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Biomedicine, gender, platform and self-tracking

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ABSTRACT

This dissertation concerns the study of the digital biomedicine grounded in everyday self-tracking practices through the theoretical lens of Science and Technology Studies, Feminist Technoscience Studies and Sociology of medicine.

The dissertation is divided into two parts. *Part One* presents the theoretical and methodological issues related to the central topic of the research. It disentangles the theoretical underpinnings that sustain the analysis – with particular regard to the recent debate on new materialism in feminist theory. Additionally, this part undertakes the discussion on the performative character of methods in shaping empirical and situated practices whereby I have carried out my research.

Part Two discusses the research findings, collected through an empirical research that focuses on two distinct issues in two empirical fields. The first analytic inquiry concerns the analysis of health platforms and apps for menstrual tracking, exploring how the supposed 'neutrality' of design performs genderless sociomaterial objects, that is without gender, rather than gender-free, i.e. free from gender constraints and stereotypes. With the second analytic inquiry I carried out some interviews to investigate the enactment of lay and expert knowledge situated into everyday practices.

Regarding the first field, I have analysed the two main Health platforms developed by the major competitors in the market of the Big Five: Health Apple and Google Fit. In this case, I investigated the gender script of the two apps developed with purposes of monitoring wellbeing by Google and Apple and to investigate the biomedical classification of premenstrual syndrome inscribed in the materiality of apps able to datafy menstruation.

With the second empirical field, I questioned the engagement of women in self-tracking practices. I carried out thirty interviews with women who use wearables for the management of wellbeing and for the digital tracking of their menstrual cycle. This second line of research aims to draw attention to how women intra-act with bioknowledge suggested by the wearables and apps used. The analysis, which draws upon feminist theoretical sensibilities on science and technology, calls into question two forms of engagement. This involvement sees overlapping knowing-in-practices which, enacted by plural patterns of engagement between the body and material knowledge, have been categorized as follows: a functional engagement with the bioknowledge inscribed in sociomaterial objects and an affective engagement with the knowledge suggested by sociomaterial objects.

Finally, this dissertation provides a reflection on the period of health emergency that we are experiencing due to the Covid-19 pandemic outbreak. Particularly the focus is on the development of the app for contact tracing: *Immuni*.

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INTRODUCTION

This dissertation concerns the study of digital health grounded in everyday practices through the theoretical lens of medical sociology, feminist studies of science and technology, science and technology studies.

The growing influence of the Internet and World Wide Web has introduced important transformations in the way we think about health. Particularly, lay people have new possibilities to access medical contents and information, exchanging experiences of medical conditions, healthcare and caregiving online. Social scientists have been researching the digitalization of health ever since Web 1.0 (usually dated from 1994) era began with the emergence websites discussing health and medical issues (Lupton 2015). A decade after Web 1.0, Web 2.0 emerged, that includes social media platforms, wireless computing technologies (Wi-Fi), geolocalization technologies, and the expansion of Information Communication Technologies (ICTs), i.e. mobile devices such as smartphones, tablets and wearables. However, some scholars are beginning to underline the emergence of Web 3.0, that is the 'intelligent web' involving smart technologies that use Artificial Intelligence (AI) to reproduce the human mind, particularly cognitive functions such as "learning" and "problem solving" (Lupton 2015; Fuchs *et al.* 2010).

Nowadays, Internet, smartphones, wearables, and sensors are engaged in the public communication of the biomedical knowledge. In this

background, the process of biomedicalization describes the extension of medical jurisdiction from illness and disease to health and wellbeing, which become an individual responsibility. Since the Second World War, researchers began to add the prefix "bio" to the word "medicine" to show the growing intertwining between life and biological sciences, on one hand, and clinical practice on the other (Cambrosio *et al.* 2006). With the term 'biomedicalization' we can understand the technoscientific practices and innovations that focus on bodies and how it is possible reshaping, reconstituting and transforming them for several purposes. This is a complex and multisited process linked to the development of biomedical technologies – i.e. biotechnologies – contributing to make hybrid the boundaries between disciplines and fields, such as medicine, academia, biology, and industry, via the incorporation of computer and information technologies (Clarke and Shim 2009).

The theory of biomedicalization invites first of all to observe the growth of a prevention biomedical knowledge grounded in the development of ICTs that work as an extension of the body. Secondly, it invites to observe how these technologies are increasingly pervasive in the monitoring of corporal functions regarding everyday well-being to prevent illness and increase a healthy lifestyle. People are engaged in biomedicine, collecting data about their health status through tablets, smartphones and wearables. This is the process of "datafication", i.e. the process by which human behaviours, emotions, and social relations are recorded and converted into numbers (Van Dijck 2014), which is at the heart of the emergence of the *self-tracking phenomenon*.

Since 2013, sociologist Deborah Lupton, a persecutor of self-tracking studies, has brought this phenomenon to the attention of sociology,

highlighting how digital technologies are fuelling a transformation in the way we think about Self, the body and relationships with humans and non-humans. Furthermore she has also argued the importance of an interdisciplinary approach to investigate this phenomenon that is in turn interdisciplinary and hybrid, where the boundaries between "biomedicine", "engineering", "science", "industry", "health", and "everyday life" are definitely blurred. The phenomenon of self-tracking is based on the growing ubiquity of communication technologies fundamental to the functioning of contemporary societies, such as the Internet, smartphones, and digital platforms. When these technologies are used with the purpose to quantify and track behaviors and biological functions, they are referred to as self-tracking technologies.

The list of such technologies is very wide: apps installed on smartphones, tablets, wearable technologies such as Google Glass and Fitbit; sensors embedded in a range of materials and devices that can record both individual's biometric information (e.g., body temperature, heart rate, blood glucose, etc.), human movements, or various aspects pertaining to environmental health (e.g. air pollution, traffic, etc.) (Coletta *et al.* 2018; Lupton 2013, 2015, 2016; Maturo and Setiffi 2016; Pantzar and Ruckenstein 2015). The enactment of self-tracking practices also contributes to the production and consolidation of personal identities and quantifies self which emerges thanks to data. The data allows us to surveil and control our body, making it comparable to others, and to measure our evolution over time by comparison with benchmarks calculated by special algorithms (Lupton, 2016) through practices of quantification of daily behaviours and activities, with the purposes to discipline one's own conduct with respect to physical fitness (Ruckenstein, Pantzar, 2015).

This study addresses such overarching concerns through the engagement with two empirical settings: the study of health sectoral platforms through the analysis of Health Apple and Google Fit and interviews with women who use wearable technologies and apps for monitoring the menstrual cycle.

The platformization of health between surveillance and reconfiguration knowledge

The rapid expansion of Internet is matched with the process of 'platformization', that is «the way in which entire societal sectors are transforming as a result of the mutual shaping of online connectors and completers» (Van Dijck *et al.* 2018, p. 30). Platforms are becoming the basis of intermediation of services and relationships.

The Big Five – Google, Apple, Facebook, Amazon and Microsoft - are the dominant digital companies in this process. They offer services in trade of access of data, often personal data. Localization and IP address, searches, clicks on video and advertisements, websites visited, photos and shared videos on social networks make the concept of privacy increasingly nuanced and ambivalent. This makes an enormous amount of data available, that digital companies can in turn use for profiling and targeting users. Big-data work on the promise of producing predictive models about citizens through technology solutions that can be contrasted, resisted and subverted, but can also reinforce the logic of digital surveillance. There is need to examine applications and effects of these emerging technologies that are pervasive and increasingly essential to our daily lives. Even if small data

are used in aggregated and anonymized form, big data provide a categorization of users in discrete groups of voters, consumers, students, readers and so on. Platforms work through the transformation of users' interests, activities, emotions and ideas into data, which are the real economic value of the digital economy. They connect users with personalized services and advertisements through the algorithmic automatization of the users' labour of research and selection of media contents (Andrejevic 2013a; Fuchs 2013; Turow 2012).

Thus, data can be used to surveil the population, in the form of a self-surveillance. Some authors look at these technologies in Foucauldian terms (Lupton, 2016; Kitchin, 2014; Sharon, 2016; Sanders, 2016). They see them as discipline techniques (Foucault, 1976). Studies on digital surveillance use the concept of the panopticon. The Panopticon is literally an architectural structure designed by the English philosopher and social theorist Jeremy Bentham in the 18th century. It is a prison that allows to monitor all prisoners in their separate cells. In turn the prisoners are unaware to be under constant surveillance by a single guard. Foucault uses this metaphor to support the role played by the gaze, the surveillance and the constant visibility to which the population is subject to, a typical feature of new forms of biopower (Foucault, 1976).

However, data are not just a tool of surveillance. The body becomes viewable through graphs and tables, generating a reconfiguration knowledge about one's own body towards practices of classification of the biomedical knowledge in everyday life. Classification is both a conceptual and material action. It is a conceptual practice in the sense that it organizes different elements into pragmatic units of analysis, which allow for cooperation across social worlds. This is achieved by producing material

standards, protocols, technologies, defined by Bowker and Star as boundary objects. Boundary objects are objects that can inhabit several social worlds maintaining some sort of constant identity (Star and Griesemer 1999).

Following these suggestions, self-tracking technologies can be comprehended as technologies of classification since they inscribe and prescribe embedded knowledge across several social worlds: from the medical field to the political one, from the economic field to daily life. They classify the knowledge into categories that, travelling across boundaries, meet the needs of users with their plasticity and customizability activating the experience process. The characteristic of daily life is *the suspension of doubt,* that is, the attitude of common sense. The thought of common sense is thinking as usual. It is the mechanism through which we put doubt in brackets, taking for granted the categories we use to classify the world (Schutz, 1945).

To put doubt into brackets means taking for granted the fact that what we know is the same as what everyone else knows; but there is tension between common sense and experience. While common sense develops an attitude that takes the world for granted, making the new already known, experience, on the other hand, which is typically open to doubt, emphasises the particularity of what the subject goes through. The product of one's experience is the consistency of the individual, or rather the ability that the individual has, to return to one's past and to revisit it through one's own sensations, taking note of one's own corporeity.

In this sense, self-tracking technologies allow us to do experience of everyday practices, however, affected by gender practices that shape identity, feelings, expectations of male and female doing (Connell 1987; Butler 1990; Martin 2001; Schwalbe *et al.* 2000).

This dissertation pursues to question the supposed gender free design values of Health platforms, like Google and Apple that try to build a digital and personal health platform in the pocket of users without considering gender-based medicine. For example, Apple's designers introduced only in 2019, after five years from the Health Apple launch and several polemics, the possibility to track menstrual cycle. Giving the possibility to track menstruations undermines the supposed neutrality of the app's design, identical for the female and male sex, not considering gender differences as a tool to promote a reflexiveness about biological and socio-cultural differences between genders that affect the state of health and illness, as well as the response to therapies. This exhibits that the 'neutrality' is still built on the male body functions, developing a genderless design – that is without gender – rather than a gender-free, or rather free from gender constraints and stereotypes.

Theoretical lens: STS and new materialism perspective

Science and Technology Studies (STS) is a transdisciplinary field, that has been established since the 1970s to study the social, political and cultural implications of science and technology.

STS scholars are from different disciplines such as sociology, philosophy, history, anthropology, engineering. They begin to study the processes and outcomes of science – including medical science – and technology, or rather *technoscience*, how inextricably intertwined (Sismondo 2010; Magaudda et al 2020). The term *technoscience* defines the interconnection between scientific and technological processes (Latour 1987). This concept eschews the distinction between science and technology, drawing attention to the

interdependence between scientific progress and technological developments, which are increasingly difficult to consider like two separate and distinct spheres. Technologists need scientific knowledge, and, at the same time, scientists need technological instruments and devices (Latour 1987). Science and technology act together in the production of sociomaterial assemblages where human and non-human actors work within entanglements that are both social and material, that is sociomaterial (Barad 2003; Gherardi 2016). The distinction between social and material is the result of an agential cut: an analytical cut that distinguishes and assigns different properties to what would be understood like a whole (Barad 2003).

The objects exist only within and through practices. They are constituted, rather than constructed, into relations where the technical phenomenon is interconnected with the social. However, the emergence of innovative technologies, such as communication technologies supported by ICT platforms, biomedical technologies, Artificial Intelligence, robotics etc., contribute to the diffusion of the analysis perspectives proposed by STS, gender and technoscience studies. These studies have also taken less deterministic positions about the role of technology in contributing to the male domain and, at the same time, more optimistic about the emancipatory possibilities it offers to women. Thus, at the beginning of the 1990s, cyberfeminism broke into the public sphere, proposing imaginaries populated by hybrid identities that cross body-matter-machine boundaries (Haraway 1985).

Meanings and bodies are questioned to redefine the terms of the discussion on scientific objectivity in the sense of "situated knowledge". Donna Haraway claims that theories have to go beyond radical constructivism and feminist critical empiricism to avoid self-referential relativism, which, like objectivity, does not see the situatedness of knowledge in corporeity and

partial perspective. In this sense, the concept of "situated knowledge" takes into account the situated vision of scientific objectivity that has contrasted male and female bodies, male and female roles, and so on (Haraway 1988). With the concept of situated knowledge Haraway insists with the corporeal aspect of any kind of vision that is partial and peripheral, the only one capable of promising objective knowledge. The knowledge draws its objectivity not from presenting itself without an origin – making invisible the subjectivity of the scientist behind theories, experiments, knowledge etc. – but from explicitly recognising the partial and situated point of view that generated it.

Cyberfeminism informs the new materialism approach that has emerged recently within social sciences. New relational materialism tries to dissolve micro/macro distinctions, recognizing that materiality, the world and the human history are produced by associations of material forces and thoughts, feelings, knowledge and bodies (Barad 1996; Braidotti 2013).

Adopting a materialist perspective allows us to see matter and meaning as entangled elements. Barad's agential realism brings together the attempts of feminist scholars to question materials and bodies as well as the study on science and technology. Humans always find themselves in entangled situations of heterogeneous entities, which have an exponential ability of influence, producing power and resistance, tensions, and ambivalences. Matter in itself is achieved by sensing and embodied knowing, showing how the engagement of people, forces, things, bodies and other entities entangle in a more-than human worlds (Barad 2003; Latour 2005; Law 1992).

We are immersed in assemblages where we learn to use our body to become sensitive to the materiality. As Latour (2004, 205) underscores: «to have a body *is to learn to be affected*, meaning 'effectuated', moved, put into

motion by other entities, human or nonhuman» (original emphasis). Materiality is able to render the body sensitive to the differences of the world. The body feels and it moves. It does not end with the skin, but it encounters, tastes, hears, and smells other material elements. It is *affected* by the 'effects' of knowledge, which is embedded and embodied within practices, by which we experience time and space.

In undertaking my analysis, I looked at the bodies as ongoing discursive-material practices, that learn to become sensitive to materiality through 'knowing-in-practices' (Gherardi 2019). 'Knowing-in-practices' is an embodied knowledge, that: «resides in the fingers, the eyes, the nose or the ears» (Gherardi 2019, p. 65), engaging complex relational practices where the body is the principal protagonist. Reciprocally, the body shapes how practices are done, and practices yield new responses across the process of producing embodied knowing into entanglements of relational and dynamic agency (Latour 2005; Lynch and Cohn 2016).

From a feminist materialist perspective, matter acts as an assemblage where human subjects are entangled with technologies (Lupton 2018). Boundaries between human and non-human, as Barad (2003-2007) argues, are not naturally given but rather historically co-constructed. The author proposes using the term 'intra-action' instead of 'interaction' in order to take into account the mutual constitution of humans and non-humans. This term is a way to reconsider the ability to act within relationships and not outside of them.

As suggested here, a variety of theoretical sensibilities informs this dissertation. Such a heterogeneous body of knowledge pursues an interdisciplinary aim. This is because studying self-tracking asks an

interdisciplinary approach in order to take into account the different processes and tensions that influence this phenomenon.

Research questions and contributions

Three research questions have been developed in order to operationalize the considerations about the central topics and theoretical framework introduced above. These research questions provide guidance in approaching empirical instances and shape the analysis. They should be understood as interpretative devices rather than definitive demands for answers.

The first issue discusses and observes the body in its making through the overlapping of discursive-material practices. I take into account the relationship between self-tracking technologies and embodied practices that perform biomedical knowledge of human subjects, specifically of women, which at the moment remains an underexplored issue:

1. How do self-tracking technologies engage the processes of embodied and biomedical knowledge? How do self-tracking technologies perform knowing-in-practices?

The second question specifically regards how the body comes to be matter though material engagements in human-app assemblages:

2. What is the role of biomedicalization in the development of health-related apps? How does the body learn "to be affected" though material engagements between humans and apps? How does genderized matter affect knowing-in-practices?

The third question tries to call in question the materiality and particularly the genderization of materiality recognized as entanglements between heterogeneous elements of thoughts, ideas, purposes, assumptions, political forces, economic interests, and knowledge(s) etc. Such tension fosters the following research question:

3. What is the role of materiality in the process of configuring the genderization of lay and expert knowledge? How does knowledge embedded in the technologies come to be matter in the intra-actions between humans and apps?

Given these research questions, I have tried to put them into work through the analysis of two field sites: (1) the script's description of the Google and Apple's health platforms, and health-related apps for menstrual period; (2) interviews with women who use wearable tracking devices and apps for tracking their menstrual cycle.

My research pursues two analytical inquires that explore, on one hand, expert knowledge of engineers, developers, doctors, entrepreneurs (and so on) incorporated into the script of self-tracking apps for menstrual cycle (typically immersed in issues related to the biology and health of the female body) and the two apps developed with health purposes by major competitors in the market of the Big Five: Health Apple and Google Fit. On the other hand, I carried out some interviews to investigate the enactment of lay knowledge situated into everyday practices.

These research questions and empirical settings outline some contributions that this study seeks to provide. In the first place, this dissertation

advances a discussion of the relationship between biomedicalization theory, a materialist approach and self-tracking phenomenon. While it is reasonable to claim that media and digital studies on surveillance capitalism constitutes a well-established body of knowledge, a sociological analysis of self-tracking practices and health platforms is still in its early days.

Secondly, this study unfolds two empirical settings in which the relationship between ICTs and the management of wellbeing is explored through the acknowledgment of performative character of social inquiry and methods. The result is a concern that Annemarie Mol (1999) has expressed as 'ontological multiplicity', by which she argues that reality is not simply observed, but it is done and enacted through material-semiotic practices. However, my aim is not to observe the reality as an object "out there" that needs to be investigated. Reality is performed by practices and agencies of subjects (observers) and objects (observed) (Barad 1999). The challenge is to investigate the consequences, interventions, creative possibilities, and responsibilities of intra-acting within and as part of our world.

Finally, considering the empirical research findings, this study offers a contribution to the sociological debate on the self-tracking phenomena and biomedicalization process. This dissertation invites to focus on the role of materiality seeing self-tracking technologies as measurement apparatuses that become matter through data, namely graphs and statistical representations. I address the design of apps as a way to investigate the gender script, that involves the inscriptions about purposes, tastes, competences, motives, aspirations of the ideal users imagined by developers, in order to explore how the materiality so configured inscribes biomedical knowledge that may suggest the knowledge through which we experience our bodies.

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The discourse I unroll in the following pages is divided into two parts. *Part One* presents the theoretical and methodological issues related to the central topic of the research. It disentangles the theoretical underpinnings that sustains the analysis – which are Science and Technology Studies (STS), Feminist Technoscience Studies and sociology of medicine – with particular regard to the recent debate on new materialism in feminist theory. Additionally, this part undertakes the discussion on the performative character of methods in shaping empirical and situated practices whereby I have carried out my research.

Part Two conveys the analysis of the research findings. The first analytic inquiry concerns the analysis of the health platforms and apps for menstrual tracking, exploring how 'neutrality' design performs genderless sociomaterial objects according to a patriarchal way of thinking about the body. With the second analytic inquiry I problematize the engagement of women in self-tracking practices.

Regarding the first field, I have carried out a description of the two major Health platforms developed by the major competitors in the market of the Big Five: Health Apple and Google Fit. In this case, I investigated the gender script of the two apps developed with wellbeing purposes by Google and Apple and to analyse the PMS biomedical classification inscribed in the materiality of apps for menstrual period.

I approached the second analytic inquiry by carrying out some interviews which investigate the enactment of lay knowledge situated into everyday practices. I carried out thirty interviews with women who use

wearables for the management of wellbeing and for the tracking of their menstrual cycle. This second line of research is intended to draw attention to how women intra-act with the knowledge suggested by the wearables and apps used. The analysis – guided by certain theoretical sensibilities, that draw upon feminist perspectives on science and technology – calls into question two forms of engagement. This involvement sees overlapping knowing-in-practices that can be categorized in two forms of engagement: a functional engagement with the knowledge inscribed in the sociotechnical objects and an affective engagement with the knowledge suggested by sociomaterial objects.

This dissertation ends with a reflection on the period of health emergency that we are experiencing due to the outbreak of the Covid-19 pandemic. The attention is placed on the development of the app for contact tracing: *Immuni*. The contact tracing app should track virus carriers through their smartphones, a technology that we always have with us, which is now basically an extension of our body. The pandemic has made visible the interconnections between science, technology and society even in the public debate (Giarelli and Vicarelli 2020; Razetti 2020; Viteritti 2020). Against this background, adopting an STS perspective allows us to see how the disalignments between political, scientific and social worlds can bring out the failure of the technology.

PART ONE

CONCEPTS AND METHODS

Chapter I

Health and self-tracking technologies

1.1 Central topics: investigating health in everyday life through Science and Technology studies

The last two decades have seen a change in the way we relate to health. A new approach to public health is growing in contrast to the previous one, which was accused of being too individualistic and victimistic (Lupton 1995). The problem was the emphasis on disease rather than on all those practices and strategies aimed at preventing it from arising (Ashton and Seymour 1988). In this sense, health begins to be comprehended holistically as a healthy state of physical, mental and social well-being, it is not just the absence of disease (Better Health Commission, 1986).

The central element of this new approach is the concept of "health promotion", which encompasses all those activities aimed at promoting well-being. This term, which is conceptually very broad, was introduced in 1974 by Marc Lalonde, Canadian Minister of Health and Welfare. In his report, the minister advocated the need to take a holistic view, paying more attention to all those environmental factors and individual lifestyles, which influence the well-being of the population, in order to prevent the onset of disease (Lupton 1995). The report was first followed in Great Britain in 1976

and then in the United States in 1979. Despite due differences (see Minkler 1989; Pattison and Player 1990), all three countries began to pay attention to individual responsibilities in promoting one's own well-being, stressing the importance of lifestyle choices in disease prevention.

The term health promotion is, therefore, generally used to underline the importance of preventing the onset of the disease by paying particular attention to behaviour aimed at promoting physical, social and environmental well-being (Tones 1986; Lupton 1995).

These claims are aimed at promoting strategies for the management of one's own body to achieve a true state of well-being through practices of self-improvement and self-care. In this sense, the emphasis placed on the choice of the best lifestyles is aimed at regulating the activities of daily life, as well as consumption activities. It aims to define which practices of self-care to promote and which ones to avoid. This has an impact on various topics, like the ideal diet, weight, quality and quantity of physical exercise to do, smoking, alcohol, sexual activity, use of drugs, fertility, abortion, contraception and so on (Coreil *et al.* 1985). The lifestyle, therefore, becomes an aesthetic project of one's self, a project for the construction of one's subjectivity (Wearing and Wearing 1992; Veal 1993).

As theorised by Giddens (1991), thanks to the implementation of redistributive policies and the extension of citizenship rights, we are moving from a "policy of emancipation" to a "policy of existence". The sociologist believes that the current key issue is the quality of life (Giddens 1991; Giddens 1999). Giddens maintains that the transition from the policy of emancipation to that of existence presupposes the radicalisation of the process of individualisation, of existential questions and relationships with others, and questions about "how one should live". The destiny of the

individual is increasingly poised between anomie and personalisation. In this sense the construction of one's own self, which takes place in the context of multiple alternatives, becomes a real commitment structured in a reflexive way which consists in making one's biographical events coherent, even if they are subject to continuous revisitations (Giddens 1991). As the domain of "tradition" disappears, individuals are forced to personalise their lifestyle:

> because of the 'openness' of social life today, the pluralisation of contexts of action and the diversity of 'authorities', lifestyle choice is increasingly important in the constitution of self-identity and daily activity. Reflexively organised life-planning, which normally presumes consideration of risks as filtered through contact with expert knowledge, becomes a central feature of the structuring of self-identity. (Giddens 1991, p. 6)

Lifestyle choices are more than ever linked to health and wellness practices and the construction of the self to improve and achieve greater awareness (Lupton 1995). The construction of a muscular, firm, healthy body, that can only be achieved through constant and punctual self-monitoring and self-management, is at the centre of the so-called self-tracking practices mediated by Smartphones, tablets, and wearables and related-sensors embedded (Lupton 2013). As we will see in the next paragraph, these technologies are already protagonist of our everyday practices. They are a real extension of our body that becomes trackable, visualizable and monitorable though sensors able to perceive movements, and biological functions transforming them into data.

Self-tracking practices quantify the body starting from the singularity of the experience situated in non-clinical spaces. The body is the object of expert knowledge, analysed and quantified through the naked eye, or medical and visualization technologies such as CT scans, microscopes and other visual machines. However, the body is also an embodied subject. It is the fleshy condition through which we experience hunger, pain, fear, pleasure, satisfaction, and joy. As Mol and Law suggest, being part of our daily practices, the body is enacted within and through our practices: "we do (our) bodies" (Mol and Law 2004, p. 4).

At this point it seems useful to note that there is a recurring concept, namely that of "everyday life". The theories of everyday life are endowed with different concepts, ambitions and scopes. However, all theories emphasize the importance of daily routines, which everyone repeats and expects others to reiterate according to a tacit knowledge that contributes to reproduce social worlds (Jedlowski 2008).

As Schutz (1962) argues, everyday life is the reality par excellence. Although there are many spheres in which we spend our existence, the reality of the senses or physical things, that is the reality of everyday life, is our ordinary environment. Every order of reality has its own characteristics, that of daily life is *the suspension of doubt,* that is, the attitude of common sense, or *thinking as usual*. It is the mechanism through which we put doubt in brackets, taking for granted the categories we use to classify the world (Schutz 1962).

To put doubt in brackets means to take for granted that the things we know are the same as those that everyone else knows; but there is a tension between common sense and experience. While common sense develops the attitude that takes the world for granted, making the new already known,

experience, on the contrary, is typically open to doubt emphasizing the particularity of what the subject goes through. Through experience the subject tries to realign herself/himself with herself/himself, confronting herself/himself with the meaning of her/his own life. The product of one's experience is the consistency of the individual, or rather the ability that individual has, to return to one's past and to revisit it through one's own sensations, taking note of one's own corporeity:

> is to take note of my weakness, of my being exposed to wounds and death; it is in any case to recognise that I exist in time and space [...] But it is also to recognise that I was born [...] and therefore that I come from a woman's body; and, again, it is to recognise the concrete possibilities with which I am open to the world: my possibility to communicate, to objectify myself, to act and to be exposed to the actions of others, in a material world where my body is in relation with other bodies (Jedlowski 2008, p. 168, *my translation*).

According to the interdisciplinary field of Science and Technology Studies (STS), living in a material world we are also in relations with things, objects, that is non-human actors. The interdisciplinary nature of the STS offers the important possibility of dialogue between different disciplines, gathering contributions from the history of science, sociology, cultural anthropology, computer science, communication sciences, and economics.

The starting point of STS is to consider both science and technology as social activities. Scientists and engineers are also members of a community, therefore bearers of interests, skills, prestige, specific knowledge, and, as such, they are not just logical operators. STS scholars analyse science and

technology as active processes: they are not natural types, with simple properties that can be defined once and for all.

When configuring a new artifact, entrepreneurs and engineers create technical, social, and economic problems, which they propose to solve through a new working assembly (Latour 1998). In this sense, the technology builders produce an engineering of the heterogeneous, as they have to build artifacts, but also environments where they have to run (Sismondo 2010). All this can only be achieved through alliances in order to combine compatible raw materials, skills, knowledge and capital, for the creation of a stable network (Latour 1998).

STS scholars agree that science and social order are co-produced, scientific arguments are conditioned by political concerns, just as good policy is influenced by scientific research. This is the case, for example, with the practices and discourses built around health and disease by specialist medical knowledge, which through the classification and standardization of disease make invisible the alliances between different spheres (political, social, legal, ethical, bureaucratic, medical, technical and personal) that make the miracle of care and well-being possible (Bowker and Star 1999; Sismondo 2010; Thompson 2005).

Science and technology are already in the society. Medical science comes out of hospitals and clinical laboratories trough democratization processes of expert knowledge. Internet, smartphones, wearables, sensors are engaged in public communication of medical knowledge and at the same time they translate the lay knowledge of people into data that fuels dataset for medical researches; habits and preferences of citizen's lifestyle that produce a direct relationship between clinicians and patients and prevent hospitalization, but also for third parties which can then produce targeted

advertisements. Lay knowledge is the tacit knowledge (Polanyi 1958) that resists formalization. It can be embodied knowledge such as being able to ride a bicycle, or to drive a car, and can be embedded in material and intellectual assemblages (Collins 1974).

