical note, as technology continues to advance and persuasive technologies become more effective, it is important to routinely investigate with empirical studies that users remain capable of overruling or ignoring their devices' demands in the future. Martens and Brown (2018), when discussing applications employed to improve one's relationship, say "if users believe that a device (like lovely) is more likely to give them an unadulterated perspective […] they may also believe that such a device is more credible than their own beliefs about their own relationship" (p. 40). There is a thin line between referring to a device for information, advice and encouragement and coming to rely on a device to make decisions for you (Martens & Brown, 2018). Increased effectiveness of devices might lead some, but not all, to no longer be capable of ignoring devices and to become reliant on

them. That is to say, wearables should not become more than persuasive as this would undermine the autonomy of users.

Modulating practices and respect for users' identity

As just discussed, wearables are not value neutral. The influencing nudges, such as 'don't forget to run today' embody norms and values as do slogans such as "live your best life" or "feel better, do better" ("Fitbit Versa™ Watch", 2018; ThriveportLLC, 2012). They do indeed as argued by Owens and Crib (2017) "embody and reinforce particular epistemologies, values and norms" (section 3, para. 1). I just defended the claim that the influences of wearables, which embody norms and values, are morally justified on an individual, immediate basis. However, another important thing to consider is that although these implicit norms and values are integrated into devices with morally good intentions, they could have unforeseen long-term consequences. They can challenge users' autonomy in the long-run by interfering with how one shapes his life and who one wants to be as an individual. Especially when one considers the framework of Deleuze, it becomes clear why the embodied norms and values within wearables potentially threaten the autonomy of users' with regards to users' identity.

As just mentioned, because every choice-architecture has an influence, as argued by Thaler and Sunstein, value neutrality is in a way simply not possible. Moreover, as I just said, values and norms are omnipresent in society. Instagram could be said to reinforce norms of perfection and Facebook could be said to reinforce norms on social engagement. In this regard, the fact that Versa reinforces norms on good health is nothing new. However, *how* wearables embody and support certain norms and values – which are expressed with certain practices - is arguable different from how other norms and values are embodied in society. If one would summarise the norms and values that are embodied by wearables, one could characterise these as 'optimisation of the self'. Each suggestion, about how one should move, eat, interact, etc. is to improve health, well-being and efficiency of the self. It is only outside of wearable technologies that one is exposed to a more diverse range of norms and values, including norms and values that it is okay to be 'sub-optimal', so to speak. Instagram and Facebook are sites users log in to frequently, yet users do not engage with these platforms continuously. Wearable technology however embodies norms and values in a *persistent* and *ubiquitous* fashion. Whether one is at home, at work or on holidays, the user is exposed, though voluntarily, to these same norms and values. One can find moments with friends to

remind oneself that it is okay to be sub-optimal, yet these moments pass, whereas the reminders from wearables do not. Because of this the internalisation of certain norms and values becomes more likely.

As explained in Chapter 2, wearables emphasize certain practices – that express these norms and values - and thereby generate a hierarchical ordering of human practices. In the process of identifying oneself, due to the ubiquity and persistency of wearables directions, one is encouraged into identifying oneself within the confines of the pre-selected objectives of wearable technologies, whether this is to be a fit person, socially skilled person, a kind person or an efficient person capable of balancing various responsibilities at once.

To name one example, say an individual prior to using a wearable enjoyed playing basketball and flying a kite equally. This individual then purchases a wearable with the objective to optimise his fitness level. As basketball is a more efficient means to become more fit, the encouragement that this user receives continuously and over-time will encourage the individual to spend more time playing basketball than flying a kite. What this example illustrates, is that wearables over time can tip the balance of previously equally preferred practices in favour of one that happens to be encouraged more by one's wearable.

Having selected one of these pre-selected objectives, in the example this would be to become more fit, users thereafter get to know themselves concerning this characteristic by means of receiving statistical graphs that summarise their performance (Nicholls, 2016). Nicholls (2016) says, a rather "impersonal form of knowledge construction –data" becomes a personalised form (p. 113). Collecting data and viewing data in such digital graphs transforms data into "an intimate object" that signifies the self (p. 113). Data summaries on one's performance of pre-selected objectives, that one views regularly, affirm to the user that these practices signify him; "the personalised data signifies the presence of subjectivity" (p. 113). One's identity, 'I am productive and happy' is confirmed by messages such as 'great job, you have been hugely productive today whilst experiencing happiness at seven distinct moments'. This subtle yet persistent and ubiquitous mediation in how one comes to identify oneself – arranging a pre-selected choice of objectives that thereafter are confirmed persistently to be part of one's subjectivity by means of data displays on one's performance - could therefore challenge one's autonomy by mediating how one perceives, or identifies himself.

On a side note, I would like to add that if the uptake of wearables continues as predicted, and wearables are integrated in various policies such as health insurance policies or governmental public health policies, or even at work, the potential that certain norms and

values are widely internalised could have other unforeseen consequences. As argued by Verbeek, devices which are used to combat unhealthy lifestyles are "sound just as long as this fight is seen as meaningful and as long as the [personal devices do] […] not develop into a source of new beauty ideal" (2009, p. 240). Similarly, other devices which encourage certain norms and values should not have adverse affects for those who do not wish to embody these norms or values. This is not an unreasonable assumption to make if one considers that for example the long-term national efforts to reduce the amount of smokers have equally changed attitudes. Whereas smoking used to be common, it is now often frowned upon. Although this is a good change, it is not the case that sub-optimal performance within health, well-being and efficiency which are promoted by wearables always indicates some type of inferiority. For example, although it is admirable when an individual is efficient and can juggle being a father, CEO, political activist, and sports addict at the same time, there is nothing less valuable about an individual who chooses to work part-time and spend his free time reading books and gardening. As such, policy makers, private parties and individuals alike ought to be cautious that such wide-scale internalisation do not have adverse effects, such as stigma towards the unhealthy and unproductive, for those who fail to live up to wearables or choose not to pursue these objectives and do not internalise such norms and values. These unforeseen consequences on a national scale must be considered so that the potential benefits offered by these wearables are reaped whilst minimising or avoiding any harmful consequences.

Wider circumstances and the potential for autonomy

Owens and Cribb (2017) explain that, following the substantive-relational account of autonomy, personal devices ought to do more that provide information, advice and encouragement to the user. To recall, substantive-relational autonomy, as defined by Owens and Cribb (2017), refers to the opportunity that individuals have for exercising potential actions. Substantive relational autonomy considers "the social embeddedness of persons and the causal role that structural circumstances have on people's capacity to engage in processes of autonomous deliberation" (Owens & Crib, 2017, section 4, para. 2). As said earlier, Dworkin arguably includes this by drawing attention to the difference between morally legitimate and illegitimate influences which impact individuals' potential to be autonomous. Moreover, Dworkin (1988) acknowledges that not every individual has equal capacity to cognitively reflect upon his life and shape his life due to the fact that each individual is

shaped by biological and environmental factors. Considering substantive-relational autonomy, Owens and Cribb (2017) argue that wearables do not promote autonomy. I want to briefly draw attention to this claim, and argue why I believe it to be invalid.

Owens and Cribb firstly argue that wearables have merely one function, which is to record the biological body. They do not consider wider societal structure in which users live, even though this influences the amount of opportunity a user has to shape his health. For example, wearables fail to consider users' socio-economic or family situation. They secondly argue that wearables cannot achieve the same feat as professionals can in supporting users' procedural autonomy. Following this, they conclude that in order for the claim of personal devices to promote autonomy, it is a necessary requirement that the users are provided "with supportive circumstances and relationships that confer on them genuine opportunities to enact their decisions", which wearables do not offer (Owens & Cribb, 2017, Section 4, para. 5).

However, whether devices are considerate of wider circumstances does not prove whether they can support autonomy. If we consider cars, for example, and draw a parallel conclusion, this would imply that cars alone cannot contribute to or support autonomy as some live in circumstances that prevent them from using a car, whether this is due to not having a drivers' license or not being able to afford a car. Although cars cannot change such circumstances, which prevent some from using a car, this does not imply that cars cannot support the autonomy of those who can make use of a car by making it possible, to, for example, work in an area that one cannot easily reach by train. Moreover, because wearables cannot offer the same expertise and support as trained professionals can, this does not prove that wearables cannot support autonomy to a lesser extent. And to recall Chapter 1, autonomy is better expressed on a scale. Finally, if one considers the various devices on sale, it is clear that some devices do, though not directly and perhaps not intentionally, consider such wider circumstances. If an individual cannot afford a membership to the gym, work out regimes can be offered that are suitable to perform at home without any equipment. Take the popular sports application SWEAT that offers home work-outs which do not require any equipment. Owens and Cribb refer to Deborah Lupton, who says, "many digitized health promotion strategies focus on individual responsibility for health and fail to recognise the social, cultural and political dimensions of digital technology use" (Lupton, 2014, p. 174). This is most definitely a pressing issue, yet not one that stems from the devices. It shows how personal devices can illuminate circumstances in society which challenge citizens' autonomy. Moreover, it reemphasises the need to carefully deliberate how wearables are best integrated within various policies.