In its entirety, this dissertation aims to cultivate a dialogue among STS and Feminist Technoscience Studies (FTS) to emphasize the feminist STS's sensibility toward the role of materiality.

The dissertation, through the analytic lens of STS and FTS, examines how health is becoming digitalized in everyday practices of self-tracking. This study addresses such overarching concern though the engagement with two empirical sites: the study of health sectoral platforms through the analysis of Health Apple and Google Fit and interviews with women who use wearable technologies and therefore also applications for health, as well as apps for monitoring the menstrual cycle.

1.2 Digitalization of Health using Self-tracking technologies

The growing influence of the Internet and World Wide Web has introduced important transformations of the way we think about our health. Particularly, lay people have new possibilities to access medical contents and information, exchanging experiences of medical conditions, healthcare and caregiving online. Social scientists have been researching the digitalization of health ever since the Web 1.0 (usually dated from 1994) era began with the emergence of websites discussing health and medical issues (Lupton 2016a). A decade after Web 1.0, Web 2.0 emerges, and this includes social media platforms, wireless computing technologies (Wi-Fi), geolocation technologies, and the expansion of Information Communication

Technologies (ICTs), i.e. mobile devices such as smartphones, tablets and wearables. However, some scholars are beginning to underline the emergence of Web 3.0, that is the 'intelligent web' involving smart technologies that use Artificial Intelligence (AI) to reproduce human mind, particularly cognitive functions such as "learning" and "problem solving" (Lupton 2016a; Fuchs *et al.* 2010).

The process of health digitisation plays an important role in building a public health care model focused on the concept of personal, participatory and preventive health (Sharon 2017). As Berg and Harterink (2004) argued, the 20th century saw a change in the way medical practice thinks about the body. Whereas it was previously treated as an object-concept, typical of scientific discourse (Law and Mol 2004), it is now increasingly seen in experiential and procedural terms. The patient begins to be placed at the centre of medical practice: body and subject begin to be seen as a single entity (Berg and Harterink 2004). The concept of health promotion develops a preventive medical approach, at the centre of which the patient is understood as the personification of a weak body, regulated by processes that need continuous monitoring, regulation, and control (Cartwright 1995; Berg and Harterink 2004).

The list of technologies that lend themselves to the realisation of such a concept is very wide: Smartphones, tablets, wearable technologies such as Google Glass and Fitbit; sensors embedded in a range of materials and devices that can record both individual's biometric information (body temperature, heart rate, blood glucose, etc.), human movements, or various aspects pertaining to environmental health (e.g. air pollution, traffic, etc.) (Coletta *et al.* 2018; Lupton 2013, 2015, 2016b; Maturo and Setiffi 2016; Pantzar and Ruckenstein 2015). If in chapter four we will discuss the technical

features of these devices that go to configure digital health platforms (Van Dijck *et al.* 2018), here we will try to address the phenomenon of self-tracking fuelled by the importance that these technologies now have in the daily life of all of us, summarized by Apple's slogan "There's an app for that"[1] . Apple's slogan plays on the possibility of thinking about any human daily activity and practice using an app and if it doesn't exist, it's enough to develop it: this too is easy and cheap. The sociologist Deborah Lupton - one of the most important scholars of digital sociology and self-tracking cultures – acknowledges apps:

> […] as sociocultural and political artefacts that are created and experienced in complex relationships and networks involving app users, app designers and developers, app stores, app blogs and news reports, as well as the broader socio-political environment involving government agencies, regulators, digital infrastructures, social institutions and many other entities. […] They are designed and marketed with certain types of use and users in mind and offer various promises to entice downloads and use but are not always taken up in these ways by users. (Lupton 2020b, p. 2)

Health is also beginning to be controlled through the use of applications that translate the information, captured by mobile devices and related-sensors embedded, into a graphical interface that users can understand easily and immediately (Lupton 2016a). When apps are designed to manage and monitor chronic diseases and daily well-being they are called 'health-

[1] https://www.wired.com/2010/10/app-for-that/

related' and 'medical-related apps' (Van Dijck *et al.* 2018; Lupton 2016a). These allow users to monitor and document a great deal of daily information: calorie intake, fitness, weight, mood, sleep, reproductive health, chronic disease, healthy environment, and so on. Everyday practices and activities, as well as bodily functions, are transformed through these devices into data, with the potential to derive statistical analyses and graphical representations. Health-related apps, such as 'FitBit' or 'Runtastic', are used to monitor and transform personal performance and physical condition into statistics and trend graphs. Medical-related apps, on the other hand, are designed with the intent to keep chronic symptoms and diseases under control. In this context, European digital health programmes, or rather e-Health[2], are also being developed with the aim to use ICTs technologies to make medicine and health services more customizable, to empower citizens about their health, and thus to cut the costs of the health system.

Self-tracking technologies are used by individuals primarily outside medical contexts to monitor or self-monitor the functions and performance of their bodies (Fox 2015). Self-monitoring technologies are reconfiguring the management and control practices of our body broken down into digital data flows (Sumartojo *et al.* 2016). At the same time, the digital data produced contribute to feeding the huge amount of big-data, which can be used by pharmaceutical companies, governments and research centres to analyse and orient, as a consequence, choices and lifestyles of citizens, as we will see in the next paragraph (Haggerty and Ericson 2000).

M-Health and self-tracking are becoming mediators of individual responsibility, increasingly emphasised in political discourse on health care first in the US and then in Europe. In particular, the great emphasis placed

[2] https://ec.europa.eu/digital-single-market/en/news/e-health-making-healthcare-better-european-citizens-action-plan-european-e-health-area

on the concept of individual responsibility, and therefore on a healthy lifestyle, is directed primarily to the growing need to cut healthcare costs (Sharon 2017).

The phenomenon of self-tracking has fuelled the Quantified Self movement (QSm) (Lee 2013; Lupton 2016b), whose motto, as can be seen from the website, is "know yourself through data"[3]. QSm was created in 2007 by two Wired publishers, Gary Wolf and Kevin Kelly. QSm supports the idea that the various self-tracking devices and the various existing applications, such as those to monitor emotions, control daily meals, step counting and so on, offer a real possibility of understanding one's body, one's mind, thanks the relative possibility of quantifying daily life (Ruckenstein and Pantzar, 2015). The intention of the two founders is to create an international online self-tracking community (Lupton 2016b) to organise international meetings, conferences, offering them the opportunity to discuss these issues, as well as offering a guide for the use of different monitoring devices[4] (Moretti and Morsello 2017). The QSm has established a new approach to the self, understandable and knowable through the collection and subsequent interpretation of the data produced through the information entered in the apps, thus building new behavioural models in order to improve one's quality of life (Li, Dey and Forlizzi 2011). In this sense, self-tracking practices are considered useful to reflect on one's self in order to transform it day after day (Ruckenstein and Pantzar, 2015). Perfection becomes not only desirable but also possible through data, which are seen as the means by which the optimum level of well-being can be achieved (Ruckenstein and Pantzar 2015; Viseu and Suchman, 2010).

[3] See http://quantifiedself.com/

[4] See http://quantifiedself.com/about/

Gary Wolf in his articles and interventions often uses the metaphor of the mirror, as opposed to that of the window, to explain the scope of QSm. According to Wolf, the data produced by self-tracking does not open a window to look into one's own self, but, on the contrary, they act like a mirror (Wolf 2009). Data are able to reflect the daily self, built up by unconscious actions, routines and habits, often taken for granted because we are immersed in the attitude of "common sense" (Shultz, 1945). This offers the opportunity to activate the process mentioned and defined above as experience (Jedlowski 2008).

As sketched by Kratzke and Cox, recent studies have highlighted how such technologies intervene in everyday life changing health care practices, consumer habits, and education models (Kratzke and Cox 2012).

About the first point, some studies have emphasized the transformation of the relationship between the doctor and the patient, as the use of medical-related apps allows for real-time communication. The design of real therapeutic apps, designed to monitor even chronic diseases, is transforming medical practice, allowing professionals and specialists to work and interact with their patients even at a distance (Vervloet M., van Dijk L., Santen-Reestman J., et al, 2011 in Kratzke and Cox, 2012).

Self-tracking devices and apps also influence user consumption. Just think of the apps designed to monitor and control calorie consumption, which consequently influences daily consumption and spending habits (Rosser B.A., Eccleston C., 2011 in Kratzke and Cox, 2012).

Finally, self-tracking technologies can also have an impact on school education, in the sense that through the apps installed on smartphones, it is possible to influence subjects such as physical education and therefore the often-sedentary lifestyle of children. Some teachers, in this regard, have

used some of these apps as part of their classroom lessons to monitor calories and plan students' daily meals, even outside of the school context (Cummiskey M., 2011 in Kratzke and Cox, 2012).

Self-tracking phenomena is reconfiguring our experience of embodiment, our relationships and our meanings of body through various practices of quantification, which can produce on one hand self-acknowledgement about how the body works, and, on the other, a growing data-surveillance.

1.3 Data and self-tracking technologies: surveilling and classifying

Users of self-tracking technologies consume digital media, "producing", at the same time, data. This phenomenon is known as prosumption, which combines production and consumption in a single term (Ritzer 2014). Users, in this case, are both consumers and producers through their daily practices, increasingly mediated by software, which:

> consists of lines of code — instructions and algorithms that, when combined and supplied with appropriate input, produce routines and programs capable of complex digital functions. Put simply, software instructs computer hardware — physical, digital circuitry — about what to do (which in turn can engender action in other machinery, such as switching on electrical power, starting a motor, or closing a connection). Although code in general is hidden, invisible inside the machine, it produces visible and tangible effects in the world (Kitchin and Dodge 2011, pp. 3-4).

The word data comes from the Latin *dare*, meaning to give. In Kitchin's words: «data are raw elements that *can be* abstracted from (given by) phenomena – measured and recorded in various ways» (Kitchin 2014, p. 28). In this sense, data, produced by apps, through the information that is recorded by human actors, measures and makes concrete what happens inside the body.

Small data, produced in your own private space, is often aggregated forming the big data, that could be accessible to third parties, and used for commercial purposes (Lupton 2016b). The phenomenon of Big data is linked to the ways of analysis and information extraction from data sets too complex to be processed with traditional data-processing application software. The term big data also refers to the use of predictive analytics and other advanced data analytics methods with the aim of extracting value from data sets of enormous dimensions. The data processed in this way can find new correlations about human behaviour with the effects of naturalization of data becoming almost a second nature of the social (Ruppert *et al.* 2013). In recent years, an economy based on digital data is developing. Data are used for commercial and research purposes by many private and public actors, offering an unprecedented insight into social and economic trends and behaviour (Michael and Lupton 2016).

Even if we encounter the phenomenon of big data more and more often in public debate, as well as in scientific debate, there are few times when we grasp the definition that is given to it. In this regard, Kitchin and McArdle (2016) list some characteristics that small data must have in order to be called big data:

- Volume: they consist of an enormous amount of data

- Speed: they are created in real time
- Varieties: they can be structured, semi-structured and unstructured
- Exhaustiveness: they try to capture the entire population, or at least much larger samples than traditional studies using small data
- Capillarity (they must be as detailed as possible), and only indexical in their identification
- Relationality: they must contain common fields, so as to allow the connection of different databases
- Expandable: changing / adding new fields must be easy, and must have the ability to expand rapidly in terms of size
- Sincerity: data can be chaotic, noisy and contain uncertainty and errors
- Quality: many insights can be extracted, and the data must be reusable
- Variability: the meaning of data can be constantly variable in relation to the context in which they are generated and inserted.

The phenomenon of Big Data is now extended to all social phenomena, e.g., the proliferation of data on many phenomena such as poverty, economic trends, the role of finance, wealth distribution, unemployment, health, immigration, science and technology, and so on (Giancola and Viteritti 2015).

The use of Big data raises several questions about the privacy and security of the data that is captured by the traces left by people using social networks, online searches, and browsing on sites like Amazon or Google. Indeed, the use, online and offline, of digital technologies leave traces on personal preferences, choices, and habits in the form of data that can be sold to second and third parties. Some scholars (Kitchin and Dodge 2007, 2011; Kitchin 2014) have highlighted several important implications and issues concerning access to and control of personal data.

Dodge and Kitchin (2007; 2011), at the very beginning of the dissemination of these practices, raised important issues regarding the security and privacy of data produced during digital everyday activities. The two scholars essentially question what happens to data and by whom they are used, imagining the possible incidents that could occur if personal information was used by third parties for their own commercial purposes: this is the case, for example, of insurance companies, which could access data to calculate risks and premiums. They have raised and anticipated increasingly significant issues today, given the spread of the collection and use of personal data by companies such as Facebook, Amazon and Google and others, which collect information through increasingly sophisticated algorithms.

Most designers and developers of apps are very unclear about how and which data is captured, analysed and then used to generate predictive insights in user behaviour. At this regard, several scholars use the term 'dataveillance' to indicate the systematic employment of digital data to surveil and monitor the practices and activities of individuals classifying them in groups or classes of people (Beer and Burrows 2013; Bossewitch and Sinnreich 2013; Boyd and Crawford 2012; Kitchin 2014; Mann and Ferenbok 2013; Van Dijck 2014). Thus, for example, a smartphone becomes an assemblage of personal information, algorithms, websites, platforms, manufacturers and retailers, policymakers, software and hardware developers, etc. It is a black box that renders invisible the process of dataveillance by which the personal information thereby gathered can easily be analysed and grouped into discrete categories (Lyon 2002). Dataveillance involves voluntary forms of self-surveillance or surveillance of others. It is built on a logic of accumulation of personal data, such as gender, e-mail, localization, Facebook friends or Instagram followers, and likes to posts or contents. All

these online practices leave tracks, which are often sold to third parties as advertisers and data-broking and profiling companies for targeting audiences. As described by Shoshana Zuboff (2019), advertising companies are driving capitalism through an intensification of connection and monitoring online of social space and time. Capitalism has become more focused on the commodification of personal data. The author uses the concept of 'surveillance capitalism' to describe the emergence of an economic system opened to data collection and data processing.

Moreover, some authors look at these technologies in Foucauldian terms (Lupton 2016b; Kitchin 2014; Sharon 2016; Sanders 2016). They saw them as discipline techniques. Studies on digital surveillance use the concept of panoptic. The Panopticon is literally an architectural structure designed by the English philosopher and social theorist Jeremy Bentham in the 18th century. It is a prison that allows to monitor all the prisoners in their separate cells. In turn the prisoners are unaware that they are under constant surveillance. Foucault uses this metaphor to support the role played by the gaze, the surveillance and the constant visibility to which the population is subjected (Foucault 1975).

Self-tracking devices, therefore, promote self-disciplining behaviour (Sanders 2016), shaping the neoliberal citizen (Lupton 2016b), increasingly responsible for one's own health. In this sense, public health care and government have the unprecedented opportunity to monitor patients' health in real time through health-related apps. Citizens and patients become data producers collaborating in the de-collectivisation of public health care (Sharon 2017). Healthy individuals also become reachable, and this offers the possibility to regulate behavioural patterns, and thus the lifestyle, of the population for preventive purposes (Sharon 2017). Therefore, we have to

highlight the ambivalent process based on the fact that second and third parties promise to improve health and wellbeing in a holistic sense through the collection of big data, which, at the same time, contributes to strengthening the typical logic of capitalist surveillance.

The Cambridge Analytica/Facebook scandal, in 2018, is an example of how online interactions can be used to classify users into discrete groups of consumers, voters etc. through likes, posts, and news, often fake news (Lupton 2019).

This raises a much-debated issue in STS that is classification. Bowker and Star (1999) wrote the following about this:

> To classify is human. Not all classifications take formal shape or are standardized in commercial and bureaucratic products. We all spend large parts of our days doing classification work, often tacitly, and we make up and use a range of ad hoc classifications to do so. We sort dirty dishes from clean, white laundry from colorfast, important email to be answered from e-junk. We match the size and type of our car tires to the amount of pressure they should accept. Our desktops are a mute testimony to a kind of muddled folk classification: papers that must be read by yesterday, but that have been there since last year; old professional journals that really should be read and even in fact may someday be, but that have been there since last year; assorted grant applications, tax forms, various work-related surveys and forms waiting to be filled out for everything from parking spaces to immunizations (1999, pp. 1-2).

Classifying is both a conceptual and material action. It is a conceptual practice in the sense of organizing different elements into pragmatic units of analysis that allow cooperation across social worlds. This is achieved by producing material standards, protocols, technologies, defined by Bowker and Star as boundary objects. Boundary objects are objects that can inhabit several social worlds thus maintaining some sort of constant identity (Star and Bowker 1999).

Following this suggestion, self-tracking technologies are technologies of classification since they inscribe and prescribe an embedded knowledge across several social worlds: from the medical field to the political one, from the economic field to that of the daily life. They are able to classify expert knowledge into categories that, travelling across boundaries, meet the needs of users. For example, an app for tracking menstrual cycle can provide a classification of medical knowledge about the premenstrual syndrome through a list of symptoms meeting the need of users to track premenstrual syndrome. They are plastic and customizable objects, so they are able to adapt to several worlds themselves, categorizing at the same time knowledge from different realities. Apps can be considered as boundary objects by which expert knowledge and bodily management in the everyday life reconfigure new possibilities for self-knowledge of bodies in relations with human and non-human actors.

However, self-tracking technologies are measurement devices which produce knowledge in the form of digital data that can be used not just to categorize but also to surveil citizens with several concerns about privacy and personal details (Lupton 2016b). This arises very complex political issues, specifically questions about who configures measurement devices.

The profiling and targeting of users by large companies therefore raises complex ethical and political implications. Big-data work on the promise of producing predictive models about citizens through technology solutions that can be resented, resisted and subverted, but can also reinforce the logic of surveillance capitalism. There is the need to examine the applications and effects of these emerging technologies that are pervasive and increasingly fundamental in our daily life. Even if small data are used in aggregated and anonymized form, big data provide a categorization of users in discrete groups of voters, consumers, students, readers and so on. Your digital identity is categorized into a certain model. It is important to have more political and social awareness of this issue, to make it particularly visible at an educational level. So we must think more critically and constructively about how we interact with technology: what data do we share across social networks and different online platforms?

1.4 Privacy, transparency and accountability in the platform society

The rapid expansion of Internet is matched with the process of 'platformization', that is «the way in which entire societal sectors are transforming as a result of the mutual shaping of online connectors and completers» (van Dijck *et al.* 2018, p. 30). These platforms are becoming the basis of intermediation between services and relationships. The sociologist van Dijck defines:

> a platform as a programmable architecture designed to organize interactions between users. Many people think of platforms simply as technological tools that allow them to do things online: chatting, sharing, commenting, dating, searching, buying stuff, listening to music, watching videos, hailing a cab, and so on. But these online activities hide a system whose logic and logistics are about more than facilitating: they actually shape the way we live and how society is organized. (van Dijck *et al.* 2018, p. 19)

van Dijck and colleagues (2018) in the book *The platform society* look to the anatomy of platforms distinguishing in them the constitutive elements:

- *Data*: platform works through content data and user data automatically collected and at the same time shaped by software and hardware on which the platform runs.
- *Algorithms*: platform processes user data through algorithms that are sets of well-defined steps which transform an input into an output. Algorithms are secret and not transparent. They often establish the success of the platform – e.g. Google – because it filters the contents giving back to users personalized contents, services, or advertisements.
- *Ownership status*: the legal-economic status that regulates taxation and regimes.
- *Business models*: the range of informal and formal ways in which a platform creates and captures value. Business models include strategies to produce innovation in economic, social and cultural contexts. Platforms in the digital world adopt "free" strategies by which they offer services asking nothing in return. But, they create

economic value from the content data created by the users. They monetize the data and produce personalized advertisement and much more with the "free" labour produced by users.

- *User agreements*: also known as "terms of service" (ToS) is an agreement that shapes the relationships between users, platform and third parties. The ToS defines the terms of privacy and how personal data can be used by the platform's owners.

The Big Five – Google, Apple, Facebook, Amazon and Microsoft - are the dominant digital companies in this process. They offer services in trade for the access of data, often personal data. Localization and IP address, searches, clicks on videos and advertisements, websites visited, photos and shared videos on the social network make the concept of privacy increasingly nuanced and ambivalent.

The users work for the platform. The data are the exchange currency in the digital market. The free services offered by the platforms is a myth (Dolata 2017). Platforms work through the transformation of user's interests, activities, emotions and ideas into data, which are the real economic value in the digital economy. They connect users with personalized services and advertisements through the algorithmically automatization of the users' labour of research and selection of media contents (Andrejevic 2013; Turow 2012).

The mechanism by which user's interests, activities, emotions, and ideas are transformed into trade value is called commodification. The commodification mechanism emphasizes the issues regarding the ambivalence of "free" services which connect contents and users. From one hand, the commodification allows users to have personalized services and needs, from a personalized management of health to booking a flat or a flight from

anywhere. On the other hand, users produce values when interacting through sectoral platforms. Platforms exploit the data produced by users, providing insight into users' interests, and selling them to third parties, with the consequent exploitation of the immaterial labour of users – that do not receive values in exchange –, and precarization of the workers of the digital economy – e.g. riders (Fuchs 2010).

For these reasons, the political, legal and economic institutionalization of platforms are extremely important: from the definition of ownership relations to user agreements about the use of their personal data.

The European Union has been moving in this direction with the implementation of the General Data Protection Regulation (GDPR) on May 25, 2018[5]. The GDPR is part of the recent attempts to create a transnational legislation to ensure data protection for European citizens. It tries to homogenise the regulatory framework of privacy into Europe with the aim to give back to the users the control of their data.

The GDPR defines personal data as all that information that identify or make identifiable, directly or indirectly, an individual or data that can provide an insight on individual habits, choices, lifestyles, or health status. Therefore, personal data include: information that allows for a direct identification of the natural person (such as name, number, e-mail), biomedical (such as genetic information, physical and mental health status, active health services) and biometric data (facial-recognition, or the fingerprint), but also the data that provide ability to track people's localization through the geolocation, or IP address.

To ensure the protection of personal data, the regulation provides the obligation to make anonymous the personal data stored analogically in

[5] https://gdpr.eu/data-privacy/

archives and especially in digital databases through encryption systems. The regulation establishes the use of aggregate data without reference to personal identity.

According to the GDPR, data owners haves the right to be informed of how and by whom their personal data are used by and for what purposes. The information about how personal data are processed must be transparent and clear, so that the individual can give his explicit consent. The data acquired must be deleted if the user revokes consent to their treatment, or if the purpose for which the data were collected no longer exists.

Regulation promotes the accountability for third parties that collect and process data. One of the basic principles is the concept of Privacy by Design (PbD) which presupposes data protection from the initial design phases of technologies or systems that involve the collection of personal data. PbD is based on user-centric insight of the entire design process. It can be used in the development of everything that presupposes the use of personal data (Lupton 2016). The concept of PbD by definition is not subject to limits, it can be applied to the design of buildings or environments, to the realization of a technological or organizational project, as well as to any design solution in the IT field.

PbD is a methodological approach based on 7 principles (Cavoukian 2010, pp. 249-250):

1. Proactive and reactive; preventive and remedial: it is aimed to enact reactive measures in order to prevent privacy risks.
2. Privacy as default: the protection of personal data is a basic setting, automatically protected, without any direct user intervention, in any IT system or commercial practice.

3. Privacy is incorporated in the design, becoming an integrated part of the system.
4. Maximum functionality - positive sum, non-zero-sum: the PbD aims to satisfy legitimate interests and objectives, going beyond the dichotomy between privacy and security.
5. Complete protection of the technology life cycle: privacy, being incorporated from the initial stages ensuring data destruction at the end of the project.
6. Visibility and transparency: all parts and components of any commercial practice or of any type of technology remain visible and transparent.
7. Respect for the user's privacy: the natural person becomes the starting point with the scope to protect its personal identity, and improve, at the same time, user-friendly options.

However, the European attempts to ensure privacy, transparency and accountability have led to the adoption of user agreements. ToSs become instruments of governance by which the owners of certain platforms manage norms and values in the relations with clients, users, partners and other third parties (Van Dijck *et al.* 2018). ToS is sociolegal conditions that users resolve not by reading the various links and tabs but by simply flagging the 'accept it' box.

However, the attempts to regulate data privacy, transparency and accountability tend to eclipse other important issues such as the possible discriminations in the access to health data which could be used into medical research (Van Dijck et al 2018). Hospitals and universities aim to create partnerships with health sectoral platforms which have sophisticated tools and sufficiently technological infrastructures to collect health data directly from the everyday life of users (Andrejevic 2013). This combines the

reduction of research costs with the development of personalized medicine. The studies conducted through health sectoral platforms are algorithmically driven to perform data-based research that make quantifiable the day-to-day wellness (Andrejevic 2014). Who has access to, and the control of, data flows? How are they recombined and analysed without knowing the algorithms that drive the data collection and processing? What kind of transparency is possible if the platform's proprietary algorithms are secret?

For these reasons, regulatory instruments need to be complemented with the attempts from governments to involve sectoral platforms – especially health platforms – in the realization of a collaborative, interoperable and open science. It is not just a privacy concern. We need to reflect on how Apple and Google are already involved in medical research with the potential loss of the ability to publicly access to knowledge.

1.5 Using technologies between awareness and resistance

Data are not just a tool of surveillance. The body becomes viewable through data, that is graphs and tables, generating a reconfiguration knowledge about one's own body. The visualization of body functions, otherwise not perceivable, can lead to rethinking daily behavioural patterns and routines, in order to achieve individual perfection, and thus become more creative, productive and happy (Crawford, Lingel and Karppi 2015). Self-tracking technologies enact self-tracking practices of management of the body (Lupton 2016b). Self-tracking practices allow us to live experiences in order to achieve greater self-knowledge through the process of quantification the body (Espeland and Stevens 2008). In this sense, the quantification of daily behaviours and practices have the purposes of

disciplining one's own conduct with respect to physical fitness (Pantzar and Ruckenstein 2015).

The technologies developed to become an extension of our body can also be understood as an extension of all those purely medical imaging technologies, such as X-rays, ultrasounds, and MRIs. Self-tracking technologies and the sensors incorporated in them allow us to record physiological elements, movements, biometric aspects, biological functions during several daily practices. This process makes bodily aspects and elements perceivable which are otherwise taken for granted, transforming not only the concept of the patient, who today is increasingly responsible for his or her own health, but also transforming the concept of body with a history which is essential for the subject's experience (Lupton 2013-2016b).

Self-tracking devices become in some cases a contemporary and objective version of diaries, transforming health in a game through an easy-to-read chronology of daily practices and bodily functions by simply accessing the app (Allen 2008; Lupton 2016b). The process, by which health practices are transformed in a game, is called 'gamification': «a technique intended to foster productivity and achieve goals by transforming work into a game» (Maturo and Setiffi 2016, p. 478). Gamification is a strategy based on language and graphics aimed to depict the user as a self-entrepreneur who works to improve wellness configured as a game with goals and rewards.

Due to the characteristics that have emerged so far, some scholars define these technologies as "technologies of the self" (Sanders 2016; Lupton 2016b). This term has been adapted from Foucault's historical studies about sexual restrictions and the different ways in which humans develop knowledge about themselves. According to Foucault, the technologies of the self are those technologies that:

> [...] permit individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality" (Foucault 1988, p. 18).

From this point of view, understanding self-tracking devices like "technologies of the self" shows how users are increasingly engaged in the care of themselves, of their own body. Self-care is defined by Foucault as:

> the art of existence - the *techne toubiou* in its different forms - is dominated by the principle that says one must "take care of oneself." It is this principle of the care of the self that establishes its necessity, presides over its development, and organizes its practice. But one has to be precise here; the idea that one ought to attend to oneself, care for oneself *(heautou epimeleisthai)*, was actually a very ancient theme in Greek culture. (Foucault 1985, p. 43)

For the philosopher taking care of oneself means learning to define oneself as an imperfect individual, to recognize one's individual needs to build a privileged relationship with oneself, experiencing this through "practices of the self". Having experience of the Self does not express a simple possession of oneself but means creating a full relationship with one's own Self, and thus achieving full satisfaction. Here, the care of the Self:

> is the development of an art of existence that revolves around the question of the self, of its dependence and independence, of its universal form and of the connection it can and should establish with others, of the procedures by which it exerts its control over itself, and of the way in which it can establish a complete supremacy over itself. (Foucault 1985, p. 239)

As Foucault argues, the culture of the self is in close relation with medical thought and practice during an epoch when gymnastic and physical training are part of the realization of the perfect and ideal body. Within this framework, self-tracking practices can be theorized as a "reflexive" project of the Self aimed to a constant self-improvement and self-acknowledgement about how the body works (Lupton 2016b).