Hence, I believe the claim that wearables do not support autonomy on the basis that they fail to consider wider circumstances to be false. The fact that wearables do not (or to a lesser extent) support users' substantive-relational autonomy says more about the circumstances in which the respective user lives than about the devices themselves. In other words, though opportunities are relevant to consider, Owens and Cribb's arguments only illuminates the *extent* to which devices can strengthen autonomy, and not that devices do not strengthen autonomy. Just because someone has grown up in non-beneficial circumstances, decreasing his opportunity to pursue second-order preferences, does not provide a valid argument that devices cannot enhance autonomy, or lack the ability to do so. It informs us, that though devices could do so, other circumstances can prevent the effectiveness hereof.

Conclusion Chapter 3

In this chapter I have analysed the various ways in which the services offered by personal devices might pose threats to wearers' autonomy. At first I argued that the information presented by and motivational strategies integrated in wearables do not threaten autonomy. Looking more closely at how this information and motivation is presented to the user I equally argued, on the basis of Thaler and Sunstein's account of libertarian paternalism, that wearables do not pose a threat to users' autonomy. Wearables present nudges that favour users' welfare and users have moreover voluntarily and willingly exposed themselves to these nudges. However, one potential threat to the autonomy of users' is how the modulating mechanisms of wearables can mediate users' identity. Because wearables offer pre-selected practices, thereby generating a hierarchical order of daily human practices, it is only within one's performance on these practices that users get to know themselves. As these practices come to take a superior position compared to other practices, they can subtly mediate how a user shapes himself and identifies himself in the long-run. Finally, I have rejected Owens and Cribb's argument that wearables cannot support autonomy. Personal devices can illuminate circumstances in society which challenge citizens' autonomy, but the fact that they do not themselves consider or alter these circumstances and thereby enlarge opportunity, does not prove that they cannot support users autonomy.

Chapter 4: Algorithms and profiling techniques

Having discussed the services that personal devices offer and in what ways this might pose threats to users' autonomy, this next chapter will look at algorithms. Algorithms are essential to personal devices, in enabling them to offer the services of information and advice. A substantial body of literature has been written addressing the ethical implications of algorithms. I do not cover each and every one of these, even though some might influence the autonomy of users indirectly. Instead, I will focus on the features of opacity and complexity and the technique of profiling and the potential implications they have for users' autonomy directly. I focus on opacity, complexity and profiling as they are inherent features of wearable technologies. If these features introduce any threats to autonomy, they will be more complicated to overcome and as such pose significant threats.

Algorithms

In order to assess the implications of algorithms, it is important to quickly explain what algorithms are. Robin K. Hill (2015) has explored the nature of algorithms and has formulated the following definition: "an algorithm is a finite, abstract, effective, compound control structure, imperatively given, accomplishing a given purpose under given provisions" (p. 47). Algorithms are "the procedural building blocks of computer programming, and of general problem-solving in the realm of discrete operations and digital data" (Hill, 2015, p. 36). To translate this into easier terms, one might think of a recipe, or a mathematical formula. If one follows a recipe, using several ingredients, the outcome is a meal. If one inserts one or several value(s) into a formula, one derives a response. Just like recipes and mathematical formulas, algorithms can be hugely simple or extremely complex. Another definition, that is more value laden, presented by Mittelstadt, Allo, Taddeo, Wachter and Floridi (2016), is that algorithms are things which "make generally reliable (but subjective and not necessarily correct) decisions based upon complex rules that challenge or confound human capacities for action and comprehension" (p. 3). This description does however highlight the complexity and opacity of algorithms.

Profiling techniques

As just said, algorithms also use profiling techniques. As Hildebrandt explains, profiling is a phenomenon human agents engage in naturally as well. People unconsciously create profiles

of their surrounding environment to detect threats, other people they are likely to get along with well, or activities they might enjoy. Even though people engage in the activity of profiling unconsciously, we do consciously reflect on the accuracy of these profiles that we have created in our minds to determine whether we will (continue to) accept, reject or reconfigure them. Thus, even though we often rely on automated habits and interaction, we are capable of scrutinising whether these are fair, just and valid (Hildebrant, 2008, p. 58). This capacity to consciously scrutinise our habits and thoughts, and adjust our behaviour accordingly, is the essence of autonomy (Dworkin, 1988).

Algorithms engage in profiling differently. Whereas humans first postulate a hypothesis and hereafter verify the validity of this hypothesis, machines do not. They discover a hypothesis in the process of detecting relevant correlations, patterns and clusters. Algorithms "recover unexpected correlations in masses of data aggregated in large databases" (Hildebrant, 2008, p. 58). This is moreover the value that algorithms offer. They are capable of discovering correlations, 'hidden' information, within large databases that humans would not be able to find, or have great difficulty to find. Wearable technologies record data, aggregate and track data, identify patterns in this data, interpret the outcome hereof (i.e. create profiles), verify the interpreted outcome, and finally, apply the established, verified profiles. In this process, algorithms filter out data that is deemed irrelevant. The detected correlations serve as hypotheses for the creation of profiles. As a result, Hildebrant who refers to Solove and Warner, argues that wearable technologies, integrated with algorithms, can identify correlations in masses of data and "confront us with inferences drawn from past behaviour that would otherwise be lost to oblivion" and anticipate needs based on these correlations (2008, p. 59).

The second distinct difference between the profiling processes of machines and humans is thus that human reflection on and evaluation of the created profiles is extremely difficult and at times impossible. Due to proprietary protections on algorithms, citizens (often) lack information of how these profiles are created and how specifically they are integrated within our environments (de Laat, 2017; Mittelstadt et al., 2016). Another reason why people cannot scrutinise the profiles created by algorithms stems from 'internal opacity'. Often times, people refer to the computational complexity of algorithms as black boxes. As engineers seek to optimise the intelligence, and with it the opportunity for technologies to operate more autonomously and improve the accuracy and amount of value we can attain with these technologies, we move to a point where even experts can no longer fully understand how the algorithms arrive at certain outcomes. They "can only yield technical

clarifications about the classificatory accuracy of an algorithm, but […] [they] cannot clarify the reasons behind its particular recommendations" (de Laat, 2017, section 7, para. 1). This phenomenon, where even experts cannot fully understand or interpret the results provided by algorithms, is called internal opacity (De Laat, 2017). The opacity of algorithms will enlarge once the vision of IoT is pursued and algorithms come to draw correlations from the data collected by many devices instead of just one.

A well-known case of a company using algorithms with profiling techniques is Facebook. By drawing correlations from people's online behaviour and expressed interests, Facebook can create profiles that categorise users into different groups with distinct characteristics. This allows Facebook to accurately target users with advertisements that match their interests. Profiling techniques are thus not used for all the information and advice that wearables present to users. One's heart rate, for example, is not deduced with profiling techniques. To demonstrate the potential of such profiling capacities, once Versa, MoodKit and Vaunt are connected within one network, the algorithms within Vaunt could for example create profiles such as that those people who play team sports are more likely to have a successful, yet stress free career. Or that the wealthy prefer fancy restaurant, Marc Jacobs and extreme sports, whereas those with less spending money prefer cheaper restaurants, H&M and a membership at the gym. Though these are hypothetical examples, it demonstrates what the types of correlations could be retrieved, and how these might generate profiles upon which suggestions are given to users.

Hildebrandt (2008) argues that these profiles are "the crucial link between an overdose of trivial data […] and applicable knowledge about our habits, preferences and the state of the environment" (p. 60). However, how these profiles are created, in an opaque and non-comprehensible fashion to users, could bear implications for users' autonomy.

Profiling techniques and respect for users' cognitive reflection processes

Mittelstadt et al. (2016) say that "the primary components of transparency are accessibility and comprehensibility of information" (p. 6). A lack of transparency, or opacity, in how algorithms create profiles thus implies that users cannot obtain knowledge concerning these profiles nor comprehend how they are generated. Moreover, the personal devices that I am discussing in this thesis are commercial products. This means that the algorithms are protected as proprietary properties of the companies for the sake of competition and that these companies are not legally obligated to share this information. The implication hereof is that

users are unable to verify whether the deduced information and the profile one is placed in, is justified or not. As Hildebrandt (2008) argues, we may "think we are making private decisions based on a fair idea of what is going on, while in fact we have no clue as to why service providers […][and in this case, personal technologies] are dealing with us the way they do" (p. 61). As Gerald Dworkin has explained, and Hildebrandt too explains, for autonomy to be respected, agents must be able to cognitively reflect on one's reasons for action and not be influenced in illegitimate ways. If one acts in a certain way or makes a certain choice, because this behaviour or choice is encouraged by the device on grounds of a specific profile, one is unable to critically evaluate and understand why this behaviour or choice specifically is encouraged and whether it is justified. The concern thus is that one cannot make fully informed autonomous choices whether to use the information or advice presented by wearables nor can scrutinise the profiles.