Data can be used to reach a greater knowledge of one's own self, to activate a process of "learning", understood as «a continuous, complex and uncertain process of appropriation that requires effort, taking the voice of the subjects involved and active connection with all the material and social elements of the context» (Viteritti 2012, p. 45, my translation). In this sense, they become biographical and personal devices, useful as collectors of data on one's daily life to activate that process that a few lines earlier we defined as "experience" (Jedlowski 2008). Users do not use technologies in a passive way, but often put in place practices of resistance and subversion. Resistance practices are different and can include forms of non-appropriation but also creative appropriation of technology, actively influencing the innovation processes (Kline and Pinch 1996).

Ronal Kline (2002) identifies three forms of resistance:

- Users can choose not to buy or use the technology
- Users can act to oppose the diffusion of that technology
- Users can use technology for unintended purposes, i.e. purposes different from those identified by its manufacturers.

The phenomenon of self-tracking is fuelled by resistance practices. Users often take possession of smartphones and wearables by implementing unexpected and creative resistance practices. They use applications in unexpected ways and take over their inscribed functions with different purposes than those conceived by developers. The purpose of the dissertation is to reflect on engagement practices: how users are appropriating knowledge inscriptions embedded in ICT that have become essential for everyday life.

The Big tech configure these technologies as measuring instruments able to transform the smallest daily activities and practices (e.g., taking the stairs on foot, taking long walks, getting up from the chair every 30 minutes) into data with the aim of building an aesthetic wellness project situated into the daily space and time of each user. The data, presented as impartial, reproduces the myth of the neutrality of technology. The challenge of this dissertation is to question the supposed neutrality of technology, investigating user resistance practices and exploring the ways in which data is never neutral or objective, but it is situated, and relational, carriers of normative and value models.

Chapter II

Health, gender and bodies

2.1 Feminist critique of medical knowledge about female body: the case of premenstrual syndrome

From the previous chapter it emerges that a variety of theoretical sensibilities informs this dissertation. Such heterogeneous body of knowledge pursues an interdisciplinary aim. This is because studying self-tracking requires an interdisciplinary approach that takes into account the different processes and tensions that gravitate around this phenomenon. Starting in 2013, the sociologist Deborah Lupton, persecutor of self-tracking studies, has not only brought to the attention of sociology how this phenomenon is transforming the way of thinking about the Self, the body and relationships with others, but she has also argued the importance of an interdisciplinary approach to investigate a phenomenon that in turn is interdisciplinary and hybrid, where the boundaries between "biomedicine", "engineering", "science", "industry", "health", "everyday life" are definitely blurred.

The intention of this dissertation is to bring the sociology of health (Fox 2015; Lupton 2013; Lynch and Cohn 2016; Maturo and Setiffi 2016; Oudshoorn 2011; Pitts 2004; Pols 2012) into dialogue with the STS perspective and new relational materialism (Esmonde 2018; Haggerty and Ericson

2000; Lupton 2016b-2019; Morsello and Moretti 2019; Sumartojo *et al.* 2016; Zampino 2019).

Sociology of health has analysed how medical knowledge is located in time and space, suggesting sets of dichotomies, especially female/male, nature/culture, mind/body. Particularly, feminism has stressed the patriarchal control over the female body. The "natural" reproductive functions of women are used by the patriarchate to legitimatize the domestic roles of women, like child-rearing and family maintenance (Clarke 1998).

Several feminist scholars have shown how medical knowledge, discourse and practice can naturalize gender inequality and discriminations. Even if medical knowledge can contribute to improve well-being, from the other side it can contribute to reinforce overmedicalization, and to stigmatize some conditions (Conrad and Barker 2010). For example, medical knowledge about premenstrual syndrome (PMS), childbirth, and menopause are used to justify moral assumptions about women's sexuality and femininity (Clarke 1998; Lorber and Moore 2002; Bird *et al.* 2010).

PMS is an interesting case of contested illness addressed by feminist scholars. Historically, menstruating women were subjected to taboos, restrictions and tacit norms, transmitted from mother to daughter. The medical studies on this are limited to the recognition of specific negative mood changes occurring during the week before menstruation. Biomedical knowledge about hormonal changes is used to justify some negative symptoms like frustration, aggression, anger and so on (Rodin 1992; Markens 1996). However, a systematic review of PMS medical studies conducted by psychologists Romans *et al.* (2012) underlines that the studies including men in the sample do not provide a real emotional and mood difference between men and women.

Feminists began to question the categorization of symptoms and moods associated with PMS proposed by the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Figert 1996). From the medical magicians of ancient Egypt to the philosophers of Classical Greece, women's condition of cyclical bleeding has been associated to stories of taboos and restrictions aimed to justify moral assumptions regarding women's sexuality and femininity (Houppert 1999). While scientists have been studying the menstrual cycle only from 1930s, when Doctor Robert Frank published an article in which he discussed the "premenstrual syndrome", as a combination of symptoms and mood swings that many women get about a week or two before their period. Questioning menstruations was driven by a desire to understand how and why men and women are different, but not to understand the biology of females (Romans *et al.* 2012).

Several feminists underline that the term PMS is frequently used in public debate to report or justify a mixture of somatic and mental disorders even if its exact etiology is still unknown (Rittenhouse 1991). This does not mean that PMS does not exist, but it is often used to label women's bad moods and attitudes only because they occur during the two weeks before menstruations. In some cases, this can become a way to describe women as unstable subjects with consequent extensive biomedical analysis of the relations between women's menstrual cycle and physical and emotional changes (Clark 1990; Rodin 1992).

This is supported by the fact that the research available on menstruations is low budgeted and flawed. Doctor Gillian Einstein, director of the University of Toronto's collaborative program in Women Health, points out that the studies carried out are small in size and most use women who experience problems during their menstrual cycle besides PMS. The studies are

constructed to indagate bad physical symptoms and potential changes in mood or temperament due to hormonal swings in women that have already recognized negative symptoms regarding their menstrual cycle. On the contrary other studies have highlighted that there is no clear link between women's negative mood and the pre-menstrual phase of their cycle (Romans *et al.* 2012; Walker 1995).

Despite its etiology is not clear, symptoms came to be classified in medical terms (Star 1999). They are classified as physical, on one hand, and, from the other, psychological and behavioural. Physical symptoms include tiredness, edematous sensation, breast sensitivity, headache, weight gain, and muscle pain; behavioral and psychological symptoms include irritability, nervousness, mood swings, sadness, depression, hypersomnia or insomnia, as well as decreased concentration (Rittenhouse 1991).

However, we must not lead to making the opposite error: that of denying that there are often even serious disorders related to menstruation. At this regard, some organizations like the International Association for Premenstrual Disorders[6] argue that the skepticism about attaching another label to women that presents them as irrational could trigger isolation and discrimination towards those women that are affected by severe dysfunctions linked to menstruations such as endometriosis, that is a gynecological problem that causes pelvic pain and infertility.

As argued by Fox Keller (1982), we need to develop a gender perspective in medical science that allows to find research protocols to overcome the stereotype of exclusively sexual and physical differences. This underlines the cognitive gap incapable of analysing and predicting different effects of treatment on organisms of different gender. Even the pharmaceutical

[6] See: https://iapmd.org/

products used by women are based on studies carried out on male bodies (Biancheri 2014).

What it is to be man or woman is socially and culturally defined, so we must begin to understand the body as bearer of gender and social meanings. The study of the body as an issue of knowledge has its roots in Michael Foucault's historical analysis about power, politics and economics. He has stressed the idea of human body as a material entity constructed by political and cultural discourses. For Foucault (1975), modern societies produce power through control over the materiality of the body. He regards medical science as the knowledge that provides the legitimation to discipline individual bodies. This provides a "biopower", that is the regulations of populations by panopticons, such as factories, asylums, schools and hospitals, understood as mechanism and technologies of power for assuring docile and disciplined bodies (Foucault 1975). Power involves the control of population through the development of self-care practices in terms of medicalization of bodies. Studies on medicalisation – understood as the extension of jurisdiction of medical knowledge to different social spheres, such as law and politics – have paid particular attention to the dimension of power and authority of medical profession, understood as an agency of social control and, sometimes, of repression of deviant conduct, as in the case of homosexuality (Conrad 1992; 2005; Turner 1987).

This leads to an understanding of the human body as a historically and culturally situated material entity in order to reject the conventional dichotomies of subject/object, and nature/culture to support the reciprocal constitution of mind and body. It follows that subjectivity is embodiment. The concept of embodiment allows for us to overcome the Cartesian revolution that gave a privileged status to mind, while the body was simply a

machine that processes cognitive computations. However, according to Turner (1987):

> To reject Cartesianism it is not necessary to deny the corporeal nature of human existence and consciousness. To accept the corporeality of human life it is not necessary to deny the fact that the nature of the human body is also an effect of cultural, historical activity. The body is both natural and cultural. (Turner 1987, p. 48)

The issue of the body lies at the juncture of different sociological approaches. Following the Science and Technology Studies (STS) perspective permits to draw attention to the role of laboratory researchers, clinicians, technologies, drugs and patients in the production and circulation of medical knowledge even more based on biomedical solution. In our societies, having a healthy body/mind regards the development of medical technologies and elaboration of biomedical knowledge. The introduction of the term "bio" is intended to signal the extension of the medical jurisdiction not only to diseases or disorders, but to the concept of well-being which, understood in a holistic sense, is at the heart of all those countless innovations and technoscientific transformations that include computer sciences and biosciences, such as genomics, molecular biology and pharmacogenomics, as well as biotechnology, nanotechnology, and medical technologies including visualisation technologies (Clarke *et al.* 2003). Using the term biomedicalisation means emphasising the development of new forms of medical treatment, organisation and care that enable and produce new ways of thinking and living life itself.

In this context the process of biomedicalisation is situated in complex and multiple trajectories of sociomaterial practices. The next paragraph addresses the prominence of Feminist Technoscience Studies in the process of recovering the material dimension of the body in its interconnection with other bodies and objects, which configure masculine and feminine ways of acting, deconstructing the patriarchal character of scientific knowledge.

2.2 Feminist Technoscience Studies and Science and Technologies Studies: a confront to question body and materiality

Adopting a gender perspective means focusing attention on how norms and sanctions, produced and imposed by social institutions, perform and act sexed bodies and subjects to a certain way of being according to the male/female dichotomy (Butler 1990).

The concept of gender itself stems from an idea of naturalness attributable to biological differences between males and females. It refers to the social and material dimension that shapes gender practices by establishing identity, feelings, expectations of male and female doing (Connell 1987; Butler 1990). Literature on gender studies considers gender as an analytical category aimed to understand the identity of the other based on gender practices, establishing, at the same time, how the "naturalization" of the biological difference between the sexes performs the construction of gender identity.

Gender practices implement the dominant ways of living masculinity and femininity in everyday life, also incorporating the possibility of crossing the dichotomy male/female, nature/culture by reconstructing

heterogeneous practices of "gender orders". The sociologist Connell defines "gender orders" as dominant models of patriarchal power that lead men to be recruited for jobs that require the use of force and violence, and vice versa women to be recruited for jobs such as nursing, or social services, in short, care roles, that require those characteristics socially and historically defined as feminine (Connel 1985).

Gender studies cross different theoretical perspectives aimed at analysing the complexity of patriarchal power relations, in which the standpoint of male, white, occidental men is interested in maintaining pay and masculine status that comes from differentiating their work from women's. In this debate, Feminist Technoscience Studies (FTS) questions the relations between gender, science and technologies.

Until the 1970s, science and technological innovation were considered the result of the application of a particular investigation's method that made them objective and therefore independent of the context in which the work of science was actually carried out. This is the positivist vision of science based on the accumulation of objective knowledge about the natural world thanks to the application of scientific method (formulation of the hypothesis, design of the experiment or observation, realisation of the experiment or observation, verification of the hypothesis through the data collected in the previous phases). In the 1970s, a new phase of science and technology studies was launched, which will be called Science and Technology Studies (STS). STS is an interdisciplinary field to study the social, political and cultural implications of science and technology. The first generation of scholars focuses on the study of scientific knowledge, proposed by the Edinburgh School (Bloor 1976), and the study of scientific controversies, proposed by scholars at the University of Bath (Collins 1981). These two approaches

define a broader perspective on the study of science that it is known as social constructionism, which recognises the socially constructed character of scientific knowledge. Scientific knowledge becomes the object of analysis, looking at the social position of scientists – who are often white, western and male – and the internal dynamics among them, their economic and political interests.

STS scholars are from different disciplines such as sociology, philosophy, history, anthropology, and engineering. They begin to study the processes and outcomes of science – including medical science – and technology, or rather *technoscience*, as inextricably intertwined (Magaudda *et al.* 2020; Sismondo 2010). The term *technoscience* defines the interconnection between scientific and technological processes (Latour 1987). This concept eschews the distinction between science and technology, drawing attention to the interdependence between scientific progress and technological developments, which are increasingly difficult to consider like two separate and distinct spheres. Technologists need scientific knowledge, and, at the same time, scientists need technological instruments and devices (Latour 1987).

Describing technoscientific processes allows to analyse science and technology as a network of relations, that connect heterogenous sets of human actors and material objects, ideas, discourses, and representations (Law 1992). Science and technology act together in the production of sociomaterial assemblages where human and non-human actors work together within entanglements that are both social and material, that is sociomaterial (Gherardi 2016). The distinction between social and material is the result of an agential cut: an analytical cut that distinguishes and assigns different properties to what would be understood as a whole (Barad 2003).

Numerous studies have drawn attention to the under-representation of women in technoscience, where this term refers to the interdependence between advances in science and developments in technology, which must now be understood as two sides of the same coin. Early FTS underlines that science and engineering are not fully open to the participation of women. The different socialisation of girls and boys to technology as well as gender segregation in educational trajectories and science, technology, engineering and mathematics (STEM) curricula contribute to the idea of technical competence as a typically male aspect.

These gender disparities also have significant consequences on the content of the reproduction of gender inequalities and constraints subordinate to patriarchal power. Women face difficulties in building and in maintaining careers, and developing their reputation to gain status and prestige, with the effect that women renounce socially perceived aspects as characterising their female identity and adhere to stereotypically masculine organisational models to break the glass ceiling.

This marks the transition from the early egalitarian feminism which questions how women could be treated more equally into and by science, to a feminism which questions how science can be used for emancipatory purposes (Harding 1986). Feminist scholars have challenged the foundations of social and intellectual orders through the gender analytic lens that questions how gender identities perform technoscience and scientific knowledge.

Feminists in STS show how gender identity has an important role in the definition of relations between humans and technology. This aspect has been investigated by studies on domestic technologies and numerous studies on medical biotechnologies, such as assisted reproduction techniques.

Domestic technologies inscribe the social division of gender roles, which relegate women to care practices. Designers in shaping technologies configure the ideal user through a gender script that configures and unfolds the potential use. One study that looks at the gender script of technologies is that on the microwave. As Cockburn and Ormorod (1993) have shown, the microwave oven was created to heat already cooked food for single men. This object was unsuccessful, until its functionalities were implemented and proposed to housewives as a support for work in the kitchen, becoming the object we know today.

Moreover, the reproductive technologies developed to respond to the desire for parenthood of heterosexual couples, increasingly meets the desire of homosexual or single couples, opening up an imaginary that goes beyond the biological differences between male and female (Perrotta 2013; Thompson 2005). Reproductive technologies have the capacity to redefine the infertility as a pathology. Women no longer need to adapt their life to the biological status of sterility, but infertility becomes a medical problem that can be fixed through technological intervention. Reproductive technologies medicalize women's condition of infertility, that now it is redefined as pathological (Grint *et al.* 1995; Wajcman 1991). Woman's body becomes a biomedical object of technoscientific practices by which the mother's role is strengthened.

However, objects exist only in and through practices. They are constituted, rather than constructed, into relations where the technical phenomenon is interconnected with social matter. Technologies are gendered (Cockburn 1992) and gender is not just crystallized in the object, but it is an ongoing process of interpretation embedded in the materiality of the design as a provisional result of interrelations between developers, sellers,

third parties and users. In this sense, technologies inscribe developers' intentions, interests, and gender identities.

Feminists underline how technoscience is not just the effect of a masculine way of understanding "Nature" (Harding 1986), but it is also an environment hostile to women. Technologies embed the idea that women do not have technical competences, becoming an aspect of female gender identity (Wajcman 1991). This has implications for access to the STEM fields, that entail the adaptation to an organizational model and a gender identity perceived as socially masculine.

However, the emergence of innovative technologies, such as communication technologies supported by ICT platforms, biomedical technologies, Artificial Intelligence (AI), robotics etc., contribute to the diffusion of the analysis perspectives proposed by STS, gender and technoscience studies. These studies have also taken less deterministic positions about the role of technology in contributing to the male domain and, at the same time, more optimistic towards the emancipatory possibilities it offers to women. Thus, at the beginning of the 1990s, cyberfeminism broke into the public sphere, proposing imaginaries populated by hybrid identities that cross body-matter-machine boundaries (Haraway 1997).

Cyber feminism is the thought and political movement, which tries to use new technologies for women. It is an epistemological project trying to overcome the dichotomy body/technology, body/mind, Nature/Culture. This is the new feature compared to the post feminism that historically seeks to create priori conditions for a critique of the universal and rational paradigm of patriarchal power. According to Haraway (1997) – the main exponent of cyber feminism – feminist theory and practice are perfectly able to reach beyond the analysis of the differences between the sex for

developing more general theoretical and social models. The cyborg is an entity constituted together by natural and technological elements. Modern medicine is the perfect example of a world populated by cyborgs, that is entanglements between organisms and machines, bodies and materials.

We live in the age of biotechnologies linked to the control of "living organisms". These are visualisation technologies that amplify the ability to visualise living matter that is invisible and taken for granted. In the biopower era (Foucault 1975), where the management of the body becomes the focus of political and capitalistic control, the concept of cyborg becomes a feminist science fiction experiment, by which feminists imagine visions of possible worlds to shape possible futures. Haraway (1997) goes beyond Foucault's biopower by looking at the body as a crossroad of multiple electronic flows that control our existence: from banking transactions to medical biotechnologies, to different forms of digitized communication. The scholar does not propose a techno euphoric vision of technology, on the contrary it tries to identify forms of resistance within the technological system in order to open creative spaces and specifically feminist forms of intervention. The cyber vision proposes a virtual body, emphasizing the specificities and diversity between males and females to overcome the discourse that sees women as victims of patriarchal power.

On the contrary, cyberfeminism authorizes forms of subjectivity and sexual individuality that escape the dominant dualisms, to put them into dialogues by deconstructing the presumed unity of the female subject so dear to American and European feminism. Meanings and bodies are questioned to redefine the terms of the discussion on scientific objectivity in the sense of "situated knowledge". Haraway claims that theories have to go beyond radical constructivism and feminist critical empiricism to avoid self-

referential relativism, which, like objectivity, does not see the situatedness of knowledge in corporeity and partial perspective. In this sense, the concept of "situated knowledge" takes into account the situated vision of scientific objectivity that has contrasted male and female bodies, male and female roles, and so on (Haraway 1988). With the concept of situated knowledge Haraway insists with the corporeal aspect of any kind of vision that is partial and peripheral, the only one capable of promising objective knowledge. This knowledge draws its objectivity not from presenting itself without an origin – making invisible the subjectivity of the scientist behind theories, experiments, knowledge etc. – but from explicitly recognising the partial and situated point of view that generated it.

Cyber feminism informs the feminist, transfemminist and queer movement that in recent years has given life to the political debates and mobilizations that have the task of questioning new sciences and technologies regarding the intersectionality and post-colonial issues. New relational materialism supports cyber feminism to address the body as a dynamic and mobile entity, endowed with an intelligence of embedded matter. The body is no longer a whole, but a multiplicity of flows, practices and material discourses. The body is matter in its capacity to support affective flows and learn to bear the fields of perception of the mind (Braidotti 2019). Relational materialism tries to dissolve mind/body distinctions, recognizing that human history is produced by associations of material forces and thoughts, feelings, knowledge and bodies (Barad 2003-2007; Braidotti 2013).

Nowadays, the techno-industrial culture employs all its efforts in the development of body visualisation devices: today, every PC, smartphone or tablet has a built-in video camera. We are witnessing body visualisation policies, controlled and monitored through the development of

biotechnological and biomedical spaces. The feminist debate gets a substantial impact to the development of the debate on the biomedicalisation process which contributes to the co-constructing of the female body as an object of monitoring and medical intervention.

2.3 Biomedicalization and digital health

The understanding of medical science as socially and historically situated provides a common basis for an interdisciplinary dialogue between the sociology of medicine, science and technology studies and feminist criticism.

Medical science is increasingly interested in technoscientific innovations. Since the Second World War, researchers began to add the prefix "bio" to the word "medicine" to show the growing intertwining of life and biological sciences, on one hand, and clinical practice on the other (Cambrosio *et al.* 2006). Biomedicine is an interdisciplinary field aimed to link the scientific research with care activity (Crabu in Magaudda and Neresini 2020). Particularly, care and well-being are linked to the development of biomedical technologies – i.e., biotechnologies – contributing to make hybrid the boundaries between disciplines, such as medicine, academia, biology, and industry, via the incorporation of computer and information technologies (Clarke and Shim 2009). It is the case of reproductive technologies that impose to rethink the biological body, reshaping the potential of organisms, redefining the boundaries between moral, ethical and cultural boundaries.

According to Adele Clarke and colleagues, the technoscientific changes in biomedicine define the transformations from medicalization to *biomedicalization.* The term biomedicalization is used to underline:

> the increasingly complex, multisited, multidirectional processes of medicalization that today are being both extended and reconstituted through the emergent social forms and practices of a highly and increasingly technoscientific biomedicine. We signal with the "bio" in biomedicalization the transformations of both the human and nonhuman made possible by such technoscientific innovations as molecular biology, biotechnologies, genomization, transplant medicine, and new medical technologies. That is, medicalization is intensifying, but in new and complex, usually technoscientifically enmeshed ways. (Clarke *et al.* 2003, p. 162)

Biomedicalization processes describe the extension of medical jurisdiction from illness and disease to health and wellbeing, which become an individual moral responsibility. There are five key factors at the basis of biomedicalization (Clarke *et al.* 2003; 2010):

- The politico-economic transformations: the commodification of health and research results, such as the privatization of healthcare systems.
- The development of a prevention biomedical knowledge grounded in self-surveillance practices. Health is becoming an individual responsibility that needs to be pursued with technoscientific practices (from screening to testing). Citizens are responsible for their everyday health and lifestyles, which are increasingly monitored through wearables, sensors, self-tracking apps and technologies.

- The increasingly technoscientification of biomedicine that changes social organization of biomedicine and clinical practice. The body is analysed in terms of vital functions, DNA coding and transcription mechanisms, not only as an object composed of organs, blood and tissue.
- The production and diffusion of knowledge regarding health, illness, disease and medicine via new media. Social networks, digital technologies, health-related apps and wearables transform access to biomedical knowledge.
- Transformations of bodies and identities. The body can be reconfigured and transformed through technoscientific practices and interventions. Biomedicalization extends: «beyond merely regulating and controlling what bodies can (and cannot) or should (and should not) do to also focus on assessing, shifting, reshaping, reconstituting, and ultimately transforming bodies for varying purposes, including new identities. Such opportunities and imperatives, however, are stratified in their availability—imposed, made accessible, and/or promoted differentially to different populations and groups» (Clarke *et al.* 2003 p. 181).

The theory of biomedicalization invites to observe first of all the expansion of a prevention biomedical knowledge grounded in the development of ICTs that works as an extension of the body (Crabu 2016; Cambrosio *et al.* 2014). Secondly, it invites to observe how self-tracking and health-related technologies are increasingly pervasive in the monitoring of corporal functions regarding everyday well-being to prevent illness and develop a healthy lifestyle. People are engaged in digital health, collecting data about their health status through tablets, smartphones and wearables. This is the

process of "datafication", that is the process by which human behaviours, emotions, social relations are recorded and converted into numbers (Van Dijck 2014). From a biomedical point of view, datafication contributes to transforming biological functions into data used for scientific research, or for supporting diagnostic or therapeutic processes.

Looking at biomedical technoscience makes it possible to see biomedicine as a network effect where experts, health professionals and pharmaceutical industries intra-act alongside citizens, patients, media, and technology. Patients and citizens can access bioknowledge and health information through Internet, social network, web sites, apps and health-related technologies, and at the same time they have new possibilities to produce new ways of interventions in health, illness, treatment, organization of medical care, and how we think and live "life itself" (Clarke *et al.* 2003).

The concept of biomedicalization captures the intertwining between culture, political economy and surveillance, organizational infrastructures, and technoscientific innovation. This theory also takes into account the Foucauldian issues about *bio*power and *bio*politics (Foucault in Clarke *et al.* 2003). Biopower is a power exercised through types of knowledge incorporated in technologies that subject bodies, behaviours, sensations, physiological processes and pleasures into forms of self-surveillance (Foucault 1975).

Biomedicalization and its five key processes is a comprehensive theory aimed to empirically analyse the expansion of biomedical jurisdiction through technoscientific transformations of bodies, knowledge, and practices. The next paragraph focuses on the agential capacity of materiality to affect body/mind within a more-than-human assemblages.

2.4 Digital comes to be matter within entanglements of humans and non-humans

The recent turn to ontology and materialism in feminist STS is informed by the feminist physicist Karen Barad's agential realism. Adopting a materialist perspective allows us to see matter and meaning as entangled elements. Barad's agential realism brings together the attempts of feminist scholars to question matter and body within science and technologies studies. Barad writes:

> Matter is neither fixed and given nor the mere end result of different processes. Matter is produced and productive, generated and generative. Matter is agentive, not a fixed essence or property of things. Mattering is differentiating, and which differences come to matter, matter in the iterative production of different differences. (Barad 2007, 137)

The boundaries between human and nonhuman are not fixed before the analysis but they are enacted within phenomena. She sees the world as an open process of mattering in which technoscientific practices are material (re)configurations enacted through apparatuses. Barad proposes Bohr's analysis about apparatuses, that is measurements practices by which knowledge is produced. Apparatuses are: «the material conditions of possibility and impossibility of mattering; they enact what matters and what is excluded from mattering» (Barad 2007, 148). In other words, subject-object, knower and known, observer and observed, are ontologically inseparable and actively engaged in practices of knowing. Subject-object is materially

embodied as part of the material arrangement – instruments such as digital devices, microscopes, test tubes and so on – which have a role in the formulation of boundaries and properties of things and meanings.

Barad draws attention to the inseparability of epistemology and ontology. It is an onto-epistemology perspective, that is the study of practices of knowing and being. According to Barad:

> Knowledge making is not a mediated activity, despite the common refrain to the contrary. Knowing is a direct material engagement, a practice of intra-acting with the world as part of the world in its dynamic material configuring, its ongoing articulation. The entangled practices of knowing and being are material practices. The world is not merely an idea that exists in the human mind. To the contrary, "mind" is a specific material configuration of the world, not necessarily coincident with a brain. Brain cells are not the only ones that hold memories, respond to stimuli or think thoughts. Brittle stars intra-act with their ocean environment and respond to differential stimuli made intelligible through these intra-actions, adjusting their positions and reworking their bodies in order to avoid predators or find food or shelter, all without brains or eyes. Knowing is a distributed practice that includes the larger material arrangement. (Barad 2007, 379)

Humans are always situated in entanglements of heterogeneous entities, that have an agential capacity to affect, producing power and resistance, tensions and ambivalences. Matter is itself performed by the sensing and embodied knowing, showing the engagement of people with forces, things,

bodies and other entities as entanglements of more-than human worlds (Barad 2003; Latour 2005; Law 1992).

We are immersed in assemblages where we learn to use the body to become sensitive to the materiality. As Latour (2004, 205) underscores: «to have a body *is to learn to be affected*, meaning 'effectuated', moved, put into motion by other entities, human or nonhuman» (original emphasis). Materiality is able to render the body sensitive to the differences of the world. The body feels and it moves. It does not finish with the skin, but it encounters, tastes, hears, and smells other material elements. It is *affected* by the 'effects' of knowledge, which is embedded and embodied within practices, by which we do experience of time and space. The body is enacted in various ways, continually being constructed through processes of incorporation and exclusion (Mol and Law 2004). Reciprocally, the body has no established boundaries, rather it is co-constituted as an entanglement of relational and dynamical agencies (Latour 2005; Lynch and Cohn 2016).

From a feminist materialist perspective, matter acts in assemblages in which human subjects are entangled with technologies (Lupton 2018). Boundaries between humans and non-humans, as Barad (2003-2007) argues, are not naturally given but rather historically co-constructed. The author proposes using the term 'intra-action' instead of 'interaction' in order to take into account the mutual constitution of humans and non-humans. This term is a way to reconsider the ability to act within relationships and not outside of them. In this regard, she uses the form "agential realism" to keep the attention on the process by which the agency of subjects and objects acts symmetrically in the production of social and material worlds. The body emerges in ongoing discursive-material practices: «'We' are not outside observers of the world. Nor are we simply located at

particular places *in* the world; rather, we are part *of* the world in its ongoing intra-activity (…) we know because we are *of* the world» (Barad 2003, 29-30). The intra-actions as bodily/materiality articulations perform various modalities of embodiment mediated by conventions and traditions.