Danaher argues that optimising transparency, to improve users' comprehension, fails to deliver a promising solution. Transparency is generally difficult to deliver due to the complexity of the algorithms. Restricting the use of complicated algorithms, that are not interpretable by engineers, is not desirable as it would imply that society looses out on the benefits the computationally complex algorithms can offer. Moreover, due to the heavy investments to advance algorithms, this option would likely be strongly resisted. Moreover, even if one eliminates "the threat of algocracy", one is still faced with the threat of epistocracy if only interpretable algorithms are used (Danaher, 2016, p. 245**)**. Not many citizens would be able to understand these algorithms without extensive education and training. As such, users would remain dependent on algorithmic experts (Danaher, 2016). In an IoT world, it would become even more difficult for laymen to comprehend algorithms as the algorithms of one device make use of the data from other devices. To provide some understanding of how one device processes data might be feasible, yet to provide some meaningful understanding to a layman on how several devices and things, that exchange data with one another, process data and translate it into profiles is simply impossible. As such, the opacity of algorithms presents a problem. Without knowing when or how, algorithms deduce conclusions we cannot comprehend, they can deduce wrong conclusions, uncover personal information, all whilst mediating our practices. As such, opacity presents a significant threat to users' autonomy. What implications might the complexity, proprietary induced transparency and inherent opacity of advanced profiling algorithms have for the autonomy of users?

As explained, the issue that algorithms are highly complex and therefore non-interpretable cannot be overcome with greater transparency, nor is it desirable to place limits on the complexity of algorithms. That being said, there are other arguments that suggest that the opacity and complexity of such devices, even when communicating with others, need not threaten users' autonomy. A first argument to defend this claim is the same one made in the previous chapter: it ought to be an autonomous choice whether one chooses to employ these devices despite not being able to understand how the information presented to the user is generated. To argue that each user must understand the technicalities and the process of decision-making these devices engage in, before one can use the information they provide, is a rather paternalistic viewpoint.

A second response is that it is simply not necessary to understand the technicalities of these devices. TomTom's are car appliances that offer drivers advice to how one can best get from place A to place B. Even though we do not understand exactly how they are able to do this we do not generally fear that they therefore pose a threat to our autonomy. We use mobile phones to make phone calls, to send text messages and to remind ourselves of upcoming appointments. Mobile phones are only able to provide these services due to their technical advancements that laymen cannot possibly comprehend. To draw a different comparison, we listen to the advice of doctors even though we do not have the knowledge to understand how they arrive at their conclusions. If one is advised to take medicine three times a day, after each meal, we do not hesitate to take the medicine.

The point I am trying to make by drawing these comparisons is that transparency need not pose a threat to users' autonomy. If our calls, messages and appointments are saved without us knowing about it, our autonomy could be challenged. If a doctor has no certificates yet practices the profession, our autonomy is challenged. If those creating and selling personal devices do so to gather personal data which can then be sold for large sums of money, our autonomy might be challenged. However, as long as one can trust the expertise and as long as one can trust that the lack of transparency does not stem from malicious intent or hidden interests, transparency and complexity need not be a threat to autonomy. If it is assumed that producers of such devices have good intentions, one could thus argue that our autonomy is not threatened by algorithms' complexity and lack of transparency. If companies do have morally wrong intentions, again this says something about them and nothing about wearables. Hence, a consumer can autonomously chose not to purchase a device for the reason of not being able to fully understand how the device generates advice, or chose to

purchase one and use one in spite of not knowing how the device generates information and advice.

One could argue that this is not a satisfactory argument if the information or advice presented is wrong. However, as I argued in chapter 3, and continue to support here even when the opacity of algorithms is considered, false information or advice does not pose a significant threat to users' autonomy. Let us assume that a MoodKit device informs a user that he/she is merely not feeling well (on the basis of a comparison with other individuals showing the same symptoms) when instead, the user is in dire need of a psychologist and medication, suffering from bipolar disease. This erroneous information would create an unintentional hindrance for the wearer to accomplish his goal, to improve his well-being. Even though this example is one that could have grave consequences, erroneous suggestions arguably do not pose a significant threat to users' autonomy.

First, using a device is entirely different from becoming completely reliant on it. One must take into account that users themselves are perfectly capable of critically reflecting upon the presented information and advice of these devices. Now, this might be a far more risky issue for individuals unknowingly suffering from bipolar disease than it is for a regular individual who is misguided by his Versa. Yet, still, these devices come with guidelines, which express their limitations. Second of all, profiles are not rigid. Algorithms continue to verify the validity of their profiles. If the user does not feel better after a month, it will likely alter its advice according to this information. Third, if devices are indeed effective this implies that devices are more often right than wrong which implies that the presentation of false information or advice does not occur frequently. To add to this, the more advanced technology becomes and the more money is spent on developing these appliances and profiling techniques, the more accurate personalised advice will become. As such, the fact that false information or advice might be given at times, without people being able to spot these due to the opacity of algorithms, does not pose a significant threat to users' autonomy.

Personalisation, respect for users' cognitive reflection processes and users' choices

As explained by Mittelstadt et al. (2016) the result of personalisation techniques based on profiles, is that people are shown different information. Personalisation benefits the wearer by eliminating informational overloads and instead presenting only information deemed relevant to that user (Mittelstadt et al., 2016). This however also implies that these profiles, though perhaps not flawed, restrict the type of information the wearer is exposed to on the basis of

the created profiles. Information might not be shown because it is categorised as irrelevant or not in line with the wearer's profile. Even though it might generally be the case that wearers benefit from the personalised information and recommendations, such profiles can lead those with more spending money to miss out on cheaper restaurants with great reviews, just because they are less expensive. However, the lack of informational diversity that comes with the goal of offering personalised information, can also undermine users' autonomy because information is what informs one cognitive evaluation processes. When one has less information one cannot engage in a fully informed cognitive evaluation.

This issue is not a significant one as it can be overcome by showing random information at times to avoid echo chambers. This technique is already employed by companies who use profiling techniques. Blendle, an online news platform, for example at times shows readers articles that do not match their interests necessarily. Instead of Vaunt glasses always showing Italian restaurants in line the users' preferences, Vaunt glasses can occasionally suggest Mexican restaurants. This ensures that the user is still shown a diverse range of information whilst offering personalisation most of the time. That being said, too much random information cannot be shown for this would undermine the value of wearable technologies: to provide personalised information to the wearer.

A second issue stemming from the creation of profiles to offer personalised information and advice is that it becomes easier to persuade, or manipulate, users into certain behaviour. Mittelstadt et al. (2016) say "personalisation algorithms tread a fine line between supporting and controlling decisions by filtering which information is presented to the user based upon in-depth understanding of preferences, behaviours, and perhaps vulnerabilities to influence" (p. 9). As such, Mittelstadt et al. (2016) say that paradoxical services are created. If we consider the wider context of the IoT again, where MoodKit, social media and one's home fridge are interconnected, the wearer might be shown advertisements that take advantage of the wearer's current vulnerability. For example, as soon as Moodkit detects that the user is feeling particularly low, and is therefore more likely to purchase tubes of ice cream, advertisements of Ben & Jerry's appear on a social media timeline. Knowing what data can be accessed is insufficient as long as those who process this data have greater knowledge about how to use and translate this data. Zarsky coined this phenomenon the autonomy trap. "These abilities lead to the enhanced opportunity to unfairly persuade and manipulate […] [people] and raise concerns both in the context of commercial advertising and agenda-setting by mass media editors" (Zarsky, 2004, p. 1017).

To respond to this threat, firstly, manipulation itself is morally wrong. Secondly, although it interferes with users' cognitive reflection processes thereby undermining users' procedural autonomy, it is an issue not inherent to wearables. This issue instead directs attention towards the moral responsibilities of companies. To raise awareness of this threat, users should be able to retrieve information on such power asymmetries and the potential for abuse and legislation helps to prevent manipulation of this kind.

Profiling and respect for users' identity

A final issue that stems from profiling, in combination with the opacity, is that they mediate users' identity through group treatment. Just as explicit norms and values, and other activities are emphasized by wearable technologies, leading to the modulation of everyday practice and as a result, the way users' come to identify themselves, this same effect is created by the technique of profiling. John Cheney-Lippold (2011), who focused on how marketing companies utilise profiling techniques, highlighted this same threat and argued that "we are effectively losing control in defining who we are online, or more specifically we are losing ownership over the meaning of the categories that constitute our identities" (p. 178).

Profiling is a necessary technique if wearables want to offer personalised information valuable to the wearer. Profiling, the act of comparing, is simply put a crucial mechanism for wearables to be of value to users. This however, means that people will inevitably be treated on the basis of categories. Moreover, the more accurate and the better algorithmic profiling techniques become, the more likely people will be to accept, or conform to, this information and advice and thus the category they are placed within as it is indeed what the user desires, even if this is not exclusively what he would desire. This implies, that users are unlikely to carefully evaluate the suggestions presented to them. As just mentioned, there is no legal or technical manner by which categorisation of profiling algorithms can be prevented or weakened for this would imply that we lose out on many of the benefits wearables offer.