The term 'embodiment' enables a discussion of how the dichotomies mind/body and nature/culture are blurred in the materiality of the bodies. Adopting Scheldeman's (2010, 145) definition of embodiment as "the way we live life 'embodied': with and through our bodies" allows us to regard embodiment as a process by which the living body becomes a material-discursive phenomenon that comes to matter in the mutual constitution of entangled agencies. The aim is not to extend subjectivity to things. As Suchman (2008) emphasises, discussing Barad's studies, humans and non-humans are not necessarily constituted one another in the same way. Agency does not pre-exist separately, instead, «agency – and associated accountabilities – reside neither in us or nor in our artefacts, but in our intra-actions» (Suchman 2008, p. 8).

Digital comes to be matter within ongoing entanglements and across a range of everyday activities and practices that combine diverse types of knowledge and capture our everyday spatiality. Here, self-tracking practices help us to see not only the entanglements amongst things, people and data, but also how they come to be matter through overlapping socio-material practices embedded in the knowledge process (Pink and Fors 2017; Sumartojo *et al.* 2016). Self-tracking practices can be understood like 'knowing-in-practices' (Gherardi 2019), that is knowledge that evades scientific formalization. It is an embodied knowledge, that: «resides in the fingers, the eyes, the nose or the ears» (Gherardi 2019, p. 65), engaging complex relational practices where the body is the principal protagonist.

Feminist new materialism approach can contribute to include non-living objects (as digital technologies) in the analysis of more-than-human assemblages in which agency is performative and distributed between humans and nonhumans. Agency is relational and distributed through intra-actions and entanglements of people with technologies. Particularly, humans and apps work together in generating human-app assemblages, in which knowing emerge as a doing situated and enacted within and across humans and nonhumans.

Chapter III

Methods after methods: the inquire with sociotechnical objects

3.1 Actor Network Theory and Feminist Technoscience Studies for situated methods

Dialogue between STS perspective, particularly Actor Network Theory (ANT) and FTS, allowed me to inform my investigation and empirical enquiry by critiquing the method as an objective standard of naturalised sets of rules and procedures.

ANT was developed in the 1980s by Michel Callon (1984), Bruno Latour (1987), and John Law (1987) with the aim of understanding the construction of scientific facts and the development of technological artifacts. ANT works saw how science is constructed within the messiness of the laboratory (Latour and Woolgar 1979). Researchers are engaged in the manipulation of their materials and apparatus of measurements (Knorr Cetina 1981). Knorr Cetina (1981) uses the term "tinkering" to underline the manipulations put into practice when materials and experiments do not work or do not behave as they are supposed to. This term was then extended to reflect on practices of the manipulation of technologies in daily life.

According to the proponents, ANT is neither a theory nor a standardised method (Latour 2005). Actor network theory has produced a variety of approaches to the study of science, technology and society, rethinking, at the same time, theory-method assumptions. In many cases becomes a reference to underline the relational nature of technoscientific phenomena as well as the role of objects in the shaping processes and relations.

One of the most common concepts in ANT-based analysis is the principle of generalized symmetry (Callon 1984) by which human actors and non-human actors are considered as capable of having an effect within a relational network. For analytical purposes this involves a redefinition of the concept of agency: both animate livings and inanimate things are endowed with agency, i.e. the ability to shape processes and thus to take an active part in the mutual constitution of relational effects. For the actor-network approach each entity does not exist in an independent and isolated manner, but this is the product of a set of relations that are never definitively stabilized. These relations exist between individuals, but also between individuals and objects as well as with objects with other objects. ANT tries to visualise the course of action, that is describing the associations between sociomaterial entities that lead to the emergence of an idea, knowledge or technology. ANT understands the social as a reassembling of heterogeneous elements (Law in Bijker *et al.* 1987) in the sense that they combine simultaneously to material and social, namely sociomaterial worlds.

In this background, ANT is a perspective that relates theory and method, supporting us to follow intra-actions (Barad 2003) between humans and non-humans. We usually imagine method as a set of particular and systematic procedures to follow in order to reach a particular destination.

However, method is not just a philosophy of method, nor a set of techniques. At this regard, Law says:

> The picture of method starts to shift. The argument is no longer that methods *discover* and depict realities. Instead, it is that they participate in the *enactment* of those realities. It is also that method is not just a more or less complicated set of procedure or rules, but rather a bundled hinterland. (Law 2004, p. 45, original emphasis)

Such an understanding of social research is close to what Annemarie Mol has defined *ontological multiplicity* to argument the reality which is enacted and done through multiple material-semiotic practices. She suggests using the term *enactment* rather than *construction* to understand objects as real part of practices (Mol 1999).

The social science method is understood as assemblages of performative and relational practices, which enact multiple and partial visions (Haraway 1988). Method(s) are assemblages of objects, ideas, researchers, knowledge(s), practices etc. Feminists distance themselves from any claim to objective knowledge. In this regard, Donna Haraway (1988) talks about situated knowledge(s), where objectivity comes from a local position of researchers.

The FTS shares some characteristics with the ANT, given their interest in the challenges of realism, ontology and the performative paradigm. In particular, feminist physicist Karen Barad, writing diachronically after the emergence of the ANT, overcomes the tension between realism (the risk of seeing only one reality 'out there' to describe given a context and the goals

of the study) and social constructivism with her onto-epistemological position of 'agential realism'. The notion of 'agential realism' describes: «an epistemological and ontological framework that provides an understanding of science as 'material-discursive' practices» (Barad 1999, p. 2). Here, reality is performed by practices and co-constituted within intra-actions between agencies of subjects (observers) and objects (observed). "Realism" is not «about representations of an independent reality but about the real consequences, interventions, creative possibilities, and responsibilities of intra-acting within and as part of our world» (Barad, 2007, p. 37).

Realism is not an independent reality "out there" that social scientists have to investigate. In this way, Barad involves Haraway's notion of situated knowledge that recognizes embodied and located objectivity, recomposing at the same time the terms of binarism subject/object (Haraway 1988). The focus is on the entanglement of matter – materiality, objects, bodies, apparatuses of measurements – and meaning. This means that there are no independent subjects/objects with inherent boundaries, but rather material practices that come to matter within certain phenomena.

The next section discusses research questions and contributions of this dissertation and how feminism informs method issues, underling how method performs research practices within engagements of things, people, ideas, institutions.

3.2 Research questions and contributions

Three research questions were developed in order to operationalize considerations about the central topics and theoretical framework introduced above. These research questions provide guidance in approaching

empirical instances. They should be understood as interpretative devices rather than definitive demands for answers.

The first issue concerns the body as an ongoing discursive-material practices. I take into account the relationship between self-tracking technologies and embodied practices that perform the biomedical knowledge of human subjects, specifically of women, which to this day remains an underexplored issue:

1. How do self-tracking technologies engage the embodied and biomedical knowledge? How do self-tracking technologies perform knowing-in-practices?

The second question relates specifically to how the body comes to be matter through material assemblages between humans and apps:

2. What is the role of biomedicalization in the development of health-related apps? How does the body learn "to be affected" though material engagements between humans and apps? How does genderized matter affect knowing-in-practices?

The third question tries to call in question the materiality and particularly the genderization of materiality understood as entanglements between heterogeneous elements of thoughts, ideas, purposes, assumptions, political forces, economic interests, and knowledge(s) etc. Such tension fosters the following research question:

3. What is the role of materiality in the process of configuring the genderization of lay and expert knowledge? How does the knowledge suggested by technologies come to be matter in intra-actions between humans and apps?

These analytic inquiries will help me to address the theoretical and methodological discussion as well as to disentangle the following empirical instances.

Given these theoretical frameworks and analytic sensibilities, I have tried to put them into work through the analysis of two field sites: (1) the script's description of the Google and Apple's health platforms, and health-related apps for menstrual period; (2) interviews with women who use tracking wearable devices and apps for tracking their menstrual period.

My inquire explores two empirical fields. With the first field I investigated the expert knowledge of engineers, developers, doctors, entrepreneurs (and so on) incorporated into the script of self-tracking apps for menstrual period (typically immersed in issues related to the biology and health of the female body) and the two apps developed with health purposes by major competitors in the market of the Big Five: Health Apple and Google Fit. With the second field I conducted interviews to investigate the enactment of lay knowledge that is situated in everyday practices.

These research questions and empirical settings outline some contributions that this study seeks to provide. Firstly, this dissertation advances a discussion of the phenomenon of self-tracking through the biomedicalisation theory and materialist approach. While it is reasonable to claim that media and digital studies on digital surveillance constitutes a well-

established body of knowledge, sociological analysis of self-tracking practices and health platforms are still in their early days.

Secondly, this study unfolds two empirical settings in which the relationship between ICTs and the management of wellbeing is explored through the acknowledgment of the performative character of social inquiry and methods. The result is a concern that Annemarie Mol (1999) has expressed as 'ontological multiplicity', by which she arguments that reality is not simply observed, but it is done and enacted through material-semiotic practices. However, my aim is not to observe reality as an object "out there" that needs to be investigated. Reality is performed by practices and agencies of subjects (observers) and objects (observed) (Barad 1999). The challenge is to investigate the consequences, interventions, creative possibilities, and responsibilities of intra-acting within and as part of our world.

Finally, considering the empirical research findings, this study offers a contribution to the sociological debate on self-tracking phenomena and biomedicalization process. This dissertation invites one to focus on the role of materiality seeing self-tracking technologies as measurement apparatuses that becomes matter through data, namely graphs and statistical representations; and, it addresses the design of apps as a way to investigate gender script, that involves inscriptions about purposes, tastes, competences, motives, and aspirations of the ideal users imagined by developers, in order to explore as the materiality so configured inscribes biomedical knowledge that can suggest knowledge to experience on your own body.

In the following sections I will discuss the two empirical approaches and the methods used to collect the empirical data.

3.3 Describing the script: apps as sociomaterial objects

As I have underlined in several parts of the dissertation, STS and new relational materialism do not see material objects as inert mediators of human actions. STSs wonder how objects contribute to the making of science, the establishment of scientific knowledge and the materialization of technologies. Therefore, the role played by objects in more-than-human worlds stimulates a new awareness towards the need to look at the materiality of things in order to fully understand the social aspect, even outside of the laboratories (Latour 1992).

FTS called in question the role of material objects both in the process of technological innovation and in the everyday life. We have often used the term object until now but have not given a definition to it. 'Object' is a material configuration of things, tools, stories, techniques, ideas and gender identities. Objects are sociomaterial technologies that materialize political functions, and gender constraints. At this regard, anthropologist Judith McGaw (1996) analyses bras, closets, collars, and bathrooms as women's technologies. She argues that talking about women's technologies also means talking about the relationship between technology and biology, because women's technologies are often technologies of the body, due to the close connection between the feminine and the intimate sphere.

Although every woman has two different breasts, bras are mass-produced and standardised in sizes that aim to be universal. Moreover, a woman's body changes continuously over the years, and each age has different needs and problems. Bra is a genderized technology that configures a standardized idea of beauty and body. It is evident that every woman will

find defects in different types of bras available on the market and it is here that the myth of technological "perfection" falls: women are the real experts, therefore the main resource of technological development is represented by the experiences and suggestions for modification and/or adjustment that every woman expresses through her own purchasing choices (McGaw 1996, pp. 19-20).

A bra is a genderized technoscientific object, that can also find political and situated meaning through non-use. It is the case of the feminist Miss America 1969 protest, when a group of feminist activists burned some feminine products among which there was also the bra[7].

I reported this research to point out that STS gives voice to objects, until then missing masses in sociology (Latour 1992). They become manifestations of human relations: *objects make humans do things*. In this sense, objects have agency. This does not mean that they have intentionality or will, but from an epistemological and ontological point of view they are present and produce effects within assemblages of sociomaterial elements.

STS perspective suggests describing the materiality of objects to analyse their contribution to action (see Mattozzi 2006). To do this, Akrich and Latour (Akrich and Latour 1992) use the concept of *script* as a methodological strategy to describe the contribution of non-humans to action. In the world of cinema, a script is the screenplay and it says what the actors have to do on the scene while they are acting. The idea is that objects have inscribed in their own configurations a series of behavioural instructions for their potential users. It outlines and disposes users' actions. At this regard, Madalein Akrich underlings:

[7] https://www.history.com/news/miss-america-protests-1968

> (…) when (designers) define the characteristics of their objects, they necessarily make hypotheses about the entities that make up the world into which the object is inserted. Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudice, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of 'inscribing' this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a 'script' or a 'scenario'. The technical realization of the innovator's belief about the relationship between an object and its surroundings actors is thus an attempt to predetermine the setting that users are asked to imagine for a particular piece of technology and the pre-scriptions (notices, contracts advices, etc.) that accompany it. To be sure, it may be that no actors will come forward to play the roles envisaged by the designer. Or users may define quite different roles of their own. If this happens, the objects remain a chimera, for it is in the confrontation between technical objects and their users that the latter are rendered real or unreal. Thus like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act. (Akrich 1992, pp. 207-208)

Designers and actors involved in the development of technologies need to imagine the subjective identities of their future users. Nowadays, the paradigm in design theory is user-oriented design, that means that groups of

users test technological objects to increase product usefulness and usability (Oudshoorn, Rommes and Stienstra 2004). However, Oudshoorn *et al.* (2004, p. 31) point out that: «although many ICT products are hardly submitted to any systematic user tests at all, (…) artifacts come to incorporate barriers against specific groups of users». In regard to this, feminist scholars have addressed that technologies embed gender constraints playing an important role in constructing gender identity (Wajcman 1991; Grint *et al.* 1995).

Against this background, this dissertation aims to question health platforms and health related apps as sociomaterial objects that inscribe practices of engagement and embodiment, gender relations and constraints, political and economic issues in a society that becomes matter through digital platforms.

Following relational materialism, I described how self-tracking technologies work within an ecology of ICT infrastructures. I studied the subject through engineering literature and documentations accompanied by four online conversations[8] with university researchers who are experts in the development of wearable technologies. Particularly, the experts interviewed[9] are part of an interdisciplinary research group established at Sapienza "Sapienza Information-Based Technology Innovation Center for Health" (STITCH) that:

> promotes, coordinates and develops interdisciplinary research activities aimed to expand scientific knowledge and industrial relocation of innovative technologies specifically

[8] The professors have become available to answer my questions and technical questions through Skype. The conversations were recorded and then transcribed. They have been carried out between May and June 2020, then during the second phase of the Covid-19 pandemic.
[9] One in Information and Communication Engineering; One in Electronic Engineering; One in Electronics and Nanotechnology; One in materials engineering.

> linked to the fields of technology and science information technology applied to medicine and health. STITCH (areas of expertise are: e-Health, Biosensors and Bioelectronics, Virtual Reality, Big Data, Artificial Intelligence, Network Medicine, Medical robotics and others. [10]

I would have even liked to interview developers, but my every attempt to do so has failed: the issues of privacy and professional secrecy clashed with my requests for possible interviews or ethnographies. For this reason, I decided to explore the technical features of self-tracking technologies interviewing some researchers close to the study of wearables developed for medical purposes. These conversations have helped me to enhance an interdisciplinary point of view reconstructing technical literature that permitted me to question some keywords – such as API and interoperability – often taken for granted in sociological literature in order to identify the two most widespread e-Health platforms: Health Apple and Google Fit[11].

Thereafter, I tried to question my embodied and situated knowledge through the historical description of Health Sectoral Platform mapping the websites of Health Apple and Google Fit and the relative collaborations with medical research centres. Health and Google are the two most important Health sectoral platforms able to communicate with several health-related apps, especially since they are the major producers of operating systems. Moreover, Health Apple is the first platform created with the intention of developing a medical viewpoint that starts from the citizens themselves, who become key actors in the process of implementing self-tracking practices to achieve a state of mental and physical well-being. This was followed by the birth of Google Fit. The historical reconstruction of the

[10] https://web.uniroma1.it/stitch/

[11] The two platforms are analyzed between March 2020 and June 2020.

two health platforms allows us to see and follow them as sociomaterial objects to investigate words and images, as well as partner collaborations. Even if they are landing pages with the purpose of convincing visitors to download the app, the analysis ensures to understand the mission of making health into digital platforms.

On the basis of these considerations, I analysed how the two Big Five prescribe the two most popular health-related apps in the digital health world: Health Apple and Fit Bit. The aim is to question how Apple and Google configure the digitalization of Health through the platformization process. With this purpose, I carried out the de-scription (Akrich 1992) of the two health platforms. As suggested by Madeleine Akrich, the description can be considered as a narrative of a network that operates through «the circulation of certain types of resources and the exclusion of other actors» (Akrich 1992, p. 209).

Health-related platforms are predicated on genderless design values. However, Apple's designers introduced only in 2019, after five years of the launch of Health Apple and several polemics, the possibility to track menstrual cycle. This exhibits how the 'neutrality' is still built on the male functioning of the body. Giving the possibility to track menstruations undermines the supposed neutrality of the app's design not considering gender differences as a tool to promote a reflexivity on female and male health.

On the basis of these considerations, I question the digital market of applications for the menstrual cycle to describe the space by which developers configure and imagine genderized users. The aim is understanding how women's health is genderized trough health-related apps referring a

controversial argument both in medical research and in public debate, that is PSM.

Following the approach used by Deborah Lupton and Annamarie Jutel (2015), as well as by Antonio Maturo and Francesca Setiffi (2016), I downloaded the first 20 apps containing the word "menstr-" in the Health and Fitness category of Google Play Store. These were used by the researcher for 3 weeks[12], at the end of which it was decided to focus the analysis on 6 apps: Clue, WomanLog, Flo, iGyno, My Menstrual Calendar and Maya. The apps were selected, after a careful analysis of the online description on Play Store, according to two dimensions. The first one is the use of medical knowledge to classify symptoms and moods prescribing a PMS approach at the knowledge of the female body. The second dimension is the declared user friendliness in order to personalize the already vast list of physical, psychological and behavioural symptoms.

From an analytical point of view, the content of the apps has been analysed with the intention of investigating the words and representations used to classify symptoms, moods and biological functions through the labels. In the previous chapter we have seen that some feminist scholars question the inclusion of medical categorization of physical symptoms and moods linked to PMS in the DSM. Indeed, when these are severe enough to influence the normal course of daily and work activities, or relationships with others, medical science talks about "Premenstrual Dysphoric Disorder" (PMDD). In 2013 the DSM describes PMDD like a mental pathology that influences the normal course of daily activities or relationships with others. In line with recent trends in quantification (Espeland and Stevens 2008), the DSM-5 establishes that to diagnose PMDD a minimum of 5 symptoms must

[12] They are downloaded on 10 January 2020. the analysis was completed in August 2020.

occur during the week preceding menstruation, which will then improve in the following days (APA 2013). Among these, we have:

- evident irritability, anger, or increased interpersonal conflict
- evident emotional lability, such as mood swings, suddenly feeling sad or tending to cry, or an increased sensitivity to rejection
- depressed moods, feelings of despair or self-critical thoughts
- evident anxiety, tension and/or nervousness
- decreased interest in routine activities, such as work, school, and relationships with others
- lack of energy
- overeating, or a strong desire for specific foods
- hypersomnia or insomnia
- sense of overpowering or being out of control
- physical symptoms such as breasts tenderness, joint or muscle pain, a feeling of swelling or weight gain

Even if the DMS defines the PMDD as a mental disorder, it remains difficult to diagnose because women need to self-report several symptoms and quantify their severity. In this ambiguity the development of menstrual-related apps is used to encourage a personalized bioknowledge based on self-tracking practices. Menstrual-related apps elaborate predictions about fertile windows, period, and PMS. They reconfigure subjective experiences of women creating a terrain of hybridization between lay and experiential knowledge and biomedical knowledge about PMS and menstrual cycle.

To investigate the script of the apps I have set two grids of analysis. The grid no. 1 has been elaborated with the aim to compare labels of symptoms and moods, inscribed in the script of the apps, with the medical categories related to PMDD. Some experts are quick to diagnose these symptoms as

premenstrual syndrome (PMS), which becomes a general diagnosis to describe all kinds of minor mood and menstruation-related discomforts in women (Endicott *et al.* 1999). The medical categories of PMS have been classified in *physical symptoms* (feeling tired, oedematous sensation, tender breasts, headache, bloating, muscle pain) and e*motional symptoms* (irritability, feeling nervous and anxious, mood swings, sadness, depression, hypersomnia, insomnia, difficulty concentrating).

Physical Symptoms							
		Apps' classification					
		Clue	**Flo**	**iGyno**	**Menstrual Calendar**	**Maya**	**WomanLog**
MEDICAL CLASSIFICATION	Feeling Tired						
	Oedematous sensation						
	Tender Breasts						
	Headache						
	Bloating						
	Muscle pain						
Emotional Symptoms							
MEDICAL CLASSIFICATION	Irritability						
	Feeling nervous and anxious						
	Mood swings						
	Sadness						
	Depression						
	Hypersomnia						
	Insomnia						
	Difficulty concentrating						

Grid no.1 – App analysis grid. See complete analysis grid in appendix

Other						
Apps' classification of Physical and Emotional	Clue	Flo	iGyno	My Menstrual Calendar	Maya	WomanLog

Grid no.2 – App analysis grid. See complete analysis grid in appendix

The grids were constructed with the intention of comparing the list of physical-emotional symptoms inscribed in the analysed apps with the medical classification discussed above, in order to explore the fit between the medical knowledge prescribed (standards, values and knowledge) by the designers and the medical knowledge codified and standardised by the DSM. The decision to add the "Other" mode (Grid no.2) was determined by the need to capture labels that cannot be overwritten to those medically categorised by DSM.

As we saw in the first chapter the process of classification allows cooperation across social worlds (Star and Bowker 1999). In this sense the apps are seen as boundary objects in which the labels of symptoms and moods become material standards, allowing the communication from medical knowledge to developers' knowledge, from marketing strategies to user requirements. The grids of analysis become a classification tool for the

researcher (Bowker and Star 1999) in order to compare different apps and interrogate the knowledge embedded in them.

However, the knowledge embedded in material objects is often reconfigured and adapted to everyday life contexts. It is not satisfactory to analyse only the point of view incorporated in the design of a sociotechnical object. On the contrary we have to question how users engage with the script imagined by the designer. In the next paragraph I will elucidate the methodology used to investigate the ways in which women enact self-tracking practices in their everyday life.

3.4 Investigating self-tracking practices: interviews as a performative method

Adopting feminist and onto-epistemological stances invite the researchers to question his subjective and situated knowledge and seeing the intertwining between body and matter. I carried out some interviews in order to investigate the enactment of lay knowledge situated into everyday practices that relate expert knowledge and individual knowledge.

I carried out thirty interviews with Italian women aged between 15 and 46 years. The first fifteen semi-structured interviews had been carried out with women who utilize the app to manage menstrual periods. Other fifteen semi-structured interviews had been carried out with women who utilize the wearable technologies to manage fitness and daily wellbeing.

The interviews were often held in public places (university classrooms or bars), or via online platforms, such as Skype and Zoom. The interviews were conducted in different periods. The first fifteen were conducted with

women using apps to monitor their menstrual cycle during the first year of my PhD, three of which were conducted via Skype. The other fifteen, whose focus is the use of wearable technologies, were conducted between June 2019 and July 2020, then three interviews were held during the pandemic and the heavy restrictions we experienced (that we will face in the last chapter). They were selected via cascade mechanism, beginning with authors' entourage, in order to respect the principles of heterogeneity and exhaustiveness. Lasting between fifty and sixty minutes, they were audio recorded and verbatim transcribed in order to analyse how apps and wearable technologies are embedded into the user's bodily knowledge.

A semi-structured interview is a performative research method that can produce knowledge through the relationship between interviewee and interviewer (Law 2009). During the sessions, the interviewee became an ally in the process of questioning and opening the black box of knowing-in-practices (De Vita *et al.* 2016). According to Mazzei (2013) the interview yields sociomaterialist insights that can be thought of as an assemblage in which the voice of the participants «is produced in an enactment among researcher-data-participants-theory-analysis» (p. 739).

The structure of the interviews with users of sociomaterial objects[13] was intended to examine four principal concerns: (1) the choice of sociotechnical objects; (2) the relationship between body and sociotechnical objects; (3) the sharing of personal data with other users, parents, friends, partners; and (4) the sensibility about privacy issues.

I set up two interview tracks: one to investigate self-tracking practices related to the use of menstrual apps and another to analyse how women

[13] Sociomaterial objects mean the heterogeneity of self-tracking technologies, in which social and technical elements, expert and lay knowledge are inevitably and inextricably intertwined. Here this term refers to technologies that work in interconnection with the body, i.e. hardware devices - such as Smartphones, Wearables and sensors - and software - such as apps.

incorporate the use of wearables and other apps for well-being purposes into their daily practices. Below is the interview outline for the use of menstrual apps in its entirety.

The choice of application

1.1 How did you discover these applications for the cycle? Which one do you use and for how long?
1.2. Have you always used the same one or have you tried different ones over time?
1.3. Do you know all the functions? Which one do you use most frequently?
1.4. Do you use it daily (try to understand if it is also used during the ovulation period) or only in view of menstruation?

The relationship between body and menstrual period

2.1. Regarding the production of statistics, graphs, chronologies of past cycles, as well as the possibility of predicting future cycles, has your way of relating to your cycle changed?
2.2. How has it changed?
2.3. And more generally, has your relationship with your body changed? Do you use other apps to monitor daily functions or activities such as fitness or diet?

Data sharing

3.1. Has the app ever been a topic of discussion with other users?
3.2. Often there is a forum or community in some apps, is there one in yours? Have you ever used it?
3.3. Have you ever let other friends/relatives/acquaintances find out about it?
3.4. Has it ever been a way to talk about these topics with your partner/boyfriend/husband (if she has one)?

The sharing of personal data with other users, parents, friends, partners

4.1. The app generates a lot of data through the information you collect. What do you think about the processing of your data and more generally about privacy issues?

4.2. Have you ever given feedback to users on the principal market stores, or sent emails requesting updates or suggestions?

While the structure of the interviews, that focusses on the use of wearable technologies and apps to manage everyday activities and wellbeing, is as follows:

The choice of wearables

1.1. When did you buy your first smartphone? And the first wearable one?
1.2. When did you start using wearables to manage your everyday life?
1.3. Which apps do you use?
1.4. How did you choose them?

The relationship between body and wearable

2.1. How has your relationship with your body changed?
2.2. How do you use them? Tell me about your typical day in relation to the use of apps?
2.3. What kind of relationship is created between the use of these technologies and the knowledge of your body?

Sharing data

3.1. What do you share about socials?
3.2. Do you talk about the use of these apps with people close to you?
3.3. Do you share your data and results through forums or social network groups?

Privacy and developers

4.1. What do you think about privacy issues?
4.2. Have you ever wondered who is behind the design of these devices?
4.3. Have you ever uninstalled an app because you were not convinced by privacy issues?

The interviews were additionally enriched by using the sociotechnical objects in real time in order to join the story of use at the practice of use.

The analysis captures two forms of engagement between human and non-human actors through which interviewees intra-act with the matter within sociomaterial assemblages. The intra-actions describe embodied knowing through self-tracking practices along an imaginary continuum at whose opposite points we can find – on one point – functional engagement with the knowledge *inscribed* in the sociotechnical objects and – on the other – an affective engagement with the knowledge *suggested* by the sociotechnical objects. This continuum shows the overlapping intra-actions that perform embodied knowledge about how reproductivity works.

The next part of dissertation discusses the empirical findings collected by the two field sites: (1) the script's description of the Google and Apple's health platforms, and health-related apps for menstrual period; (2) interviews with women who use tracking wearable devices and apps for tracking the menstrual period.

PART TWO

EMPIRICAL FINDINGS

CHAPTER IV

Matter(s) of health platforms and health-related apps

4.1 Biosensing technologies: smartphones, wearables, and health-related apps

Smartphones, tablets, and wearables are mobile computing devices with many integrated sensors used to track (or *self-track*) information about users' daily activities and practices[14]. In engineering terms, these mobile devices may be referred as biosensing technologies because they are *sensible* to *bio*: they are technologies able to detect and perceive bodily information and movements. The sensors embedded in them can be distinguished in optical sensors – e.g. ambient light, image, and display sensors –, as well as in motion and location sensors – accelerometer, gyroscope, and pressure sensors. Sensors collect information from the user's body producing data that are sensitive to heat, light, and movement.

A sensor is a device which has the purpose to capture and measure changes in spaces, and in chemical and physical parameters of body-matter, sending the signals to an aggregator, namely a computer processor. The

[14] Here, the terms 'self-tracking technologies' and 'biosensing technologies' are used with the same meaning.

sensors transmit these signals via radio protocols such as Bluetooth or WiFi to the aggregators – e.g. smartphones, tablets, wearables – which use Application Programming Interfaces (API) in order to guarantee the interoperability between hardware with different software and features (McGraith and Scanaill 2013).