As such, the necessary technicalities within personal devices also generate and reinforce group types, and are unable, by design, to promote individuality. Moreover, wearables persistently engage in group categorisation. To quote Cheney-Lippold (2011) "if a certain set of categories ceases to effectively regulate, another set can quickly be reassigned to a user, providing a seemingly seamless experience online that still exerts a force over who that user is" (p. 177). Furthermore, no matter how advanced profiling techniques become, thereby making it possible that not 100 but 1000 types of groups can be created, types

abstract from individuals so that the set of classes is never identical to the set of individuals. This threat to autonomy is of a similar kind as the one identified in chapter 3, and together they reinforce one another.

If, for a moment, one assumes that wearables are adopted on mass scale, and through IoT networks, are able to deduce types indicating that those with an above average height are more likely to excel at basketball and that those with a below average height excel at horse riding. Based on these profiles, wearables would more quickly suggest to an individual who is 2.10m to play basketball as an efficient means to accomplish the second-order objective of improved fitness, whilst at the same time it being a practice he would likely excel at. People who are short would, for example, be advised to do horse riding. At first, as was argued in chapter three, wearables can tip the balance in favour of certain practices with which users come to know themselves. Then secondly, one is further mediated into those practices which profiling techniques on the basis of group characteristics have led the wearable to encourage. Thus, wearables as modulating mechanisms mediate which practices are most closely related to one's identity and mediate users' behaviour within the confines of group types, instead of individual characteristics. This threat, and the threat identified in chapter 3 both stem from inherent features of wearables and present themselves in subtle manners over time.

Conclusion Chapter 4

In this chapter I have argued that the opacity and complexity of algorithms need not pose a challenge to the autonomy of users. One need not understand how information is generated and one can autonomously choose to use information one is unable to verify the validity of. I also argued that the presentation of false information or advice is not a significant threat for three reasons. Users' are firstly capable of reflecting upon this advice and information prior to and upon using it. Secondly, profiles are not rigid and with time the device will self-correct the presented information or advice. Third, if wearables are effective this implies that users are not often exposed to false information or advice. Finally, I discussed how profiling techniques might interfere with the process of identity formation. Similar to the threat found in chapter three, I argued that profiling techniques can challenge the autonomy of users by displaying information and advice that is generated on the basis of certain groups. The more advanced and accurate wearables become, the less likely the user is to evaluate whether or not other information or advice might suit him even more, or equally for that matter. As such,

the individuality of users is moulded on the basis of averages and group types instead of unique characteristics of individuals.

Conclusion

This thesis has tried to contribute to the academic debate discussing how the IoT and its applications in society could influence the position of citizens, directing attention towards the autonomy of individuals using wearable technology. I choose to focus on wearable technology, which is one such IoT application, due to its relative maturity and due to the interest it is receiving from both consumers and public and private parties as tools for various policies. Moreover, if wearables are to empower users in becoming better and more human wearables ought to respect users' autonomy. Employing Gerald Dworkin's characterisation of autonomy and the framework of control societies as described by Gilles Deleuze in which he suggests that citizens' autonomy is under threat, I posed the question '*Do personal technologies, in the context of the Internet of Things, pose a threat to users' autonomy?'* Agreeing at first with Brett Nicholls that wearables are appropriately characterised as modulating mechanisms of control, I subsequently formulated three conditions of autonomy with which to assess wearables, namely respect for users' cognitive reflection processes, respect for users' choices and respect for users' identity. Taking Owens and Cribb's article as a starting point to build my arguments, I assessed the services that wearables offer and how these services are offered, and concluded that wearables could challenge the autonomy of users.