As specified in the methodological chapter, I questioned the technical aspects of self-tracking technologies by asking experts engaged in the development of digital technologies for medical purposes to talk about their research topics. The researchers suggest distinguishing three areas in the development of biosensing technologies: the development of new materials and sensors, the systems of telecommunication via wireless, and data processing. The following two quotes highlight how research on biosensing technologies should be interdisciplinary in order to enact a system that interacts with the human body immersed in the lived space:

> … until a few years ago, I was teaching a course for the master's degree in management engineering. I also had a course in telecommunications engineering that talked about pervasive technologies, pervasive systems, and among these, obviously, wearable technologies because they are, together with all the tracking systems, the pervasive technologies par excellence, right? Because they allow us to interact with the environment and also with the human body, and therefore with ourselves, in a transparent and automatic way. Obviously, in this field, there are different types of research strands, based more than anything else on what have been, let's say, the enabling pillars of these technologies. On the one hand, there is the more exquisitely technological research, precisely in terms of devices, so let's say electronics, electromechanics, also based on nanotechnologies, which obviously concerns above all the development of new materials and sensors. Let's say that this part is

> not really the one I deal with in my research activities, because it is more technological, but it is certainly the most important one. In my opinion, it is the one where there is the greatest scope for development. There have been so far and there will be more and more in the future, especially in the field of nanotechnologies, micro- and nanoelectromechanical systems, and so on and so forth. These are the systems that make it possible to interact on a physical level in an increasingly complete manner, taking more and more parameters, etc. etc. (Professor in Electrotechnics and Computer Engineering).

The area of research of new materials focuses on the development of communication systems that need to be even more nano-, micro-, and smart than existing ones in order to interact with the body and collect more reliable and accountable parameters, respecting privacy-secure communication protocols. Also in this case it is useful to quote an excerpt from the interview with the expert in electrotechnics and computer engineering:

> … the other two enabling pillars from a technological point of view are wireless communication systems, i.e. without wires, because obviously it would not be possible with wires; they try it with underwater robots because communication is more complicated there. They try to connect them with fibre optics, and then sometimes they get tangled up and end badly. Then this is the part of telecommunications, and here there is a whole research project on new communication protocols. They can be at body level, i.e. body networks, or at a more extensive level, but in any case you have the possibility of making sensors communicate through appropriate protocols with two main constraints: low consumption and above all - which is the most important issue now and in the future - privacy and security. Currently, the most widely used protocol is the Bluetooth in its most current evolutions; there are others

> that can be used, but they are always variants of the Bluetooth... in any case, there is research from the point of view of telecommunications on what can be increasingly secure protocols from the point of view of data preservation, and it is becoming less and less power consuming, and more and more power demanding (Professor in Electrotechnics and Computer Engineering).

The information collected in the form of signals must be transmitted to other devices with protocols that model systems of telecommunication without wire. Research in this area is geared towards developing protocols that transmit signals while limiting energy consumption and protecting personal data. Nowadays, the most secure protocol is Bluetooth technology and its variants.

Then, all signals must be processed, stored, and visualized through appropriate algorithms supported by hardware – such as a smartphone, smartwatch, web site, or tablet – with different layout constraints. Moreover, part of the research in biosensing aims to apply machine learning to the process of data elaboration in order to extract new knowledge from data. In this case, sensors learn from the habits of users to predict anomalies, for example, notifying a change in the path of heartbeats. Machine learning research also aims to develop the elaboration of data through the anonymization of personal information. Research in this area tries to transmit the data from the sensors to the external devices already encrypted. In this regard, it is useful to quote an excerpt of an interview with a professor in Nanotechnologies, Electronic and Microelectromechanical Components, who explains what a sensor can do in practice:

> … the sensor is "the little man" who operationally collects the data. If we want this "little man" to be intelligent, it has to collect data in a

good way and therefore it has to clean them from what we call artefacts. So the sensor is good and reliable if it actually collects sensitive data and not random data due to the fact that the patient is moving or doing things etc., he thinks he has discovered who knows what and instead it is an artefact. Then one: sensor, comma, intelligent sensor, i.e., able to remove any source of noise from the signals it is collecting. Once the sensor is sure of having removed all the noise, and therefore of actually having the data of interest, the sensitive data relative to what it is studying, here we come to the second phase, that is data are fed to an algorithm. This algorithm, if it is complex, runs on a computer; if it is not heavy, it can run on a microcontroller that is integrated in the wearable itself. In other words, there is a microcontroller that is integrated in the wearable itself. In order to be wearable, it must generally be a tiny thing, just a few square centimetres in size and weighing a few grams. In there, thanks to miniaturised electronics, that is, thanks to the progress of electronic microtechnologies, there is a kind of minicomputer inside, that is called microprocessors, which is the same as those in our computer or our mobile phone. If the algorithm is too heavy, the integrated microprocessor may not be enough, so we feed it, i.e. we transmit the data wirelessly, with a Wi-Fi, with a wireless communication system or Bluetooth, or any other ad hoc communication protocol. We could use the home Wi-Fi, for example, but we could also use another protocol, okay? I transmit them [data] to the computer or another processor, which does all its processing and then provides you with a visual representation, a layout, with various graphics, avatars etc. This is an important phase. The visualisation phase, because if you just send the doctor [the patient or the caregiver] curves with the transform of something as a function of something else, or an amplitude as a function of time, the doctor might not appreciate it, okay? Because maybe he didn't take a course in processing, he didn't

> take a course in signal processing, so you have to visualise it for him. That's the least fun part for me, obviously, I mean, for me the important part is to get to the information. For me the information is electronic in nature, it's a signal, okay? I've had apnoea [s/he is working on wearables for Parkinson's patients that also detect sleep apnoea] when the signal is above a certain threshold, if it's in amplitude or within a certain band if it's in frequency. To the doctor this does not say anything, but for me this is the information, so to get from me, which is an electronic device, to him, you need someone, something, that is the *graphic interface* that transforms the electronic information into information for the doctor and therefore into an avatar. And so, the avatar is an interface for the patient himself and for the physiotherapist, okay? But it can be, I don't know, a pie chart of those pie charts where, for example, it is written that in the day of Tuesday, June 23, the patient had 15 events of block of the walk, then 3 events of slowing, two events of lateralization of the walk, here. The doctor reads these data and says "eh boy, last week were half and then I have to intervene at the level of therapy and then he gets these data. (Professor in Nanotechnologies, Electronic and Microelectromechanical Components)

From this extract it is possible to draw attention to the essential components of the design process of biosensing technologies, namely body-wearable systems. These are three:

1. **Sensors** based on the body parameter that needs to be tracked.
2. **Communication protocols** by which the signals captured by sensors are wirelessly transferred to a microprocessor embedded in a computer device.
3. **Data processing**: in this phase the algorithm processes the signals collected by sensors, transforming them into a *graphical interface*, that can be

an avatar, or a graphic, or simply stats. This graphical interface allows us to visualize the electronic information, so the signal.

These phases can be translated into research areas that interact with each other to develop systems of technologies with features that should work around the body. The main feature is the reduction in size and weight of the sensors to create a network of body-technologies that aim to capture and process chemical, biological, and physiological parameters. The sensors become protagonist of the day-to-day life of the users which track their lifestyle with apps, that is graphical interfaces of data processed by algorithms and collected by sensors embedded in smartphones and in wearable devices such as wristbands, glasses, microchips, and smart clothes.

Designing wearable technologies and new apps needs the interaction between different knowledge(s) and disciplines in order to construct the initial question and necessity of new biomedical knowledge both for users and for experts. Indeed, the principal aspects is the engagement of the users that must use these technologies. Users must engage in self-tracking practices mediated by digital and sensing technologies that must be purchased, incorporated into the body's aesthetics, in addition to the fact that these require maintenance due to continuous software updates, battery recharging, and, of course, Internet access.

Boundaries of the body go beyond the skin, becoming the focus of actors in the world of politics, industry and science. It becomes a sociomaterial objects that need to be quantified (Espeland and Stevens 2008) by patients and clinicians, as well as entrepreneurs, engineers, designers, social scientists, stakeholders, and policymakers, which are engaged in the building of a personalized medicine model, where the aim is to individualize practices of care (Haggerty and Ericson 2000; Lupton 2016a). In this sense, biosensing

technologies mediate intra-actions between medical practices and self-tracking practices, scientific knowledge and lay knowledge, political and economic forces.

The communication between bodies, sensors, and aggregators is not the only condition to be fulfilled. Access to Internet is also needed to connect devices to a server that is capable of transferring data from one piece of hardware or software to another at different points in space and around the world. To do this, software installed on specific hardware – i.e. an aggregator such as a smartphone – must be Internet-enabled and interoperable to transmit data across multiple devices running different operating systems. This is possible through Application Programming Interfaces (APIs) that enable interoperability between hardware and software located in different places in the world, as detailed below.

4.2 Interoperability in the digital ecosystem of Health Platforms: Google and Apple

Interviews with experts have also been useful to deepening the technical characteristics of API technology. We are connected to each other through different devices – smartphones, PCs, tablets, wearables etc. – that link data around the world. But how are the data transferred from one point to another? How can we book a flight, or make a reservation with a device? The answer is: through Application Programming Interface (API). According to Webopedia[15], an API is «a set of routines, protocols, and tools for building

[15] Webopedia is the online tech dictionary for students, educators and IT professionals. For more detailed: https://www.webopedia.com/#

software applications. Basically, an API specifies how software components should interact. Additionally, APIs are used when programming graphical user interface (GUI) components. A good API makes it easier to develop a program by providing all the building blocks. A programmer then puts the blocks together»[16]. API is a messenger that connects software of different devices. It takes a request and tells the system what to do and then it returns a response back to you. To give an example, the API is like the waiter at a restaurant: when you order food and drinks, ask questions about the menu, and pay the bill, you do not worry about stoves, ovens, dishes, managing stocks and much more. The waiter is the interface, that connects your request with the complexity of the restaurant's infrastructure. API works like the waiter; it is the mediator that allows different programs to work together, programming when and how software components should interact.

API is used in different ways and for different reasons (Helmond 2015; Langlois *et al.* 2009; Zittrain 2008). For starter, API can be used to get access to data from third parties. For example, weather apps on smartphones use the API to get access to data from third parties that have temperature sensors and other measuring devices around the world. Moreover, the API can be used to hide the complexity behind some requests and tasks. App developers do not have to worry about how to get their apps to communicate with your smartphone's operating system, for example, and then with the sensors embedded in it or with Wi-Fi, GPS or Bluetooth technology. App developers do not have to worry about what device their app will run on: what hardware it has, what screen resolution or anything like that. Instead, the operating system's owners release blocks of API that works as an

[16] Cfr: https://www.webopedia.com/definitions/api/

intermediator between application software [17] and mobile Operating System (OS)[18]; so if an app wants to show a button on the screen, simply it asks the system via the API to render one. API allows controlled access to data and information on which new applications or platforms can be developed.

Additionally, APIs can be used as gatekeepers for privacy, like the access to the location of a device. For example, the operating system of a smartphone has a handful of APIs that can be used to get location, so iOS or Android can easily notify when an app is using GPS, or requires access to some data, like your name, email address, photos and likes. This happens when an app or a website uses Google or Facebook accounts to complete a login. In this way, the app or website requests from the API to access to some personal data; then the system informs the user that an app is trying to access the user's location, email, personal contacts, likes, posts and much more.

APIs define interactions and allow the interoperability between two applications. They are a set of instruments that specify how developers can use data from other digital platforms or enterprises. APIs become the instrument by which platforms regulate the access to their servers and data, as well as the tools whereby they catch the innovation – without disclosing their codes, and algorithms – that comes from third parties or developers. In this way, they can develop new applications, software, or extend new

[17] According to Webopedia: «An application is any program, or group of programs, that is designed for the end user. Applications software (also called end-user programs) include such things as database programs, word processors, Web browsers and spreadsheets» (https://www.webopedia.com/definitions/application/).

[18] According to Webopedia: «A mobile operating system, also called a mobile OS, is an operating system that is specifically designed to run on mobile devices such as mobile phones, smartphones, PDAs, tablet computers and other handheld devices. The mobile operating system is the software platform on top of which other programs, called application programs, can run on mobile devices» (https://www.webopedia.com/definitions/mobile-operating-system/).

functionalities without knowing how the platforms or hardware of the systems work.

The term *platform* is now often used in day-to-day life with different nuances and meanings that share a tendency to indicate the structure that interconnects otherwise independent parts and elements to each other (Van Dijck *et al.* 2018). That is why we find it in different fields: from information technology (basic software on which run applications or programme), and construction engineering (e.g. forklifts, or oil retrieval facilities etc.), to political organization (proposals and requests that start a negotiation).

Between the Big Five, Apple and Google are the two multinational technology company that together control the markets of app stores – Play Store and Apple Store – establishing some rules for the developers who want to release their applications for their operating system: iOS and Android. They control access to their market establishing some rules:

- Specifying the criteria that an app must have to respect the licensing conditions
- Controlling if the app does not discriminate values and beliefs
- Regulating the appearance of the interface of the app through the support of software development kits
- Specifying the terms of services for using users personal information

In addition, Apple and Google determine the success of the apps through the algorithms that co-determine the order of appearance, capturing – at the same time – new ideas to embed into their own products (Dolata and Schrape 2014).

One of the interesting aspects in the ecosystem of platforms is the health sector, that has become even more patient-centred with the mediation of the sensors embedded in the spaces, in smartphones, and in wearables. Sensors

are low cost and are already embedded into smartphones for different scopes – e.g. for the screen rotation, or GPS etc. Health platforms with their secret algorithms exploit the already embedded sensors to track the body in its constant movement. Algorithms remove the noise transforming the signals captured by sensors in sensible information for the users. They construct the data and the interface that have to be simple to read for the users. Obviously, algorithms are secret, but the health platforms can be indagated analysing the content of the web sites, the functions and the parameters that users can self-track, and what kind of data is produced, such as the research collaboration with second and third parties.

Analysing the platforms allows to describe, on one hand, the concept of wellness promoted through the data built as neutral and genderless. From the other point, it allows us to reflect on the conflict between the public and private sectors with regard to the establishment of an even more personalised and individualised medicine, as well as on issues relating to the privacy of personal data that could be used by second and third parties to categorize the population in discrete groups in order to predict and shape the choices and behaviours of individuals.

The following paragraphs describe how the developers of the two operating systems are shaping their sectoral platforms about health with the aim to create data to sell to third parties, and to collaborate with governments, universities, and biomedical research centres.

4.3 Health apple: A more personal health app. For a more informed you

Apple launched "Health" in 2014 during the Worldwide Developers Conference, that is the conference that Apple holds every year in California. During the conference Apple disclosed the launch of the HealthKit: «the development framework used to access data stored in the Health app»[19]. HealthKit provides a repository of data that can be used, with the user's permission, to make several apps collaborate. Users can decide which app to use for tracking sleep, heartbeat, or period. HealthKit works as a repository for all developers, healthcare, societies that want to develop a software to access the data produced from iOS sensors, devices and software. It is a library, that is a Software Development Kit (SDK), a collection of reusable software development tools which contain the instruments to create an application software able to interact - in this case - with the operating system of iOS. In short, SDK is: «a programming package that enables a programmer to develop applications for a specific platform. Typically an SDK includes one or more APIs, programming tools, and documentation»[20].

HealthKit is the SDK required to develop a platform-specific app. It is a programming library aimed to standardize and merge the data from multiple apps and sources in the Health App, that is customizable. For example, users can include data, delete data, calibrate it to their personal needs, and changing app's permissions. The Kit, therefore, includes tools and resources providing the basis for the common language that allows for the

[19] https://developer.apple.com/documentation/healthkit
[20] See: https://www.webopedia.com/definitions/sdk/

communication between the Health app and the different software applications, devices, and sensors.

The user has a single app to archive the data from the other health-related apps and hardware able to connect via wireless or Bluetooth to its iPhone. The iPhone draws the body area network that can be directly linked to healthcare systems to monitor chronic disease or simply to create a direct relationship with the clinicians, that can observe the patient during the daily activity reducing the hospitalization time. From the other point, Health app can be used to monitor ones' Self in the day-to-day life, with the aim to achieve self-awareness and self-improvement because: «An app a day keeps the doctor away»[21].

Apple captures the innovation from below realising open-source tools like ResearchKit[22]. ResearchKit is the set of instruments that developers and clinicians can use to create apps for the medical research. In this case the apps are developed with medical purposes in order to create reliable data directly from patients. If HealthKit is used to create self-tracking apps for the daily wellness, whereas ResearchKit allows to develop a sectoral platform for research and for the clinicians that use Apple devices.

Medical research comes out from labs and includes the active participation of patients engaged in their day-to-day activities. ResearchKit becomes the platform by which actors can communicate and doctors can receive a huge amount of data from users' daily experience. It is the case of collaboration between clinicians and Apple to study Parkinson's disease, a chronical disease with symptoms that change from patient to patient. The use of an app, that tracks the body's parameters in terms of chemical, biological and physical elements, gives the possibility to create a personalised

[21] https://www.apple.com/ios/health/
[22] https://www.apple.com/researchkit/

treatment. At the same time, it is possible to create a huge database with data collected directly from the patients reducing the cost of the research, the time of hospitalization both for patients and for doctors, which can in turn construct a more direct relationship.

The scope is to cut the gap between research and personal experience. It is not just medical research, or development of applications. Users are the very active actors in this health-sectoral platform in which several actors from different worlds are in play. The iPhone becomes a travelling lab.

Some medical research exploits the possibility of creating apps with specific features in order to process some body signals captured by sensors already embedded in ones' iPhone. For example, mPower app is developed to track Parkinson disease: the gyroscope and the accelerometer allow to measure manual dexterity, balance, memory, generating valuable data not only for the patients but also for researchers who have thus been able to better understand the factors that can alleviate or worsen symptoms such as sleep, physical activity and mood. The Autism and Beyond app was also developed by Duke University to diagnose autism at an early age. The application uses the front-facing camera and innovative face recognition algorithms to analyse the emotional reaction of children aged 18 months and older to a series of videos. It therefore allows accurate screening without the need to take the child to a specialist, promoting early diagnosis and timely treatment. Another app – named EpiWatch – tries to predict epileptic seizures through the Apple Watch. Researchers hope that the Apple Watch can help to predict epileptic attacks. Since its launch, EpiWatch has enabled patients to accurately record the onset and duration of each attack, establishing a correlation between epileptic episodes and medications taken. When they feel a crisis coming, patients can just tap on the display and a

personalized setting activates the accelerometer and the heart sensor of the watch and sends a warning to a family member or a trusted person.

The above examples of apps have been briefly exposed to underline how ResearchKit is becoming a real *software laboratory* open to interconnections between users and doctors thanks to the mediation of the iPhone and/or Apple Watch. ResearchKit is open source providing to foundations and clinical institutes among the most important in the world with the possibility of doing research using the iPhone and Apple devices. Among these foundations we have:

- *American Heart Association*: a non-profit organization based in the United States. It was founded in 1924. Originally based in New York City, it now has its headquarters in Dallas, Texas. Its mission is to educate people about a healthy lifestyle to avoid heart attacks, and to allow people with heart attacks to maintain a healthy life after overcoming the danger. Their research is based on the prevention of heart attacks. And in 2014, they started doing research to provide a first guideline to prevent heart attacks in women. In fact, women suffer fewer heart attacks, but paradoxically they die more often than men because the symptoms of heart attacks in women are different from those in men, so prevention for women is often done in the wrong way. As the association itself states in some reports and articles, women are not fairly and adequately represented in research trials. Some improvements have been made from the point of view of gender medicine, but still women continue to be neglected in the south on cardiovascular diseases. Women's hearts are not the same as men's, and their signs and symptoms of heart disease can look very different. This association will collaborate with Apple to

develop and make apps more and more handy for patients who are able to keep their lifestyle under control and easily communicate with specialists.

- *Boston Children's Hospital*: a paediatric hospital based in Boston. This hospital aims to cure and keep children healthy, it conducts various research on genome mapping. Their specialty is to do research on rare diseases, such as neuroblastoma, hemophilia, gliomatosis. All rare diseases that affect children. The research goes towards the study of stem cells, and the mapping of genomes, to identify possible therapies for the management and treatment of these pathologies. To do this they also invest in digital health, developing apps that allow parents to keep their children's health under control and easily communicate with specialists.

- *Danna Farber*: is a cancer treatment institute, founded in 1947, located in Boston and has the mission of providing for adults and children with cancer the best treatment available today, developing tomorrow's treatments through cutting-edge research (cutting-edge research). It was born with the aim of creating an approach to cancer that seeks to prevent its onset, thus discovering a lifestyle aimed at preventing the need of treatments and cures in the future. The intent is to educate patients on a healthy lifestyle, for this they collaborate with Apple, and have developed an app through which patients and doctors are in direct contact with each other and patients can always be updated in reference to the events organized by the center.

- *Duke University School of Medicine* was founded in 1930. It was created with the intention of creating an inclusive community, which includes learners, investigators, and clinicians, where traditional

barriers are overcome, and the values of interdisciplinarity and collaboration are embraced, the intent is to circulate ideas and accelerate the translation of scientific discoveries to improve men's health both locally and around the world. Also due to this the research on which the hospital focuses is biomedical, to seize the opportunity to ensure that basic, translational and clinical science converge to facilitate new discoveries and transform fundamental knowledge in order to improve the health and well-being of patients and the general population worldwide. Of course, the technology becomes a valid support for mapping the bio of patients and thus improving the search for data by creating huge datasets on which to carry out more in-depth research[23].

- *Emory Healthcare*: an integrated academic healthcare system that provides the best care for their patients, trying to base their research on the population that fills their hospitals. It is based in Georgia and its research is located on a territorial base.

- *Harvard Medical School*: which was founded in 1782. Their mission is to create a community of doctors as inclusive as possible, to improve the health and well-being conditions of citizens.

- *NYU Langone Health*: a medical school based in New Yourk City. It combines Education and Research. With their studies they seek to advance biomedical research into new and effective treatments.

- *Oregon Health and Science University* (OHSU) aims to improve health and quality of life through technological innovation, education and research. Even in this case, the main medical research in which the research body is engaged with the mapping of the

[23] https://medschool.duke.edu/about-us

genome, in addition to educating citizens to take care of their health and their daily well-being. It is located in Oregon and its objectives are to apply biomedical research to translate it into discoveries that can be applied to medical treatments and improve the lifestyle of patients already suffering from diseases, but also to prevent the onset of diseases.

- *SageBionetworks* is a non-profit biomedical research and technology development organization that was founded in Seattle in 2009. Their mission is to join the data-driven research to innovate human health. Big data has become an important component of biomedicine. Their team is based on an interdisciplinary team of scientists and engineers who work together to provide researchers with the ideal technological tools to deepen from a scientific point of view the data collected into everyday life with smartphones and different daily devices. They are for an open science and believe that it is useful to promote practices that manage to integrate analytical data towards a life science that increases medical knowledge, in order to improve the quality of life for all. Their projects in scientific coordination, challenges and benchmarking, and digital health span across their teams in research, technology, and governance. Being cross-disciplinary and open enables them to collaborate more effectively.

- *Stanford Health Care*: the hospital ensuring a continuous connection with patients digitally through the MyHealth app. With this app, the patients can be instantly informed about test results, they always have doctors' prescriptions at hand and keep track of their biomedical information. In short, having a medical record within

reach by a "tap". In addition, you can always make appointments and pay medical bills through the 24/7 app.

- *University of California San Francisco* (UCSF) is a hospital that seeks to combine research, teaching and patient care through digital technologies. The research they carry out mainly concerns cancer, neurodegenerative diseases, and stem cells.

- *Universitätsklinikum Freiburg*: The University Medical Center Freiburg is located in Freiburg, Germany. It is a teaching hospital. This medical center is one of the largest hospitals in Europe. The medical services of the University of Freiburg were founded in 1457. Their goal is to ensure the best treatments for patients by combining research with innovation. Their research tries to overcome the barriers between medicine and engineering to create an environment as collaborative as possible.

- *University of Cape Town:* was born as a Medical School, but today it includes 6 faculties: Commerce, Engineering and the Built Environment, Law, Health Sciences, Humanities and Science.

- University of Hong Kong is a public university founded in 1911. Its origins are rooted in the College of Hong Kong of the University of Chinese medicine founded in 1887. It is one of the most important universities in the world and one of the most prestigious in Asia. Here, medicine becomes an interdisciplinary science that communicates with other sciences and above all uses technological innovation to democratize medical knowledge and get out of the narrow hospital or academic areas.

- *The University of Nebraska* is a research university located in Lincoln in Nebraska. It was founded in 1869. The University of Nebraska

aims to create a stimulating and interdisciplinary environment for its students and has several faculties. This is joined by the University of Nebraska Medical Center (UNMC). The development of daily technologies is seen as a way to create bioinformatic databases that can help make the health system increasingly effective.

- *Oxford* is the largest university of learning, teaching and researching in the English-speaking world. Oxford is one of the most prestigious universities in the world both from a research stand point and a teaching one. Its focus is on the digitalization of health systems, collaborating with the NHS to succeed in creating an increasingly open and interdisciplinary health system.

- *The University of Rochester* is a private university based in New York. It was founded in 1850 and has a college of Arts, Sciences, and Engineering. Among their other faculties there is also that of medicine, and like other universities it tries to establish itself and to seek research that goes in the direction of a biomedicine, creating a database that is connected by patients / citizens.

- Yale School of Medicine (YSM) and School of Public Health (YSPH) have extraordinary strengths in basic science, translational, and clinical research and consistently rank in the top handful of medical schools receiving funding from the National Institutes of Health. It is based in New Haven Connecticut and was founded in 1813.

Having seen the partners working with Apple to develop an ecology of health and wellness apps, it is worth clarifying the difference between the notion of Health App and Health Platform. The first one is developed to be a repository for medical, fitness and health purposes, fuelled day-by-day by

the users. The second is Apple's Health platform, thus an architectural design that allows for the intermediation of services and users.

We can say that iPhone is about to become a clinical cartel constantly up-to-date in accordance with the model of personalized medicine: the doctors can administer drugs precisely thanks to a daily relationship with their patients, who are always informed and involved in the treatment process (Cartwright, 1995; Berg, Harterink, 2004). In this regard, Tim Cook – Apple CEO – says: «Apple's greatest contribution will be 'about Health'»[24]. Apple also wants to clarify that personal data is only used with the direct consent of users and/or patients, specifying that the closed Apple operating system typically ensures protection and privacy.

Apple is trying to make its Healthkit platform the standard for making health records accessible from a smartphone. The aim seems to be to create a platform in which medical records are interoperable in a healthcare model in which wellness is centred on the personalisation of care practices. It works to collect reliable medical health data from everyday life through sensors embedded in everyday devices – smartphones and wearables – built to become an extension of our bodies.

4.4 Google FIT: Coaching you to a healthier and more active life

Google Fit was launched by Google on October 28, 2014. It is a health-related platform for tracking fitness and wellbeing, and it works on an Android OS, but also on Wear OS and Apple iOS, while Health only runs on Apple devices. Google Fit exploits the sensors embedded in Smartphone

[24] https://www.cnbc.com/2019/01/08/tim-cook-teases-new-apple-services-tied-to-health-care.html

and wearables that track physical activities such as walking, cycling and so on. It was launched during the Google I/O conference, where I/O plays with the worlds input/output or "Innovation in the Open", held in Californian.

Google Fit was born after Health by Apple, and the basic logic is the same. Fit is an app that can become a repository – such as Health – of fitness and wellness data captured by other apps that have implemented the API released by Google.

Fit presents itself[25] as a coach who teaches how to lead a more active and healthier life following the advice of the American Health Association and World Health Organization (WHO).

The Fit app transforms practices to achieve a more active and healthier life into a game. The gamification of lifestyle is oriented to develop a less sedentary lifestyle, encouraging walk on foot, or taking the stairs. Every time the user decides to do an activity that requires physical movement the user earns a *heart*-point in the *game* of self-improvement. If the user works out, or jogs, he earns two *heart*-points. Fit encourages to monitor all movements to achieve a daily well-being that is easier to track through a smartphone always with us, and wearables, especially wristband types.

Google promotes the WHO's guidelines about fitness and wellness to reduce risk of heart attacks and cardiac attacks, improve sleep quality and mental and physical wellbeing. Fit is a more democratic app than Health because it runs on both Android and iOS devices.

Again, we must clarify the difference between the Google Fit app and the Google Fit platform. The Google Fit app wants to be a personal coach that helps achieve fitness goals based on user's health and activity history from the smartphone or smartwatch (see section 4.5). Google Fit platforms is the

[25] https://www.google.com/fit/

repository of data from apps which works through Google Fit API. Google has even developed a Software Development Kit that provides developers and third parties the technical instructions to design fitness and health apps. The SDK is composed of APIs to make data sources interoperable from different connected apps and devices. In this way Google builds an ecosystem of partners from industrial and political world to always bring -up-to-date apps[26].

APIs allow fitness and wellness app to access the data from the Google Fit platform without requiring users to install the Fit app. In this way, the Google Fit platform is powered by the information and data collected by other apps, which are included in the Google Play market. The process is twofold. Google Fit fuels its platform with biodata, but at the same time app developers get access to data collected from sensors available on Android and companion devices.

This allows the users to have a repository of their fitness and health data, checking their improvement on the website, tablets, smartphones or smartwatches. The fitness platform supports over 75 different third-party health-related apps. It includes fitness, meditation, nutrition and sleeping apps.

Google Health has partners in the world of public health and academic organizations. The aim of Google Health is creating innovative solutions for individuals, caregivers and health professionals to improve the lives of people[27]. The partners are:

- *Aravind. Eye Care System*. It is a hospital in India. The collaboration aims to develop and use machine learning for retinal imaging to diagnostic diabetic retinopathy.

[26] https://developers.google.com/fit
[27] https://health.google/partners/

- *Ascension*. It is a leading U.S. health system. This cooperation has the scope to transform the clinician experience for the patient, with a focus on the personalization of patient-doctor relationship.
- *Rajavithi Hospital*. It is affiliated with the Ministry of Public Health Thailand. Even in this case, the collaboration focuses on the use of machine learning for the diagnosis of diabetic retinopathy.
- *Sankara Nethralaya*. It is a non-for-profit charitable eye hospital Chennai India. The partnership focuses on machine learning to improve retinal imaging, as in the previous cases.
- Stanford Medicine. The partnership is aimed to use Google's data science, machine learning and artificial intelligence capabilities to create a model of personalized medicine.

Google Fit is the main competitor of Apple's HealthKit platform. However, there are some differences between the two platforms. Apple is trying to push their HealthKit platform into a medical health model in order to become a clinical cartel. It works to collect reliable medical health data from day-to-day life creating a direct relationship between clinicians and patients. While Google is pushing to increase the popularity of monitoring apps with the aim of creating a platform that can aggregate data collected from all the devices and apps that exploit its software and hardware (van Dijck et a. 2018). Google Fit uses knowledge from several public and private partners and health institutions, raising several privacy issues (Kitchin and Dodge 2007). The data feeds both digital health platforms and the digital surveillance of practices, online habits, user purchase choices in a society in which the platformization process makes the boundaries between surveillance and individual empowerment increasingly hybrid.

4.5 Health Apple and Google Fit: a comparison

As we saw in the previous chapter, Google and Apple play a fundamental role in the process of health digitalization. They own technological infrastructure able to capture innovation with the releasing of programming instructions for developers who want to create an app able to work on Android or iOS operating systems and devices. In this way, they capture the innovation that comes directly from below. It is up to the user to decide which activities to track or whether to use the apps of the platforms already pre-installed on their smartphones or wearable devices, with the possibility of using other apps more in line with their monitoring needs and, if necessary, synchronising them to the platforms of the two giants.

For these reasons, I analyse the two apps with the aim of understanding how app's design configure particular forms of knowledge and experience, while rendering others invisible and illegible.

Apple Health was the first app launched with the scope to track all health and fitness user's experiences in one digital place outside of hospitals. Apple Health was developed to be a space where data – steps, cycling, swimming, runs, quality of sleep, or health data like glucose levels, heartrates, blood pressure etc. – are collected from a range of hardware, particularly from iPhones, Apple Watch, but also third-party devices and apps.

The first step is to give Health app some information like gender, date of birth, weight, and height. After that, the app can be set up and synched with thousands third-party apps[28]. It is important to stress that gender is not used to personalize the practices of health tracking.

[28] https://www.apple.com/ios/health/

Apple Health gives the possibility to create an archive of data from various apps that are designed to promote health. It is able to process all data to see various bodily details and parameters like VO2 Max (the maximum oxygen absorption measured during incremental exercise), calories burned, resting heart rate, walking heart rate and heart rate variability (that can help to indicate signs of heart health anomalies with no gender considerations), the different stages of sleep, sexual and reproductive aspects.

There are four main sections of Health Apple: Today, Health Data, Sources, Medical ID.

Today is the Home screen. It is developed for displaying three indicators that can be personalized:

- "Move" measures the calories burned
- "Exercise" measures the physical activity
- "Stand" measures the time spent standing

The three indicators are transformed into an intuitive cycle. When the user closes the cycle, it means that user has achieved the goals set. The user can manage the activities and fitness goals following the game suggested by the app (Fig. no. 1).

Figure no. 1

A new feature is the tracking of environmental sound levels. It keeps track of the user's exposure to noise pollution considered increasingly important for the quality of life. Using Health Apple is an ongoing engagement just like the effort to stay healthy. Health Apple helps in this process using machine learning. The algorithms automatically create highlights to bring the information into the form of averages and trends. In this way, it is possible to set a self-improvement based on a daily quantification of the health status or the amount of physical activity that changes over time, or in a particular month (see figure no. 2-3-4). The main default screen is completed with the feature about the minute dedicated to mindfulness.

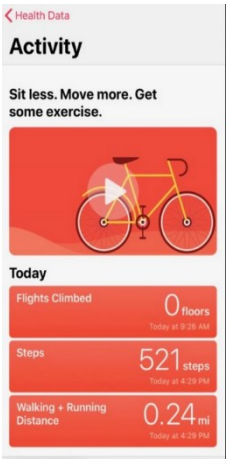

Figure no. 2

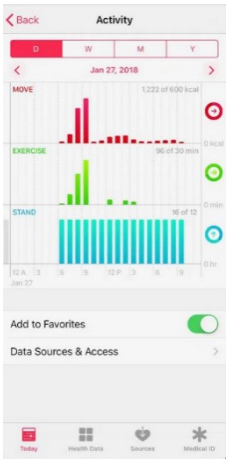

Figure no. 3

Figure no. 4

Health Data shows the summery of all recorded health information and activities (Fig. no. 5-6-7). *Sources* tab is the button where the user can find medical articles, and scientific literature.

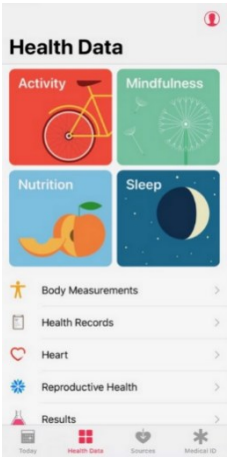

Figure no. 5

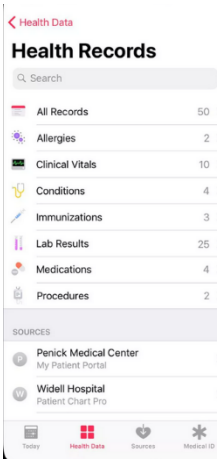

Figure no. 6

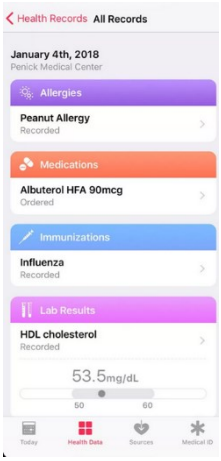

Figure no. 7

The section of *Medical ID* can be used to create a digital Medical Record (Fig. no. 8). Apple Health is not just a hub for all tracked data, but it tries to become compatible with technological healthcare infrastructures with the purpose to create a digital medical platform (van Dijck *et al.* 2018). The user must just create a 'Medical ID' that collects vital information such as allergies, medications, blood type, organ donor, emergency contacts. This information is not shared with other apps, but it is stored only in Health with accurate security and privacy protocols. In this way, Health can be used to store medical records and files. Apple calls this feature 'Health Records', since if a hospital has a partnership with Health, the user can see her/his health records – vaccinations, lab results, medications and much more – directly in her/his iPhone.

Figure no. 8

The monitoring of menstrual cycle was only introduced in September 2019. Health Apple helps to predict menstruation and ovulation days by entering cycle dates regularly. It is also possible to enter data relating to sexual activity. The app creates very simple graphs to check the duration of the cycle and its variations. Moreover, Health Apple can incorporate data from other third-party apps for the menstrual and reproductive cycle, even if the application is not designed to process any interrelations between menstrual data and other wellness information stored in it.

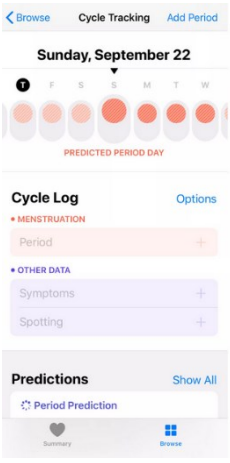

Figure no. 9

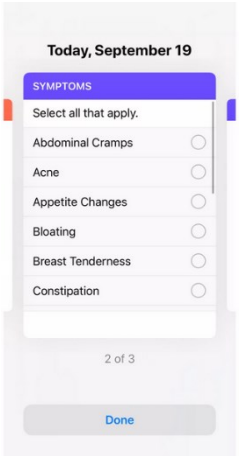

Figure no. 10

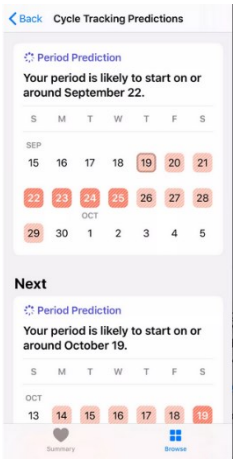

Figure no. 11

Moving to Google Fit analysis the first thing to say is that this comes after Health Apple, as we see above. Google Fit has an intuitive design, and it was developed to help its users to keep track of their fitness and physical movements. While Health Apple has the aim to become an app that incorporates health data from users but also from medical institutions, Google Fit is developed to be a digital coach.

Setting up Google Fit is easy and only takes a few steps:

- Enter your height, weight and gender
- Set your activity goals
- Pair Google Fit with compatible Wear OS devices or third-party apps or fitness trackers

We can see three main sections of the Google Fit app: 'Home', 'Journal', and 'Profile'. The *Home* screen shows a summary of the current day. This includes 'Move Minutes' and 'Heart Points', 'Step taken', 'Calories burned', 'Distance covered' Google Fit adopts the same graphical trick of Apple to summarise the performance of daily objectives: i.e. rings that display and quantify how much has been done and how much more needs to be done to reach the set target (Fig. no. 12).

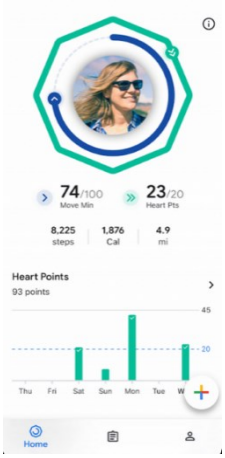

Figure no. 12

The *Journal* is the section where it is possible to find all recorded activities and to see real time statistics about wellbeing estimated though steps taken, move minutes, sleep quality and so on. Google Fit can automatically detect the exercises completed through the sensors embedded in the smartphone or in other wearable devices. On the contrary, the user can edit activities manually choosing from a list of more 120 fitness activities from cycling, swimming, running to yoga (Fig. no. 12-13).

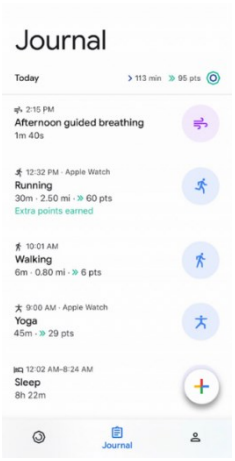

Figure no. 13

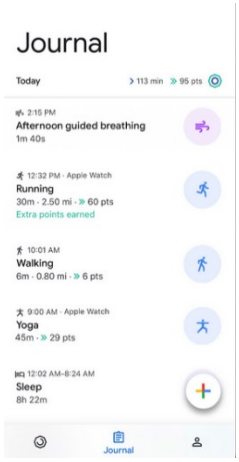

Figure no. 14

The *Profile* is the page where users can set goals and edit personal information to receive personalized recommendations and coaching for activity goals.

Google Fit gamifies fitness activity through the features 'Move Minutes' and 'Heart Points'. These features are based on the Heart Association's activity recommendations. 'Move Minutes' records the time during which users do physical activity like walks, runs, or yoga. 'Heart Points' are earned per minute of intense exercise at a higher pace. The focus on 'Move

Minutes' and 'Heart Points' is a way to transform physical activity in challenges with goals easier to understand.

Google Fit is a versatile app for tracking activities that help us stay healthy, but users often use specific apps based on their individual physical activity. Thus, Google Fit aggregates and processes data from compatible third-party apps and devices, creating a space where the user can find all the data collected by the apps used related to wellness. In this way, it provides a data-driven holistic view about health and well-being. It works through algorithms which produce move metrics and real time statistics, giving to the user credits and rewards for runs, rides or walks including sleep, weight, nutrition, speed, pace, elevation, route and more.

In conclusion, the analysis shows how the two health apps prescribe different forms of knowledge and experience. Health Apple aims to become a digital health record, a space where the lay knowledge encounters expert knowledge. It promotes the improvement of their healthy status through the knowledge about the body and self-monitoring practices that are legitimatized by medical partnerships and researchers. Google Fit gamifies health through points earned with moves and physical activities (Maturo and Setiffi 2016). Even if Google highlights its engagement in partnerships with medical centres of research, Fit is a regular fitness app that aggregates data from health-related apps to offer a place where the users can read their improvements with simple graphs and statistics.

The design of the apps prescribes different users. Health Apple addresses a user loyal to their expensive products, a user that trusts in the Apple experience which is synonym of privacy, security and end-user insight. Google addresses a generalist user that should use an user-friendly app with plural purposes, because it needs to adapt at the pluralist experiences

of the users. Google configures a prosumer using the necessity and feedback of users.

However, the two apps perpetuate a genderless healthy user. There are no customisable features based on the users' gender. The design of the apps promotes a knowledge of the body without gender health matters, demonstrated by the fact that the starting point of the app is an already healthy and heterenormed body. There are no references to bodies with disabilities or non-binary bodies or menstruating people. The possibility of monitoring the menstrual cycle was introduced taking it for granted that only women should do so. Indeed, the feature to track the menstrual cycle was only introduced at the end of 2019. For this reason, in the next paragraphs the analysis is about apps that have as focus women’s health with the aim to investigate how gender is prescribed in apps developed for menstruating people.

CHAPTER V

Apps as sociomaterial objects: problematizing the gender script

5.1 Women's Health and period self-tracking apps

As we have seen above, health-related platforms are based on genderless design. The 'neutrality' is still built on the male functioning of the body: giving the possibility to track menstruations would have undermined the supposed neutrality of the app's design, identical for the female and male sex, not considering gender differences as a tool to promote a reflexivity on female, male and no-binary bodies.

On the basis of this considerations, I question how women's biomedical knowledge is genderized through health-related apps referring to a controversial argument both in medical research and in public debate, that is PMS and PMDD (Clark 1990; Rittenhouse 1991; Rodin 1992).

Apps for the menstrual period can be used to manage the different aspects of the women's reproductive system from the use of contraceptives to the collection and transformation of physical, emotional and biological symptoms into data (Lupton 2016b; 2015). Data quantify different aspects regarding the menstrual cycle that can be visualized through stats, graphs and chronological report, processing personalized patterns based on bodily

information like cramps, skin, hair, sleep quality and more. The main information required from users is the registration of the start and end of their menstruation, so the algorithm can predict the future period windows. However, the user is encouraged to track emotional and physical information – such as mood swings, cramps, skin, hair, sleep quality, tiredness – to predict PMS, ovulation and fertile windows. In this sense the biomedical knowledge incorporated in the apps' scripts meets the lay knowledge which women experience in everyday life.

Against this background, the next paragraphs will discuss the grids in the appendix that try to make a comparison between the labels of symptoms and moods inscribed in the script of the apps with premenstrual symptoms, that need to be tracked and measured to get a diagnosis of PMDD.

De-scribing the contents, the languages and the functions of the apps for menstrual period allows to analyse how bioknowledge is quantified through digital categories that comes to be matter within the apparatuses of measurements – the apps – of everyday experiences and knowing-in-practices (Barad 2007; Gherardi 2019).

The apps analysed have been seeded into two groups: those that have tendency to standardize the body according to the medical classification "Physical Symptoms" and "Emotional Symptoms" - Clue, Flo and iGyno –; and those that tend to become gatherers of symptoms and moods - WomanLog, My Menstrual Calendar and Maya. Every app has a 'Plus' version that provides for the payment of a monthly subscription to have some add features, and especially to have advertisement in the app removed. Clue is different because it does not feature advertisements in the free version, yet the pro version has additional features which we will later see.

5.2 Women's Health between gender constraints and gender-neutral design

Clue, Flo and iGyno are presented in the market stores as revolutionary because they combine user-friendliness with the reliability of algorithms based on biomedical knowledge.

In this regard, Clue stands as a scientific tool for women who want to learn about their bodies. The app allows to track symptoms and moods, records the onset and flow of menstruations, in order to get predictions about the next menstrual periods by reporting ovulation and fertility windows (Fig. no. 1). Clue suggests the importance of tracking symptoms, like weakness, sore breast, and sensitiveness, to create an intelligent analysis of the menstrual calendar based on chronological and personal reporting. Self-tracking practices are encouraged because they make visible personal patterns in moods and symptoms based on the self-knowledge of the woman's body. It is the only app that talks about the cycle of transgender, and gender non-conforming persons, which need to learn to face hormonal changes[29]. Particularly, the scientific approach to the analysis of the symptoms tracked allows one to have an overview to understand how hormonal changes could influence the brightness of the skin and hair, daily energy level, sexual desires, and mood swings. It teaches users to understand "The science of your menstrual cycle"[30] using a medical language incorporated into graphs and statistics (Fig. no. 3).

Clue builds its reliability on a biomedical bibliography informing users why it is important to track "Physical" symptoms – such as "Energy Level";

[29] https://helloclue.com/articles/cycle-a-z/tips-for-using-clue-when-you're-trans
[30] https://helloclue.com/period-tracker-app

"Breast Sensibility", "Headache" -, and Behavioral and Psychological" symptoms – such as "Happy", "Sensitive", "Sad" and "PMS" (Figure no. 2). It is important to underline that PMS is presented as a black box label: the user cannot quantify the physical and emotional symptoms that construct the medical category PMS, explaining how the user should understand it. As Clue specify[31]:

> *PMS is a recurring pattern of emotional, physical and behavioral changes in the days before your period that impact your daily life. These include headaches, bloating, irritability, back pain, joint or muscle aches, and sleeping and digestive issues.*
>
> ***PMS is common, but still not fully understood***
>
> *About 8 in 10 people say they experience one or more premenstrual symptoms, and about 1 in 10 people experience symptoms significant enough to warrant a clinical diagnosis of PMS (1), though estimates vary.*
>
> *Despite being common, scientists still aren't sure exactly why PMS happens — or why some people have symptoms while others don't.*
>
> *People may experience different premenstrual symptoms from cycle to cycle, as the presence of symptoms may be affected by diet, exercise, and stress.*

Clue suggests a biomedical knowledge about PMS. Clue does not quantify the symptoms of PMS, on the contrary it tries to explain to women how to acknowledge the PMS in the individuality of their experience.

[31] See: https://helloclue.com/articles/cycle-a-z/how-to-track-pms-in-clue-app

Moreover, Clue has a paid version to build a sustainable company that it is supported directly by users and not by selling data. To do that, Clue decided to include extra features in a premium subscription. They include a review with a summary of the most recent cycle and the possibility to find scientific research and contents based on personal lifestyle and tracked categories.[32]

Figure no. 1

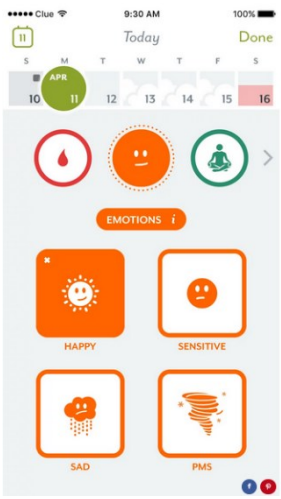

Figure no. 2

Figure no. 3

Flo is aiming to become an app that covers all aspects of female health. It is the most downloaded health app in the Market Store. Flo uses an Artificial Intelligence (AI) algorithm to get the most precise period and ovulation predictions to become both a period tracker and an ovulation calendar (Fig. no. 1-2). The AI-algorithms become more precise when users log symptoms, which reflect a medical terminology. Flo adds a wider range of symptoms to help women at all stages of their reproductive cycle - teenagers, young mothers, menopausal women, etc. - to follow their health. AI helps capture the interconnections between physical and emotional changes and the cycle,

[32] https://helloclue.com/articles/about-clue/introducing-clue-plus

encouraging women to develop a vision around their reproductive health. However, Flo tries to become a 360° tracker of women's health adding symptoms not due to medical categories. It is interesting to pay attention to the labels "Guilt", "Obsessive thoughts", "Apathetic", "Confused", "Very self-critical". These, in fact, are categorized as "Mood" symptoms suggesting that a woman should learn to recognize them as part of the menstrual cycle (Fig. no. 5).

Flo ensures that users receive evidence-based medical information through the collaboration with fifty medical experts from Europe and North America, and eight universities, medical associations and health organizations: European Board and College of Obstetrics and Gynaecology, United Population Fund, The Society of Endometriosis and Uterine Disorders, The University of Adelaide, Texas Christian University, North-western University, European Board and College of Obstetrics and Gynaecology. [33] It means that Flo sells user data to third parties in order to guarantee users a sustainable and free business. Moreover, it is possible to synch Flo to Google Fit and Health App to have a complete overview of lifestyle and health. It offers daily health insights with articles and surveys to improve the daily wellness. In this sense, Flo aims to become a reproductive physician in the pocket of the user (Fig. no. 7).

[33] https://flo.health/

Figure no. 4

Figure no. 5

Figure no. 6

Figure no. 7

iGyno is the most downloaded app in Italy. It was developed by Mirco Bettelini. He has a degree in economics and a great passion for computer science which led him to study programming languages to create websites and apps for mobile devices. He had the idea to create an app for health women after the death of his mother due to breast cancer. iGyno was born to sensitize women to the importance of prevention. It is aimed to become a virtual gynaecologist. The app has an instant messaging system developed in collaboration with some doctors of the Italian Gynaecologists Association, to put the user anonymously in contact with a team of about eight specialists. This option is limited for the users that decide to pay for the Plus version. There are innovative functions such as video tutorials, which teach you how to touch your breast for a self-examination with additional images to monitor any changes, sending them directly to a team of doctors or to a personal doctor (Fig. no. 10). These video tutorials display a female body, with no mention of non-binary or transgender people. iGyno allows to check your menstrual cycle and calculate the probability of pregnancy by managing a personal calendar with the ability to enter daily notes

of up to 23 physiological symptoms, and thus predict the arrival of your cycle, ovulation, and fertile days (Fig. no. 8-9). Even in this case, biomedical knowledge is the focus of the app. Interestingly, iGyno also boasts the victory of some awards, such as the *SMAU Mob App Awards*, which establish it as the best app in the gynaecological field.

iGyno focuses heavily on the digitization of the figure of the gynaecologist, devised like a women avatar, who becomes both a visual support for self-learning to recognize any anomalies related to one's body, and a real intermediary through direct chat with experts (Fig. no. 11). However, iGyno tries to make the monitoring of symptoms and moods less invasive by using terminology that is close to stereotypes and taboos: so, for example, the medical category 'mood swings' becomes 'crying fits' in the app.

Figure no. 8

Figure no. 9

Figure no. 10

Figure no. 11

The gender script of iGyno tries to configure a user that needs to quantify their symptoms using lay labels, for example 'Crying fits', but at the same it inscribes a biomedical knowledge in the form of preventive practices through the process of datafication (Van Dijck 2014). The advertisements and the partnerships with researchers and gynaecologists underline an app completely immersed in the platformization of health. It is a hybrid that synthesises the problematisation of gender and PMS that we found in Clue

and the quantification of everyday emotions and symptoms, while reproducing gender stereotypes and constraints that characterise the apps of the second group.

5.3 Women's Health for a user-friendly design

WomanLog, My Menstrual Calendar and Maya are presented into digital market stores as trackers of symptoms and moods. They are described as small digital spaces - among the many that populate market stores – by which it is easy to track the menstrual cycle to get period predictions and keep track of a wide and ambiguous list of physical and emotional symptoms. The labels of physical and emotional symptoms inscribe a lay knowledge in order to build a user-friendly graphic interface.

My menstrual calendar is presented as a diary aimed to track different aspects of "your life as a woman", from symptoms to moods, from weight to ovulation and fertility (Fig. no. 15). The focus is on the ease of the use with the possibility to customize the graphics choosing between different colours and avatars. It is possible to change the cat that greets the user choosing between a rabbit or a dog, as well as the colour of the app theme to blue or green (Fig no. 12). Moreover, it is also possible to customize the labels of the symptoms, creating a personal list to track. Designers are trying to enlist prosumers who are looking for a customisable app that offers an easy-to-use service, such as those women who just need to have a digital reminder of the arrival of their periods.

Figure no. 12

Figure no. 13

Figure no. 14

Figure no. 15

WomanLog seeks to become an ally to manage your cycle as an easily controllable appointment (Fig. no. 16-17-18-19). The focus is on enabling reminder notifications for the arrival of menstruation and fertile windows, or remembering to take the pill. There are more than 90 symptoms to track using an ambiguous terminology which often reproduce stereotypes regarding the menstrual cycle. The symptoms to track are numerous often with a no clear meaning, such as “Mental Fog”, “Fatigued”, “Bored”, “Anxiety”, “Calm”, “Confused”. The colour pink linked to labels, that are not clearly gender-neutral, suggests a gender script that aims to construct a stereotypical view of the menstrual cycle as a 'pink' affair.

Figure no. 16

Figure no. 17

Figure no. 18

Figure no. 19

In Maya, too, the focus is on ease of use (Fig. no. 21-22). Everything is centred on the graphic that allows one to read, thanks to intuitive colours, the different phases of the cycle, thus monitoring (in an entertaining way through emojis and animations) any symptoms and mood swings linked to the arrival of the cycle. Here, both emotional and physical symptoms are linked to avatars that try to turn the monitoring of premenstrual cycle syndrome into a game (Fig. no. 22-23). The gender script of the application seems to be aimed at a teenage girl about to discover her menstrual cycle.

Figure no. 20

Figure no. 21

Figure no. 22

Figure no. 23

The apps analysed question the heterogeneity of the digital market where competition is very strong. Designers need downloads to earn money from advertising, so they aim to design an app with attractive and customisable graphics. We have seen this process through the description of the script that builds the graphical interface. In this second group, we find gendered objects designed around the idea that menstruation is a female affair: pink is the predominant colour, and symptom labels are not based on biomedical knowledge, but often on taboos and stereotypes

typically associated with menstruation. On the contrary, symptoms are classified by ambiguous labels and, in some cases, are based on a stereotyped knowledge of the menstrual period seen as the cyclical phase in which women are aggressive and emotionally unstable.

5.4 Apps as genderized objects between ideal user and biomedical knowledge

We can see the apps design as an albeit provisional result of gender relations and biomedical knowledge(s), which configure several ideal users. While Clue, iGyno and Flo focus on biomedical knowledge and scientific algorithms that help women understand how their bodies work and gain an overview of their health; WomanLog, Maya and My menstrual calendar aim to be user-friendly applications designed as menstrual cycle calendars. In this way they are configured for different users:

- Clue is aimed at a woman who wants an app that is accurate with a design that is clean of gender stereotypes such as flowers or the colour pink. Clue configures a user who wants to use a gender-neutral app. One of its goals is to build a gender-free app for trans people - and the LGBTQ community in general - as they approach discovering their cycle. Clue helps them to see the data as a tool to understand the regularity of their menstrual periods, with the sole aim of enabling people with periods to recognise and talk about any hormonal or physical changes related to their cycle. The aim is thus to combat the stigma that prevents women from seeking health care for menstrual pain or cycle-related complications.

- Flo mainly targets women who are trying to get pregnant or who are already pregnant in pregnancy and post-pregnancy mode, while combining biomedical knowledge (such as references to scientific articles) with symptom labels related to a discriminating representation of premenstrual symptoms (such as "Guilt", "Obsessive thoughts", "Apathetic", "Confused"). Flo tries to present itself as an app that allows women to have a digital tool always in their pocket that can synchronise female reproductive health with other health and fitness apps installed on their smartphone. However, pink combined with stereotypical representations of menstrual symptoms make it an app that mixes medical references and stigma related to the menstrual cycle, creating a trustworthiness masked by stereotypes and taboos.
- iGyno is targeted towards women that prefer to develop self-care practices. iGyno tries to intercept women that have difficult in talking about private questions and aspects regarding health and particularly reproductive health. Again, the colour pink underlines the need to position oneself in a digital market where medical knowledge and data are used to justify prejudices and taboos historically built around the female body.
- WomanLog translates medical terminology into a layman's classification of symptoms that is easy to understand. The app's gender script is pink with a floral theme. The user is faced with a very long list of symptoms that can be monitored. It seems that the aim of the developers is to meet the needs of every woman, so that she can find the expression that best reflects her mood or physical pain.