In chapter three I first argued that, not only at first glance but equally when the nudging strategies employed by wearables are taken into account, wearables do not threaten the cognitive processes of users nor do they pose morally illegitimate influences on users' choices. I substantiated this claim on Thaler and Sunstein's account of libertarian paternalism. I additionally argued that, assuming that the choice of consumers to purchase such devices is a rational and autonomous one, the exposure to such value-embodying devices is a voluntary, willing and an autonomous choice of consumers. If however the purchase of these devices is not a fully autonomous one, which Owens and Cribb suggest based on wider consumerist cultures, this would say less about wearable technology and more about the wider societal circumstances. Third, I posed the question why the nudges presented by wearables, which often promote the welfare of users, would be less legitimate than the manifold nudges found in society which do not. Focusing on wearables long-term effects however, I argued that wearables could challenge the autonomy of users' by mediating how they come to identify themselves. Building on Nicholls' claim that wearables induce a hierarchical order of individuals' daily practices, I argued that the persistent and ubiquitous

emphasis on such practices, which come to signify the self as a user purports to get to know himself better, make it more likely that these practices are internalised. As such, those pre-selected practices encouraged by wearables are likely to subtly take an increasingly prominent position in users' identity. Before concluding this chapter, I argued against Owens and Cribb's suggestion that one ought to be sceptical of wearables ability to promote autonomy as they fail to consider wider circumstances, which enable real opportunity, and because they are unable to deliver the same support as professionals can. I argued instead, that this illuminates the crucial importance of wider circumstances for enabling greater opportunity for individuals to act autonomously.

In chapter four I focused on one of the main enabling and necessary technologies of wearables, algorithms with profiling techniques, and specifically on the two features of complexity and opacity. Here, I first argued that although limited understanding and oversight into how wearables deduce information and advice might appear to impose challenges on users' abilities to cognitively reflect and make well-informed decisions regarding what to do with this information, these features do not pose significant threats. This is because one can autonomously choose to use this information without being able to verify this information and because not knowing how such information is generated need not undermine one's autonomy. Ultimately, I argued, that this implication boils down to trust and it is only when parties take advantage of the opaque and complex manner in which information is generated to for example manipulate or persuade users, that users' autonomy is undermined. However, once again, this threat would not stem from wearables but from those in control of wearables. Moreover, the presentation of wrong information of advice does not make a significant difference which I argued on the basis of wearables effectiveness, expected increased effectiveness, profiles being self-correcting, and individuals' ability to reflect on the value of this information and advice prior to and upon using it. I then briefly considered the lack of informational diversity that stems from personalisation, arguing that this effect can be balanced with occasional random information to increase informational diversity. Moreover, I argued that the potential to misuse this personalisation as a means to persuade or manipulate users is again not an inherent threat brought upon by wearables but one created by parties with morally wrong intentions. Finally, when considering the long-term effects of profiling techniques on users' identity, I identified a threat similar to, and arguably enforcing, the threat identified in chapter three. As profiling is an important technique for wearables, this threat is inherent to wearables and significant. The mechanism of profiling is reliant on averages and group characteristics, implying that these techniques

are unable to consider outliers and individual characteristics. Even if the amount of profiles increases, none of these types will be equivalent to the unique markers of one individual. Nonetheless, the increasingly accurate profiles that algorithms deduce will likely align with the interest of users. Given the way in which these profiles align with users' preferences or interests, users are less likely to critically evaluate what is suggested. As such, a second layer through which wearables may mediate the individuality of users comes into force, namely that users will be likely to adapt to these profiles moving away from their unique profile. Adding to this threat is that not only wearables could mediate identity in such a way, algorithmic profiling in other platforms and devices will have the same effect. As argued by John Cheney-Lippold, profiling techniques on websites and social media platforms for personalisation and marketing purposes induce the same mediating effect.

That being said, these threats are dependent on the effectiveness of devices, many people use these devices and whether wearables are indeed used as tools in various policies. In other words, these threats are dependent on the extent to which wearables come to take a prominent place within citizens' life. Only then, when wearables become core to individuals' daily life, would these threats be able to unfold. If they do however, and one relates them to the framework presented by Gilles Deleuze, both these mediating effects stem from wearables inherent features. Moreover, both these threats present themselves subtly, over a longer period of time. As such, both threats echo Gilles Deleuze's suggestion, namely that the autonomy of users in so called control societies, in which wearables constitute modulating mechanisms of control, is challenged.

To conclude this thesis, I want to acknowledge that my exploration of wearables is limited in two ways. First of all, where I have relied on Gerald Dworkin's account of autonomy, other accounts of autonomy might have exposed other implications or instead provided reasons why some of my arguments have less merit. Secondly, it might well be the case that there are other implications which I have been unable to identify. Third, I have not considered any indirect threats to users' autonomy, and it is possible that one of these proves important. Further exploration of this research question could thus prove hugely valuable. Finally, if wearables are adopted on a large scale and if they take an increasingly prominent position in policies, it could be of interest to explore how strong this effect really is, with, for example, psychological research. Finally, perhaps the literature discussing the morality of wearable technologies could consider these potential threats and designers in turn could seek ways to avoid the materialisation of these threats altogether.

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