- Maya's design plays with pastel rose. It is constructed on the idea of traditional stereotypes linked to the concept of "femininity". The focus is on the pleasantness of the graphical interface, which must be easy to use to attract a young user who wants an app to track her cycle on her smartphone. The emoticons and stylised icons of young women seem to construct a comfortable space for girls who are experiencing their own little psychophysical changes.
- My Menstrual Calendar prescribes a script for users who want to just have a memorandum of their upcoming menstruation. It is an app that aims to replace the analogic calendar, a repository for having an easy-to-use digital agenda with their cycle information. My Menstrual Calendar is customizable, with the options to personalize the shade of the graphical interface's colour choosing between pink, that is the default interface, or blue and green. It has been designed to respect the traditional link between femininity and pink, but with the option to change the colour to blue, that it is classically associated with men. It is quite clear that the design of My Menstrual Calendar is looking for downloads.

Apps for menstrual period are aimed at translating women's reproductive health – bodily functions, emotional, physical and behavioral changes – into digitized information. These data are often sold to third parties such as universities, research partners, health insurances and companies (Kitchin and Dodge 2011). Recent press investigations have exposed the use of aggregated data by companies[34]. Some companies incentivize workers to use

[34] Particularly the press is beginning to emphasise that app's developers could sell data to second and third parties. For an overview, it is interesting to cite the articles available on the subject:
https://www.washingtonpost.com/technology/2019/04/10/tracking-your-pregnancy-an-app-may-be-more-public-than-you-think/?noredirect=onandutm_term=.7833e7e2ec3f
https://www.internazionale.it/video/2019/07/23/app-mestruazioni-marketing

menstrual health apps to minimize healthcare spending and to plan work for the following months by predicting pregnancies.

That said, this analysis allows us to look at the script that shapes and at the same time collects the data that can be sold to third parties. The script performs the data, as it refers to a certain vision of gender, as well as to certain biomedical knowledge through which companies, which market apps, manage to collect data that are always constructed and situated within visions and ideas in which bodies assume meanings and materiality. Analysing the gender script of these apps allows to question the apps as genderized objects (Oudshoorn, Rommes and Stienstra 2004; Oudshoorn 2004). Apps configure ideal users using algorithms and quantifying PMS or, in general, menstrual experience. Biomedical knowledge is inscribed with the aim to build reliable data, or better suggesting that their algorithms are constructed on scientific knowledge with the aim to produce objective data (Kitchin 2014; Van Dijck *et al.* 2018). However, data are not objective but rather they are performed by the design of the apps. Each app collects different symptoms through diverse categories highlighting different levels of biomedicalization that tend, on the one hand, to translate everyday experiences of physical symptoms, biological functions and moods by placing them above the biomedical categories; and, on the other hand, they try to add symptoms to the list of symptoms with the aim to encourage users to track them.

In the domain of digital health, the gender script of menstrual-related apps suggests the need to assemble a personalized knowledge based on self-tracking practices and data (Andrejevic 2014; Crawford, Lingel and Karppi 2015). Menstrual-related apps make predictions about periods, PMSs and fertile windows. They take the women's subjective experience

and create a hybridization ground between lay and experiential knowledge and biomedical knowledge about PMS and the menstrual cycle. Menstrual apps can be used to manage different aspects of a women's reproductive system from the contraceptive use to collecting and transforming physical, emotional and biological symptoms into data (Lupton 2015; 2016b). Data quantify the different aspects regarding the menstrual cycle that can be visualized through statistics, graphs and analysis to learn personalized patterns based on chronological information such as cramps, skin, hair, sleep and more.

The apps take bio-knowledge into everyday life through the medical category, which are sometimes translated with the use of lay terms, reproducing in some cases stereotypes and myths about menstruations. It is interesting to note that only Clue inscribes a gender-free design, not using colour pink and thinking about LGBTQ+ people with the possibility to set up the app in cycle mode of different lengths and thus monitoring only mood swings perhaps related to hormone treatment.

However, the technology is often used in different ways that are subversive of the ideal project envisioned by the developers. Self-tracking practices are extremely time-consuming, particularly when the subject has to define his or her emotions and the moods which may depend on a multiplicity of factors and events. Symptoms have to be tracked manually by the user who has to self-report emotions, mood and physical symptoms based on his or her subjective experience. The number of downloads[35] does not see how apps are used or not used, this is why it is important to conduct qualitative interviews proposed in the next chapter.

[35] https://www.businessofapps.com/data/app-statistics/#3

CHAPTHER VI

ENGAGEMENT IN PRACTICE

6.1 Thinking about the body: women and self-tracking practices

As we saw in the previous chapter, apps are designed so that they can encounter certain types of users with various interests and purposes. We understand the health-related apps as designs of *assumptions* about user's purposes and requirements. However, people do not usually engage with the assumptions the designers had in mind, but they often engage in different practices with which they tinker with the sociomateriality of apps that, at the same time, *suggest* different ways of thinking about the body. The empirical analysis seeks to investigate two concerns: (1) how the body learns to 'be affected' through material entanglements between humans and sociomaterial objects, and (2) how self-tracking practices enact situated practices-in-knowledge within embodied knowledge processes.

The two issues reflect my engagement with medical and digital sociological literature and the analytical sensibilities of feminist critics, through which I questioned my concerns during fieldwork. Using the concept of 'intra-action' (Barad 2007), 'situated knowledge' (Haraway 1988), 'knowing-in-practices' (Gherardi 2016), and 'learn to be affected' (Latour 2004), the

following empirical analysis captures two forms of engagement between human and non-human actors.

The following sections draw attention to how interviewees intra-act within human-app assemblages of health platforms, along an imaginary continuum at whose opposite points we can find – on the one hand – *functional* engagement with the knowledge *inscribed* in the apps and – on the other – an *affective* engagement with the knowledge *suggested* by the apps. Particularly, the *inscribed* knowledge involves the inscriptions (as we saw with the concept of 'script') about purposes tastes, competences, motives, aspirations of users and designers. However, inscribed knowledge *suggests* how users should use the apps: for example, how many steps to take in a day, how many are calories burned, how much one sleeps and so on.

The two forms of engagement are considered as a continuum whereon overlapping intra-actions can produce different embodied experiences that tinker with sociomaterial objects of everyday life, enacting at the same time knowing-in-practices. Here, I address two types of sensible knowing situated into human-app assemblages: *inscribed* knowledge and *suggested* knowledge.

The chapter discusses semistructured interviews carried out with the purpose of questioning how the knowledge embedded into sociomaterial objects is often reconfigured and adapted to everyday life contexts. Adopting feminist and onto-epistemological stances invites the researcher to question her/his subjective and situated knowledge and to see the interview as a performative method capable of producing a relationship between interviewee and interviewer. In some cases, I have become an ally in practices aimed at questioning and opening the black box of sociomaterial objects.

The chapter is structured to discuss both self-tracking practices related to the use of menstrual apps and the incorporation of wearables and other fitness and wellness apps into women's daily practices.

6.2 Wearables in a choreographic multiplicity

Users often monitor aspects of everyday life through smartphones and smartwatches just because they automatically track daily steps or heart rate. The smartwatch is used because it is aesthetically pleasing, considered a technological whim to replace the analogue watch. The engagement in the use of these technologies is functional to manage calls, messages, e-mails, meetings. Wearable is used to control small tasks without using smartphone, because it is faster to use a gadget that is always on the arm as a true extension of the body. Giuseppina tells us:

> Then... more than anything else, passing through a shopping mall, I saw a Samsung model, the Galaxy Watch, which was also at a good discount, and I liked the look of it. So, I took it without checking too closely the benefits and technical features. I confess this. It was a nice object, unlike other types, the Samsung one has a peculiarity. It has a round shape like a watch and the possibility to show only the hands on the LED screen. So, good or bad, it had a certain continuity compared to a mechanical watch. (Giuseppina, age 50)

Giuseppina is a lawyer, and she liked traditional watches but also the technological gadget. The Smartwatch is a beautiful object that can be used both as classic watch and as technological tool. Giuseppina learns to adapt the use of mechanical watch at the use of a technological object designed to

track not only time but also space. At the end of the domestication process, however, she began to consider the technology too invasive and ended up using it as a small surrogate for the smartphone to 'monitor the time' and keep track of emails and call notifications:

> It's a nice item, but it had become less nice to me over time and it became a little bit nice again when I decided to use it only for specific tasks, taking away most of the notifications and functions. This is paradoxical because in the end I have the same function as a traditional clock and practically in addition to the function of monitoring time I ended up using it only to take a sporadic look at the daily steps, rather than the heartbeat. All in all, this is an information that seems quite accurate. So, I excluded all WhatsApp notifications and all notifications in this world otherwise my pulse was vibrating every 3 minutes, that not even in a seismic zone. I only left the notifications for incoming calls. It is useful because if I leave my mobile phone in another room, I can see who is calling me and I can decide if I have to quickly reconnect to my phone or if I can ignore it. The same goes for e-mails. (Giuseppina, age 50)

If the smartphone is a PC in a small space, the smartwatch adapts the smartphone's layout in an even smaller object. However, the wearable has sensors that can monitor the body and how it moves in space by transforming practices, habits and body parameters into digital data, which quantify and suggest behavioural patterns based on the recommendation of OMS about the physical activities - such as running, or walking – to reduce the risk of heart attacks, improve sleep and overall wellbeing. The following quotes pay attention to the different ways in which interviewees embed the knowledge suggested by the use of these devices in their lives on the basis of different necessities combined with the technological features.

For example, Stefania used her Smartwatch because she worked in a jewellery shop, and a famous watch brand gave her a Smartwatch to test. At first, she played with the smartwatch because she could check WhatsApp, e-mails, and notifications from other social network without using her smartphone. Lifestyle and fitness data was information she looked at out of curiosity, then the screen broke. She says:

> Frankly, the only statistic I used to change my lifestyle was the pedometer, because I was taking far fewer than ten thousand steps. When I was studying or rather working, I was taking less than three thousand steps. That's why I set myself of taking ten thousand steps a day as my goal, and so maybe the next day I would try to take a couple thousand more steps and so on. But otherwise, I don't look at the graphs. I use it as a normal watch basically. Then, being a great operating system, I synced my WhatsApp, my Instagram, so maybe I'd spend two hours changing the wallpaper rather than checking other things. It was a nice toy; I had a lot of fun with it. Now I've broken the screen and have to send it in for repair. (Stefania, age 29)

Stefania does not question the knowledge inscribed in the smartwatch, she is not sure if she knows the name of the health app that tracks her steps or her heartbeat; but, at the same time she enacts practices of resistance to the knowledge suggested by wearables, since she does not use it as a fitness coach. However, she intra-acts with the materiality of the wearable device, wearing it and watching at her daily steps, which generates awareness about her sedentary life. The agency of wearable technologies is enacted by the automatic production of data based on knowledgeable inscriptions such as algorithms, sensor reliability, OMS recommendations, but also marketing concerns about how watch manufacturers can compete with tech giants.

Functional engagement in the knowledge inscribed into technological tools depends on the appeal that technological devices arouse when they promise aesthetic beauty and ease of use. However, the intra-actions between humans and nonhumans produce an unwanted awareness, that influences the user and leads them to inquire about data, as Teresa's experience shows. Teresa bought the Apple watch to complete her collection of Apple products that she uses both for work – she is an architect and uses graphics programs that run better on Apple devices – but also because she can no longer do without the interconnection between various everyday technological tools:

> … (daily steps and heart rate measurements) it's not an information I'm basically looking at, but… that is, it's not something I was looking for, but the moment I saw that I could access that information, I actually started to notice it. In the meantime, I noticed that I was bradycardic, which was not something I knew about myself, that is, I have very low heartbeats of my own, which denotes the fact that I do sports. And it made me happy to know that I have heartbeats in the range of an athlete. I do sports because it makes me happy, I mean, I did it because it made me feel better and take better care of me. So seeing that I have a positive result… they tell you that you have to train your heart to see positive results and actually… I don't know how much I had them before, but I noticed that I have good heartbeats using the Smartwatch. (Teresa, age 33)

This quote shows how the Smartwatch is not used to become a personal health assistant as suggested by the design of digital developers, even though it promotes some behavioural habits aimed to the quantification of wellbeing on the basis of medical recommendations.

Here, it is possible to underscore that even functional engagement with the materiality of wearables can produce knowledge reconfiguration. The knowledge reconfiguration raises, for example, greater awareness of the level of fitness activity or sedentariness. Nevertheless, it emerges that it is fun to know how many steps are taken in a day, but there are several limitations linked to the battery life. In this regard, Chiara's experience of with her wearable is interesting. She learns to understand how much she walks around the city of London. Now she has a different awareness:

> I was aware that since I have been living in London I have been walking a lot for a practical matter. I don't have a car here and it's much easier to get around by underground and bus, but that means you have to walk between stops. I was not aware of how much I was walking or running… I also noticed that there are days when I run longer, and other when I felt tired and without energy. The FitBit quantifies these oscillations and I tried to understand them. I asked my friend, who is an athlete, if the oscillations could be due to my period or if I needed more rest days without running. Anyway, I was aware of these oscillations because I was using an app. (Chiara, age 38)

Chiara is an Italian researcher who works in London, she has figured out that she can quantify some activities that she does not quantify without a measurement instrument. It is important to note that the menstrual cycle is used to justify a feeling of fatigue, emphasizing that when talking about women's daily well-being, it also comes to menstruation. But this is the argument faced in the next section. The measurement instrument shapes the information that goes back to Chiara, who questions and tries to understand if it is reliable; indeed, she says:

> … I'm not really sure that (the quantification of daily steps) is so realistic because one day I was in the car and there was traffic, I wasn't driving, I was in the back, and I realized that the FitBit kept going on and I thought: "ah! So maybe every time I took the underground, and it was going slowly, it got confused and thought that I was walking". So, I tried to do some experiments to see how reliable it is. Anyway, this object produces a certain kind of awareness. I always feel the same way about this kind of awareness that sometimes… I mean, while I was more or less aware of my menstrual cycle, in this case here I had no idea how much I was walking. However, last week I put it in my bag because it was dead, and I forgot it there... (Chiara, age 38)

Chiara tinkers with the FitBit to test the GPS's precision, on the contrary when the focus of tracking is the cycle, she tests the reliability of the app comparing data with her bodily experience. She takes for granted her knowledge about her period: self-tracking practices aim to have an objective proof of her personal knowledge about how her reproductive life works. On the other hand, the intra-actions between Chiara and the non-human actor enact several knowing-in-practices, which produce awareness based on the questioning of the knowledge inscribed in the materiality of the digital bracelet. Chiara thinks that her FitBit is not very reliable after all. She does not trust the knowledge that the FitBit suggests about her body, indeed she forgets to charge it by leaving it in some corner of her bag.

Here, the engagement in the use of wearables comes to be matter through a choreographic multiplicity of entanglements between smartphones and apps in the constitution of human-app-assemblages. The inscriptions of bioknowledge produce a functional engagement, that is an engagement linked to non-use, subservice or underuse of the digital capabilities of the devices. Wearables come to be matter through a functional engagement in

the sense of self-tracking practices aimed at using them as aesthetic objects or as a smartphone in a smaller and more convenient space if one wants to always have calls, messages and social networks under control. Women do not embed the technology in their daily activities, often they use it as a mechanical watch, or they forget to charge it. In the next paragraph we see how women engage in the use of apps for menstrual period management that becomes the digital version of the paper agenda.

6.3 Apps for menstrual period: learning to be aware

Women must learn to control personal cyclical spotting that is different in duration and flow. Keeping track of the cycle's length through a diary and calendar, as tacit knowledge suggests, requires a certain amount of time and commitment (with the purpose of estimating future periods). The app translates the need to manage the start and end of menstruation through a measuring instrument capable of quantifying and predicting the future biological phases of menstruation.

The interviews show that apps are definitely a valuable ally in managing your menstrual calendar. Remembering and predicting menstrual cycles for the next month takes time, but the app does it easily and automatically thanks to an algorithm that gets to know you and over time learns to better predict the length of your cycle. This is the principal cause of engagement in the materiality of the app: a functional engagement to have a digital calendar in the pocket to remind the arrival of the period at any time. For example, Adele explains how she has used it:

> …for about a year or so. I started using it because I'm a big mess and I often forgot to mark it on the calendar… even with the app I'm a mess, but with the app I tend to be less [because] when I think that the period is coming, I open the app and check the previsions. So, I use it to know easily when the period is back. Let's say, so I can organize me… (Adele, age 46)

The app supports human organisation. It is easy to note the beginning and end of the period because the smartphone is already incorporated in our lives. The app automatically organises the messy calendar to visualise the chronology of the cycle through 'objective data' that can be used to manage all the inconvenience linked with monthly spotting. For example, Chiara recounts how she has decided to replace the paper agenda with a digital one:

> It happened that I was at a conference and the cycle arrived unexpectedly. I mean, I did not remember it properly... but it was quite problematic because I had to present my research in public… hence, there were several factors of annoyance and then I thought that... I mean, if I note down in the diary then I forget to check, maybe I'm not looking. And I thought this thing of the app... that is, the thing that I find useful is that it has a calendar so if I click on the calendar, I visualize the whole chronology of my cycle since I downloaded it. (Chiara, age 38)

The diary needs to be fixed and the notes have to be checked. In contrast, the app easily creates statistics and provisional data on the basis of biological data collected by the woman. Self-tracking practices bring back the material aspects of menstrual cycle, rendering the body sensitive to the differences of biological changes. The body is translated in digital information, even if the woman does not record all the informational demands of the

app. The following quotes pay attention to the different ways through which the women interviewed embed the app in their lives on the basis of different outlooks and necessities. It depends on their knowledge about how reproduction works, so on engagement with the knowledge inscribed in the materiality of the app.

For example, Jasmina does not understand why she should record her mood, symptoms and temperature, her cervical position or mucus amount. She does not know how this information can be useful to create a more reliable prediction of fertile and ovulation windows. It is interesting to underscore that she opens the black box of statistics and average menstrual and fertile windows only during the interview. Statistics and averages are produced on the basis of a chronological report of past menstruations. These functions produce data that can be visualised only if the user tinkers with the app in order to understand how it works. Before that, Jasmina had never tinkered with the app, and she did not know that it could be used to record all that information. She says:

> We can see it… that is, I don't really like this app, but I'm accustomed to use this one. See, you can record symptoms, mood, test results, contraceptives used… all these things, a little bit weird… maybe… let see, reports, predictions, chronology, sexual activities, temperature? Symptoms? Let's see, it tells you how many times you recorded this symptom in the past thirty days. I mean, it does graphs, too. But, I don't know… why I have to record all these data? Maybe I didn't invest time to understand why I should collect these data… (Jasmina, age 27)

In this case, the interview becomes an ally in the intra-actions between the interviewee, knowledge of her fertility and the knowledge inscribed in the app. This extract shows the functional engagement of Jasmina in the

materiality of the app. She had not questioned the knowledge inscribed in it because she only needed a memorandum of the beginning and end of the menstrual window.

Functional engagement with the knowledge inscribed in the app also depends on the gender stereotypes linked to menstruation. It emerges that menstruation is a 'thing' that needs to be made invisible through the materiality of the app. Chiara recounts that, when she downloaded the app, she looked for one that did not seem to be obviously a program to track periods:

> The icon is violet with a drawing of the number twenty-eight. I think that is regarded as the menstrual period's length. By the way, I was looking for an app that didn't look like female stuff for menstrual period… I just felt weird that someone could see stuff for my period on my smartphone. So, when I chose it, I thought about the icon, too. (Chiara, age 38)

Another example that underlines the impact of gender stereotypes about the use of apps is the consideration that reproductive knowledge becomes an issue only if a woman is seeking to become pregnant. Contraception is based on methods such as the pill and condoms that ensure protection without worrying about the regular changes that occurs in the female reproductive system. Each cycle can be divided into three phases: follicular phase, ovulation and luteal phase. These changes can be altered using hormonal birth control such as contraceptive pills. The use of these contraceptives is not linked to the need to think about hormonal changes. Acknowledgment of the ovulation phase is considered over-information because, as Palmira says, it is not necessary to know our hormonal changes when you can employ ready-for-use contraception:

> I don't understand… I mean, there is written fertile and ovulation window. I mean, I know that in the ovulation period you could have some spotting. Or maybe… I remember that spotting should be between the two phases. However, since I don't want to get pregnant, I am not interested to understand these things. I mean, I don't want to get pregnant, so I am not interested if I am fertile or not. Maybe it is very useful for women who want to get pregnant. (Palmira, age 20)

The richness of this extract shows that the interviewee has not questioned the medical knowledge inscribed in the app. She has confused knowledge about fertility and ovulation and uses the interviewer's presence to tinker with the artefact. The materiality of the app provides the possibility of using it to better comprehend one's individual sensibility. Palmira is subordinated at the historical stereotypes about menstruation seen as a reproductive business that can become an issue only while trying to get pregnant. Until that time, it is important to know cycle length to understand if it is regular or not and, consequently, to control it.

Here, it is possible to underscore that even functional engagement in the intra-action with the app can produce knowledge reconfiguration. The knowledge reconfiguration gives rise, for example, to greater awareness of one's cycle length. Even if the app is only used for noting the beginning and the end of menstruation, its capacity to produce averages and predictions can enhance and extend knowledge of the user's own cycle, as Palmira explains:

> I knew that my cycle was coming because that I had a traditional backache, so I didn't need the app. But I realized that my period was irregular, and I thought 'let me understand how much it is random'. Then I began to use the app in order to understand my irregularity. And I had realized through the average produced by the app that my

> period is about 35 days long. So, I utilized it just to understand my period's irregularity… my friends are so regular, they don't need the app. (Palmira, age 20)

This extract shows how functional engagement produces however awareness about some personal cycle's features. Now Palmira knows that her cycle is 35 days long. However, she is convinced that her period is irregular only because it is not 28 days long, even though medical knowledge affirms that menstruation is regular if it occurs anywhere along a 21- and 35-day cycle. In this sense, Palmira has not questioned her knowledge that is linked to the myth of regularity that defines a cycle as normal only if it is 28 days long.

Here, self-tracking practices show how materiality and sociality act symmetrically producing overlapping knowing-in-practices. The materiality of statistics and graphs produces different meanings embedded in the knowledge about one's own cycle, which at the same time acts in the ways in which the app is used.

6.4 Learning to be affected by wearables through data and graphs

This section shows how the entanglements between humans and non-humans can produce overlapping forms of intra-action by which both personal and expert knowledge are reconfigured. Here, the focus is on the form of engagement with expert knowledge suggested by the use of health-related apps and wearable trackers embedded in reflective tinkering practices. Humans involve in the self-quantification of fitness activities and bodily parameters to learn to be affected by practices of wellness'

management such as races, the number of calories to be consumed, or the quality of sleep.

The body is broken down into a knowledge mediated by numbers and practices embedded into human-app assemblages. For example, Sofia uses different apps to monitor her race. She compared the statistics from her wearable with the statistics from the Garmin – a wearable bracelet specified for who runs – of her friend and she noted that the app Strava is more reliable for notifying the kilometres covered during a race:

> Actually, I use both at the same time, because I have seen that my smartwatch measures my heartbeats better, while the STRAVA app is more reliable… let's say that there is a small difference in the calculation of times, maybe this is due to the GPS. Instead, the time of STRAVA matches with the time of Garmin, that my friend with whom I go running has. So, I see that my Xiaomi measures my heartbeats and my stride very well, instead STRAVA is better to quantify times and distances. For this reason, I use both. (Sofia, age 50)

The principal characteristic of affective engagement is the use of wearable trackers and apps to learn how to manage wellness and how to workout. The interviewees decide to buy a wearable tracker to visualize some parameters that make objective the improvement of their physical activities, like racing. Teresa tells us when she decided to change something in the process of managing of her wellness:

> … among other things I decided to also change my approach to personal care that I had never taken into consideration before that. I started to run alone, but I needed to have a coach that I found in the Apple smartwatch. I simply want to know how long I run, manage music etc. and so I use the smartwatch to follow my progress, in the

> sense that since I had never raced, and I did not do sports with a personal trainer… I hated running because it is the classic thing that causes breathlessness and you die. So I started to search information online to learn how to run without hurting yourself. I inquired and I understood that I had to run for a while, for several kilometres and walk a few meters. So, I had to figure out how much I was doing because if I started running one minute and walking three, then I needed something. There are faster internships at slower intervals, and so it was necessary for me to understand what… how much I was running… the app was useful to quantify my run and my improvement. That is, you need feedback, on the contrary after a while you become demotivated. As I think that if one trains to lose weight, if she/he does not see results then she/he gives up. (Teresa, age 33)

Teresa decides to monitor herself to learn how to run and to quantify her progress. But the knowledge produced trough wearables is very heterogeneous. It can be used for different purposes. For example, Chiara bought the FitBit to monitor her heartrate while running, because she read that this is an important parameter to track. She said:

> I bought a FitBit because I had started running, and I was reading stuff about running and there was an indication of what your ideal heart rate should be while you are running. Obviously, I did not know how to measure my heart rate while running. I mean, I do not know if my degree of breathlessness can be an indicator of the acceleration of heart beats. So, I decided to buy the FitBit on Amazon. It looks like a Casio watch. Let's say that it is a bit ugly. I tried to synchronise my phone with the bracelet via Bluetooth. I discovered a new world… it counts your steps, it tells you how many hours you slept, and the quality of sleep. (Chiara, age 38)

Chiara's engagement depends on the necessity to quantify heart beats, but then she sees that it can be used for several purposes. She uses the FitBit to track her bodily parameters and to learn how to run in the correct way. The self-quantification is mediated by self-tracing technologies that develop affective practices by which humans learn to understand how the body reacts if subjected to training.

Wearables can become a personalized coach in the process of learning to manage lifestyle. Interviewees see the wearables as measurement instruments to approach the world of fitness, without going to the gym. The gym is expensive, but it is also a commitment that implies time and organization especially for women with children. It is very difficult to reconcile family, work and even gym. To this regard Simona says:

> … Running is the only sport I could do even in very small amounts of time. Indeed, at the end of the day anyone opens the door, goes running and then comes back. You do not have to take courses, follow timetables, get to the gym, and then it is quite cheap. There are my daughter's commitments, my work and my husband's work, and the commitments at home. So, you understand that it's really something you have to want … (Simona, age 41)

And the smartwatch is the symbol of her voyage towards running and a healthy lifestyle:

> My husband gave it (the Garmin) to me because I wanted it so much and I care more about it than all the jewels I have. The fact that I told my husband that I wanted the Garmin is because I was aware that sport had come into my life definitively. It's a small symbol of my decision to become a sporty woman. It's cute because it's very practical, it has a series of features for running. For example, it has a very precise

> GPS, it synchs with my smartphone and then I see the messages on the display. It's useful, because, for example, when I'm with my daughter, I don't hold my phone. That is, I leave it in my bag and I reserve myself for her, and take out the phone just in case I get an important message. (Simona, age 41)

Simona has a degree in Economics, works in a betting company in Rome, and she is the mother of a 7-year-old girl. She sees the smartwatch as a symbol of her healthy lifestyle and an extension of the smartphone itself. Talking about smartwatch usage practices allows us to analyse how self-care practices are embedded in intra-actions between technologies that enact different embodied knowledge. She learns to be affected by data produced by the Smartwatch, that suggests thinking about the body as the result of healthy practices. To this extent Simona says:

> Here is for example of a very trivial thing… See here? There is a graph. This is a chart, this is the chart of the activities I do, okay? For example, this is yesterday's activity, yesterday I ran here, but all last week I didn't do anything, because I was still fresh from the marathon. This very stupid graph which makes me see that I didn't do anything, somehow stimulates me to do something else because I like to see the full graph bars. I see the days go by and I say to myself: 'Oh! Damn, I haven't been working out, I haven't done anything'. So, it's a triviality, but all day long I see what I'm doing and so somehow it pushes me to want to do better, it's stupid but it has a great impact on me (...) I chose to see this graph, because it also helps me understand how much I'm training, I like it (...) I've customised it, and here there are a whole series of things, like daily steps, calories, here there is the time of the sunset (...) Yes, for example when in summer I go running in the morning, maybe I try to understand what time it dawns so as not to go in the dark (…). And

> then there's the time. Then here, for example, there is the heart rate and it gives you a track of the last 4 hours, and it tells you what you have done. But I never look at this, I don't care because I know I'm dedicate to training (...) But there is a graph I look at. This is really stupid. It's called Vo2 max, look here (she shows me the smartphone). It's the volume of oxygen in your blood, this bullshit here tells you how much oxygen you have in your blood depending on the training you do. Here, it's not good, here it's excellent and here when you get to the pink you are really… you are younger, you understand? You have a level of, let's say, oxygen, like you're younger than you are. And us 40-something losers look at this a lot, because you can feel, this is one thing, this is one of those things that leverages along with the graph. But these stupid things work, they work on me. (Simona, age 41)

Simona engages within knowing her level of wellness, that it is measured on the basis of training captured by her smartwatch always with her. She is aware that the graph acts as a motivator, a coach reminding her of her progress. Particularly the graph of Vo2 max is a way to gamify the physical activity level, comparing the graph with her husband and friends. However, she does not think that the graph is really reliable, demonstrated by the fact that she has repeated several times that it is a 'stupid thing to consider'. In this sense, her engagement is aimed to question the knowledge suggested by the wearable. She trusts the data directly produced by her training, but she questions the graph that is supposed to show the oxygen in her blood: it is not clear how this index can be calculated only through the level of physical activity achieved, as it is usually calculated with specific devices that take into account the haemoglobin and other biological elements.

Sofia has a different story. She is a sporty nutritionist. She decided to buy the Xiami smartwatch to monitor her sleep and in particular her heartbeats at night as an indicator of her athleticism. Now it has become indispensable to her, and she also advises her patients to buy a tool that objectifies their sedentary state through numbers. She said:

> I've been using the Xiami Mi Band for a year and a half because I actually saw that it had a slightly better sleep sensor than the others, more sensitive, and then I need something to quantify the physical activity I do. Let's say I never take it off, it was love at first sight, I looked at all the models and prices. I didn't need a very expensive device because I didn't need a very precise detail of physical activity. And then I wanted to understand how it works in order to recommend it to my patients because often they can't objectively say how much physical activity they do, how much they walk a day because the diets I do are based on their metabolism, but also on the life they lead. So maybe they say "I'm always standing, I walk a lot" and then they come back after two months and say "... but you know, it's six thousand steps a day" which is very little. So they feel like they're doing a lot, but... and it's nice because it makes them realise that in the end it's not a lot and that they have to do more. Returning to me, you know, I wanted to understand if I sleep well, if my deep sleep is long enough. In fact, it's often a perception that maybe depends on all the other things, not on the sleep itself. I like to monitor my sleep, I go and see how much sleep I've had, how much deep sleep, how much less sleep let's say lighter. (Sofia, age 50)

Sofia learns to quantify her perception through an object that she likes and that she always carries with her. She uses the wearable as a tool to make an objective awareness of certain aspects of life, such as sleep. Wearables

work beyond the skin, as a boundary object able to collect biomedical information suggesting knowledge in the form of graphs and numbers.

Tracking becomes itself a competence. Humans learn to use the wearables and to carry it with them in every sphere of life, they learn to be affected by the knowledge suggested by the health-related technologies and develop an affective engagement either with the aesthetics of wearables and with numbers and graphs. Elena tells us about her experience of engaging in the learning process of the Apple smartwatch. She has been using it for a few months now, and is starting to set it up according to the information she is interested in knowing and keeping track of:

> So it's got a thousand useless functions, including a whole play aspect that I hardly use, I use the physical activity monitoring function a lot. You have the ability to set... I mean, basically I don't care what day it is simply that I wear it and if you leave it with more or less original settings, without it being too... because it's very customisable, you know? So you can set it according to what you like and don't like. I've been testing it for a few months now so I've left it more or less with the original settings because I think it's a good way to understand everything that it offers and then maybe make a selection and take out some features. Basically healthy living is based on these three rings and you theoretically have the goal of completing them, that is, advancing the bars of these three rings that have three different colours and are concentric. When you complete one, he gives you a lot of compliments. He says: "Wonderful! Bravo!" So if you see, it's three concentric rings, the outer one is red and that's the one that signifies physical activity... ahem! no calories burned. I mean, I set it and theoretically I have to burn 750 calories to close the red circle, which is the one for calories burned, okay? I've just put the smartwatch on so clearly it's pretty much 0. During the day, it estimates the movements I do in terms of

> physical activity, calorie expenditure, and if I close the circle, there's an animation on the screen. There's a brilliant loop that closes, and it tells me "Yee, good, you've reached your calorie target". OK? The other two circles work the same way. This circle shows the time in minutes spent exercising. This is the function I use when I run. That is, I start the timer and it counts my kilometres, the average pace. The last one, the light blue one, is the standing. So if I spend an hour straight sitting down, it tells me to get up. I have to get up and I have to move for at least a minute. If I do that 12 times... see that's 1 in 12? ... ...during a day, even the blue ring closes. If I forget it at home, I get a shock because then I don't fill in the circles for that day, and I find the calendar empty and I say to myself: "Eh! I didn't do anything!". And I have to remember that I didn't put it in. But because the people at Apple clearly make money if you use it, what happens is that you don't just have this month's history. It also has another aspect. If you wear it for six months, at some point you get a trend report. Let's say, a history report for your healthy life. So it tells you what goals you've achieved, what you need to improve on, what aspects you've been good at. But to do that you have to wear it; you have to make sure you wear it at least 5 days a week all day long. (Elena, age 43)

Elena is a researcher and mother of two children. She does not have a lot of time to train and the interconnection between her iPhone and Apple Watch is a tool that helps her lead a healthy lifestyle. Affective engagement is based on practices-in-knowing aimed to understand data, that acts in the form of three circles. The three circles become matter when they influence engagement in self-tracking practices. Technologies become personalised assistants that act through the production of graphs and statistical reports, which perform the practices in order to achieve a healthy and balanced lifestyle. This produces an affective engagement that enacts practices, aimed at

discovering one's own body, suggested by the knowledge embedded in self-tracking technologies. She is aware of the trade-off between the data-value that she produces for Apple and the benefits that she gets back from the use of Apple's devices. She says:

> Theoretically you could also wear it during the night but that really bothers me. I don't really care. It bothers me when I sleep so I don't want to wear it at night. I mean, I know if I sleep well or not because it depends on how I wake up in the morning. The key to use Apple watch is that it can be hyper-personalized, okay? You can use it and set it up for different purposes. Maybe you use it less for working out, maybe you use it more because you work in the office and your job is very sedentary and this device helps you get up, stretch once an hour, or helps you to understand the right dosage of melatonin or whatever that allows you to get a good night's sleep. I realise that it has a positive impact on me because I enjoy it. And I know that. The thing is, that's how it works for me, so I benefit from it. Although I still think that it is a slavery in some ways and so there is like a trade-off between your perception of what you take and the perception of what you give. My husband could never wear this object because among other things he develops a set of data, which then clearly are sold, so you work for them. But I know this more than well, it's not that I don't know it. The fact is that even though I know it, I choose to wear it. Yes, it is true… the big digital companies should pay me because I am giving them something that they then sell, but it is also true that for me, Elena individually, this data has no value. The data has value in aggregate form. I do not have the tools to use them, so for me, it has value because it has it for them. I think the Apple Watch is a tool… considering that as I told you, I left the settings normal, so I have notifications if a message comes in, i.e. this one vibrates, rings, vibrates and rings because this is

> an Apple 3 Series. If I lose my phone at home – and it happens to me very often – I can talk with the bracelet like 007. And most importantly, this object has a function for me… it is a stupid feature, but it's fantastic… I am the joke in the house because I spend half my day looking for the phone, I had to find another phone and make the phone ring. Now I can press this little button on my Apple watch and my phone rings. My kids say: "mummy it is there" and so on. Just for this reason alone, if it were a watch with phone finder, I would be fine with it, because it would already be a great improvement in my daily life in terms of well-being. (Elena, age 43)

Elena chooses to wear her Apple watch day after day, aware of the risks and benefits included in the digitisation process. She synchs her Apple watch with her iPhone, becoming together a measuring apparatus in the process of implementing self-tracking practices. She is aware that she is a prosumer, but she knows that digital technologies are now indispensable: they are part of our daily practices.

At this point the thing to do is to try to incorporate them into reflexive practices of use, non-use or under-use. An example of this is provided by Elena when she tells us not to use her Apple watch at night because she knows when she sleeps well and when, on the contrary, she sleeps badly, so there is no need for Apple to have this type of information. But in other cases, the Apple watch helps her to understand whether she is leading a healthy lifestyle and encourages her to move around and achieve the goals set by Apple's circles. This prompts her to give up her data in exchange for analysis, statistics and reports on her lifestyle. The intra-actions between Elena, body, wearable and iPhone produce new kinds of affective engagement between herself and measurement practices. In Elena's words on the production of data-value for free, it emerges that inscribed knowledge – the

entanglements of expert knowledge of engineers, doctors, designers etc. – is the real currency of exchange through which Apple manages to retain the loyalty of the user who gives up personal data in exchange for personalised assistance in achieving daily well-being.

Analysing how women incorporate wearable technologies into their body management practices allows us to investigate how they perform their understanding of everyday well-being and the idea of keeping their bodies fit. Instead, shifting the focus of the interview to digital menstrual management allows us to investigate how women perform the gendered knowledge suggested by menstrual cycle apps. As we can see in the next section, the knowledge suggested by the app becomes a way to think about one's cycle through data and statistical predictions.

6.5 Tinkering with the suggested knowledge embedded in the apps for menstrual tracking

This section shows how the entangled agency between humans and non-humans can produce overlapping forms of intra-action by which both personal and expert knowledge are reconfigured. Here, attention is directed to the form of engagement embedded within reflexive tinkering with expert knowledge suggested by the app. The agency of the app emerges through its capacity to make visible how fertility should work on the basis of the data recorded by women. The body is broken down into a series of symptoms such as acne, back pain, headache, changes in mood, then translated into traces of sociomateriality conveyed by statistics and graphs.

The principal characteristic of affective engagement is recognising that the functioning of the app depends on biological knowledge that becomes visible in concrete daily experiences. The interviewees are becoming more sensitive to recognising various changes in their bodies when linked to menstrual phases. Even if they know their menstrual symptoms and mood, the app provides proof of such connections. In this regard, Maia says:

> At first, I recorded symptoms and other things because I wanted to understand. I mean, I thought: 'Maybe these symptoms such as headache and back pain are regular, maybe they reappear in the same way'. So, I kept a note. But now, I'm sick of recording this information. I just don't really have time for the app, either. But sometimes I record it if I have a bad headache or particularly strong pain. Then if it occurs again, I can say: 'Well! It was because of my cycle!' […] I mean, I like to know when I am in the max period of fertility because I know that it is linked to some symptoms, like spotting, etc. I like to know if they are linked to my cycle or not. (Maia, age 26)

Here, Maia collides with the suggestion to recognise PMS in some symptoms of her daily mood. She uses the app to track her symptoms and emotions, but this does not mean that she records all the information suggested by the app. To the contrary, she just tests her bodily knowledge to confirm some connections. After that, she embeds the app in a reflexive underutilisation, because she recognises when her mood or various symptoms are linked to her cycle; for this reason, she does not always feel the need to record that information. We can note how intra-actions between humans and non-humans translate agential capacities and forces by a setting of uses that take into account the materiality and sociality of the lived experience.

As a counterpoint, Adele monitors symptoms to confirm that she is on the threshold of menopause. In this case, the app is a repository of traces

that make it possible to join and to demonstrate an assumed awareness. She recounts:

> …seeing how much time, how many days my periods last, the amount of flow, on which days it is concentrated. Those are data I come back to. In fact, it is through the app that I have understood that my cycle has become shorter—for example, from 28 days to 25 or 26 days. When you can visualize this through statistics, you have a different awareness and possibly you are surer about your body. Indeed, among other things, it is more useful for giving me knowledge about my body. Because I have a coil, I have no problem controlling my cycle from that point of view, to control my fertility or not, or rather to become pregnant or not. Let's say, I'm quite… Yes, the app gives me further knowledge of my body, how it changes and how it is changing. (Adele, age 46)

This extract shows the agential relationship between humans and non-humans. The agency of the non-human actor lies in its capacity to produce personalised statistics that are reconfigured through self-tracking practices embedded in everyday activities. Some interview quotes show that women often play with the app even if just for short periods or for some needs, such as when Ada was trying to get pregnant:

> It helped me because I more or less knew my fertile days. Obviously, it's not one hundred per cent sure! There must also be some luck. We succeeded immediately. I was pregnant by the second month! So, I don't know if it was the accuracy of the app or luck […] I recorded the times we had sex, so I could see more or less the two days in which I got pregnant, which were the two days close to my ovulation day. (Ada, age 31)

Ada knows how fertility works, pointing out that she is not sure about the accuracy of the information the app provides her. Maybe, if she had not used the app, she would have obtained the same result. However, it gives her support in determining when she is in the fertile window, becoming an ally in her aim of getting pregnant.

If, in the previous extract, attention is on the possibility of visualising ovulation days, in the next one the app can help to visualise how fertility works; as well as, it can organise dates and thereby play an active role in condom-based contraceptive dynamics. Ofelia explains:

> I mean, before using the app, I didn't have exact control over at-risk days for having sex. I mean, I know that there are other ways of knowing that, because [name of app] doesn't discover anything. However, it's so much simpler with it. The cycle comes, and I just record it in the app, it's usually already scheduled. Moreover, there is the possibility to track symptoms and… Look how beautiful! You can track everything, even acne. But, when I have a partner, I often need to know if I will be on my period or not in order to organize, you know... I mean, it's simpler to organize. Obviously, if you use a contraceptive method, you don't stop using it. But, I mean, it can be useful, that is, it's better to know. So, you are even more aware of your body than your relationships. (Ofelia, age 25)

Ofelia has biological knowledge about how a woman's body works, and she recognises this knowledge in the app's materiality. She knows that the prediction of fertility and ovulation windows depends on biological mechanisms that could be calculated manually with the use of a calendar; however, she had never calculated her ovulation days prior to obtaining the app. Ofelia's affective engagement is embedded in her reproduction experience of a 25-year-old university student who only thinks about her

reproduction in order to avoid pregnancy. The app is considered an enhancement of condom use, becoming a contraceptive itself.

The same function can be used in different ways, as suggested by Chiara's experience. Chiara is 38 years old with high investment in her academic career. She has postponed having a child, thinking that one day she will satisfy her need for motherhood. But now that her reproductive life is approaching the menopause phase, she knows there is a high probability that she will fail in her desire to have a child. Here, the function of visualising the ovulation window becomes a way of reflecting on the body in relation to reproductive and sexual life, as Chiara explains:

> My awareness has changed regarding a whole series of things! For example, since I was not trying to get pregnant – at this precise moment, I don't even have a partner […]. I never even thought about using the Knaus-Ogino method as a contraceptive. The whole story of when I'm ovulating, I mean, awareness of when I was ovulating, I would have preferred not to have this awareness. […] I don't know how to explain… the app doesn't produce any kind of changes. It's not that… It's the fact that displaying certain types of information makes it hard not to think about it. So, for example, since I've been using this app, every time it tells me 'today is a fertile day' I'm thinking, 'another day of my life that hasn't been used'. I don't change my mind or do things differently, but… (Chiara, age 38)

Chiara embeds the visualisation of ovulation windows materialised through statistics and graphs in her ideas about motherhood. She sees the averages and the forecasts as unfertilised eggs. In this sense, the use of the app is embedded in her thoughts about fertility, ovulation, motherhood and gender discrimination regarding PMS definition. She says:

> For example, when I take the pill and the app tells me 'You're ovulating', I think 'What a fool!' I mean, it's not very rational […] Then it says 'PMS', which I imagine means premenstrual symptoms. But I think this is a sexist thing, as it never occurred to me to record whether I had symptoms. (Chiara, age 38)

It is interesting that Chiara uses human language to make fun of the app. She tinkers with the non-human actor with complaints about the definition itself of PMS, since recording symptoms and mood reproduces and thereby keeps alive sexism and taboos around the female period.

In this second engagement form, the body becomes matter within practices of effective engagement between human and non-human actors. The agency of the app performs the recognition of some bodily elements otherwise taken for granted. On the other hand, the women interviewed tinker with the suggested knowledge about how the body should work. The result is an affective engagement of apps and bodies, which become more sensitive to understanding menstrual phases.

CHAPTHER 2020

Immuni for tracking and tracing virus carriers

1.1. Introduction

The Covid-19 pandemic has confronted the political, scientific and social world with complex and global challenges, first and foremost that of overcoming disciplinary boundaries. The pandemic has made the interconnection between science, technology, politics and society visible, putting issues on the institutional agenda that would not necessarily have entered it (Razetti 2020; Giarelli and Vicarelli 2020). Against this backdrop, adopting an STS perspective allows us to "look between" relations to rethink the phenomena as relational effects in which the causes are the effects (Viteritti 2020).

The pandemic has transformed the way we think about physical and material space by introducing individual protection objects that enable society to live with the virus. The pandemic has made the need to digitalise work and teaching practices, but also conferences, entertainment events, aperitifs and even dinners to bring friends and family a little closer together, sharing flashes of everyday normality (Affuso *et al.* 2020).

A dissertation on the digitalization of daily well-being mediated by self-monitoring practices could not ignore the current context of crisis in the National Health Service (NHS). NHS, more regional than national, has

several weaknesses fuelled by years of privatisation and cuts in health spending, accompanied by a weakening of the organisation of general practitioners.

Based on these considerations, this chapter attempts to question the *Immuni* app, reconstructing the history of its development. Indeed, this is a history of adaptations between supranational institutions (the EU privacy committee), national institutions (the government and the task of producing an app to track the contacts of Italian citizens), and regional institutions (which, in some cases, release other tracking apps). The contact-tracing app should track virus carriers through the smartphone, a technology we all have with us all the time, now an extension of our bodies. This would make contact tracing more immediate and reliable than the manual tracing carried out during the first wave.

To investigate the alignments and disalignments of the Immuni app placed within sociomaterial assemblages in which analogue contact tracing practices attempt to remedy the atavistic disorganisation of the regional and territorial health system, I narrated my personal experience with the Covid-19 using the technique of auto-ethnography.

These auto-ethnographic accounts reinforce the methodological discussion presented in C*hapter Three*. The pandemic has also shaken up the social sciences from both a theoretical and methodological point of view. Important initiatives have been advanced to produce collaborative analyses and reflections that are obviously still in progress to face the new challenges. For example, it is very interesting the crowd-sourced document initiative launched by the sociologist Deborah Lupton. The sociologist writes:

> Isolation measures to contain the spread of COVID-19 means that social researchers who have for doing fieldwork in a pandemic - specifically, ideas for avoiding in-person interactions by using mediated forms that will achieve similar ends.
>
> Social research has been conducted online for many years, of course. There are many examples of using online survey tools or doing content analyses or ethnographies using existing online interactions as research materials. Interviews have been conducted by phone or Skype for a long time. This document was initially directed at ways for how to turn fieldwork that was initially planned as using face-to-face methods into a more 'hands-off' mode. However, people have added useful material about 'born digital' research (content already generated on the internet by online interactions), which provides an alternative source of social research materials if researchers decide to go down that path.[36] (Lupton 2020a)

Adopting an auto-ethnographic perspective lets to merge the embodied and situated knowledge of the researcher (Barad 2007; Gherardi 2019) and his/her personal experience (Jones *et al.* 2016). Autoethnography allows us to tell our stories to each other, especially at a time when our habits have been disrupted, requiring us to rethink our cognitive and relational resources. As Stacy Holman Jones (2016, p. 19) says:

[36] Lupton, D. (editor) (2020) Doing fieldwork in a pandemic (crowd-sourced document). Available at: https://docs.google.com/document/d/1clGjGABB2h2qbduT-gfqribHmog9B6P0NvMgVuiHZCl8/edit?ts=5e88ae0a#

> … telling our stories is a way for us to be present to each other, provides a space for us to create a relationship embodied in the performance of writing and reading that is reflective, critical, loving, and chosen in solidarity (p. 19).

The chapter is organized as follows. First, I analysed the development phases of the app, then I reconstructed its history through the documentary analysis of online newspaper articles and statements as well as official documents published on the website of the Government and the Ministry of Health[37]. Secondly, I investigated the script of the app through the description of the graphical user interface (GUI) and the main features that regulate the functioning of the app thanks to secondary sources such as GitHub[38] and the official website of *Immuni*[39]. The chapter ends with two autoethnographic stories with the aim of questioning my own experience by providing an alternative source for analysing the pandemic emergency that is also transforming the way we do research.

1.2. Contact tracing between surveillance and encrypted data

Contact tracing has shown us how, in some countries, the smartphone has become an excellent tool to contain the pandemic at the expense of citizens' freedom. This is the case of China, which has strengthened its mass surveillance system, already heavily based on Big-Data and AI, and of

[37] http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioNotizieNuovoCoronavirus.jsp?lingua=italianoandmenu=notizieandp=dalministeroandid=4852
[38] https://github.com/*Immuni*-app/*Immuni*-documentation/tree/master/Design
[39] https://www.*Immuni*.italia.it/

Israel, which has turned smartphones into digital weapons to defeat the enemy called Covid-19 (Gan and Culver 2020).[40]

The Chinese government has decided to create a function called Health Code within We Chat, a platform already developed and used by the population to carry out most of their daily activities from making call, to sending voice messages, booking medical examinations, recording movements and so on. In this way, the Chinese government decided to incorporate within a system already widely metabolised by citizens an additional function that indicates the probability of having meet the virus through three colour codes. These codes are calculated based on movements, time spent in possible places of epidemic concentration and exposure to potential virus carriers. The government's strategy was therefore not to create an additional app, but to use the existing system which in turn can communicate with payment systems (Alipay) and the Chinese equivalent of Google Maps, namely "Gaode Maps". In this way, the cross-referenced data comes not only from official government sources that input the official positivity of an ID into the system, but also from cameras and sensors located in smart cities, travel flows recorded by Gaode Maps and electronic payment flows recorded by Alipay.[41]

Another interesting case is that of Israel, which has declared a state of war. This time the enemy is not in the Gaza Strip, but it is the Covid-19. The Israeli authorities are very secretive about the details put into practice to fight the enemy. However, Prime Minister Benjamin Netanyahu has declared that he will increase the ability to locate those infected through any existing digital technology, including military technology, with the aim of

[40] https://www.agendadigitale.eu/sicurezza/privacy/coronavirus-i-sistemi-per-tracciare-i-positivi-come-funzionano/
[41] *Ibidem.*

identifying people who have been in contact with the positives and forcing them into a 14-day quarantine (Kitchin 2020).[42]

The two examples above are extreme cases of the use of digital technology to monitor citizens through the data produced by their self-tracking of financial and physical movements and online conversations (Lyon 2002).

Europe has moved to regulate the development of digital technologies to manage the pandemic while protecting citizens' privacy as required by the GDPR (EU 2020). General Data Protection Regulation sets strict limits on the processing of personal data, making it difficult to use smartphone location data to track the course of the epidemic. Indeed, GPS is considered very invasive as well as being a dangerous tool to support digital surveillance. It was therefore decided to use Bluetooth, since it is a proximity technology, mainly used for matching wireless devices.

The Pan-European Privacy Preserving Proximity Tracing (PEPP-PT) platform, consisting of 130 European experts, was created for this purpose. PEPP-PT was created to develop a platform to support European governments in the process of designing applications that comply with the privacy rules set by the GDPR (Tang 2020).

The basic principle for complying with the GDPR is the use of anonymised data. For this, the PEPP-PT requires that each smartphone is identified by encrypted data that does not lead back to the individual. This system is designed to prevent abuse by third parties, including governments, by ensuring high standards of data protection, especially at a time of crisis such as that generated by the management of a pandemic.

Tracking apps work if they can record the proximity and contact time between two individuals (human actors) and this is only possible by

[42] *Ibidem.*

making smartphones (non-human actors) interoperable, hence different operating systems. Therefore, the first hurdle to overcome when creating contact tracking apps for public health is to make different operating systems interoperable (Kitchin 2020).

This is where Apple and Google come into play, as for the first time they have collaborated to make their operating systems - iOS and Android - at least partially interoperable (Leonelli 2020). In a first phase, in May, the two giants released APIs to enable the interoperability of apps developed by health authorities to be downloaded from their respective market stores. Subsequently, Apple and Google worked to create a more stable platform based on Bluetooth Low Energy (LE) to ensure that the different operating systems could communicate. This solution is more stable and obviously requires an upgrade of the operating system, which could be the starting point for the development of applications based on the use of Bluetooth[43].
Following European directives, the digital tracking system is to be organized around voluntarily downloadable apps that do not require the creation of an account and work through Bluetooth technology. Low-energy Bluetooth continuously sends small data packets in broadcast mode: a system based on the transmission of a special code to all connected devices at the same time. Until then, iOS had never allowed apps in the background to transmit Bluetooth in a pre-encrypted manner, in order to prevent apps from sending data uncontrollably. But with the new update each digital trace is collected and stored in an encrypted way, without direct reference to the user's identity. The device transmits a unique encrypted key at regular intervals, listening to receive the keys of the devices with which it has connected (the association is only stored on the server).

[43] https://www.macitynet.it/gli-strumenti-apple-e-google-per-tracciare-covid-19-arrivano-la-prossima-settimana/

However, developers warn that, to be efficient, the participation rate in the digital tracking system must include at least 60% of the population (Stokel-Walker 2020; Kelion 2020). It is difficult to achieve a 60% participation rate given the low level of trust in governments and third parties that would monitor people we meet on a daily basis. In addition, the rate of people who have the opportunity to connect to the internet, or who have a smartphone that supports the updates needed to make operating systems interoperable, is relatively low (Leonelli 2020).

To sum up, tracing apps that follow the European Commission's guidelines are based on Bluetooth low energy, must be downloaded voluntarily and do not require any form of registration, which means that once installed they generate an encrypted code that is independent of the user's identity. Once the pandemic emergency is over, all data must be deleted from the servers, whether they are government-owned or private. In the next section we will look at the app chosen by the government to address the Covid-19 pandemic.

1.3. In Italy: the *Immuni* app

Immuni is the open-source app chosen by the Italian government to manage the Covid-19 pandemic. It is developed by a 48-member company "Bending Spoon" which has roots in Denmark and is also based in Milan. The company is mainly active in the development of apps for mobile devices ranging from fitness to personalisation of backgrounds and images. The partners of Bending Spoon are mostly Italian and young people, mostly from Veneto and Po Valley, with the presence of H14 (i.e., the Italian family

office of Barbara Eleonora and Luigi Berlusconi, shareholder of Fininvest), and Polish, Hungarian, Bulgarian, Danish and Mexican shareholder[44].

The app is extremely easy to use, it is one of the first in Europe to take advantage of the updates released by Google and Apple, and follows the European PEPP-PT guidelines: Bluetooth (LE), and a unique coding system without reference to personal identity. There is no need for any registration, the only information required is the region where you live, otherwise downloaded the app works in the background by accessing the device's Bluetooth.

Immuni was released on 01/06/2020, for the first week it was active only in 4 regions chosen for the test phase: Liguria, Puglia, Abruzzo and Marche. Since 8 June, the tracing service was activated throughout Italy. The app was released and advertised as a weapon in the hands of citizens that would have prevented a second lockdown and all that this entails: i.e., smart-working and closed schools, phenomena that have caused an exacerbation of discrimination of family roles on the basis of gender. Women have seen an increase in the responsibility of care roles and family commitments because of the closure of schools and personal care services, the exacerbation of risks of domestic violence, as well as the increased likelihood of exiting the labour market.

In this context, it is representative that the dichotomisation of care roles is reproduced by the launch of *Immuni*. The graphical interface of the app depicts her and him: she with a baby in her arms; he at the PC (Image no. 1). Against this background, the launch of the app was greeted by several protests from different parts of the public opinion.

[44] https://www.repubblica.it/politica/2020/04/16/news/coronavirus_scelta_l_app_per_il_tracciamento_dei_contagi_si_chiamera_*Immuni*-254235342/

Image no. 1

The company Bending Spoon, pressed by the Minister for Equal Opportunities and Family Elena Bonetti, immediately ran for cover. Within a few hours, Immuni's graphic interface was changed. The GUI now depicts a family on the right; a man and a woman in the foreground enjoying their freedom; a white man and a black woman with a dog on the left (Image no. 2)[45].

Image no. 2

[45] https://www.*Immuni*.italia.it/

As we have seen, the script of an application inscribes ideas and configures the user it addresses. Let us analyse the differences between the first and second images. The first one reproduces a man and a woman at the window and insists on genderized care roles. The second GUI broadens the perspective with avatars designed to show a happy-go-lucky man and woman (friends or partners) in the foreground, a black man and woman chatting on the left, and the inevitable traditional family of man, woman and child playing outdoors on the right. In addition, the space changes: from the dark colours and narrow spaces of the first image we move on to light colours and the happiness of experiencing nature and sociability.

The app is available in several languages: Italian, English, German, French, and Spanish. The first interface that appears once you download the app onto your smartphone is as follows:

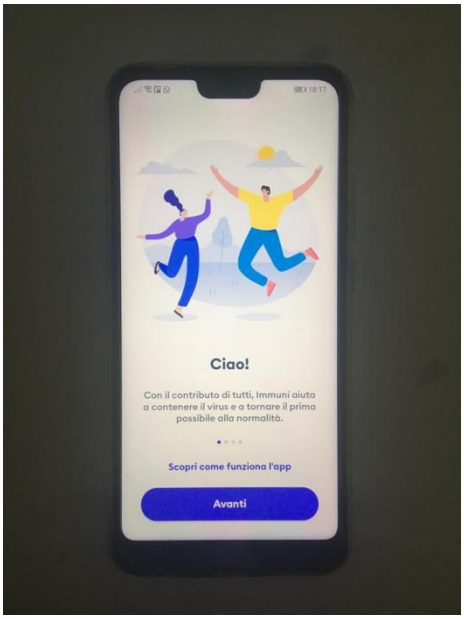

Image no. 3

Immuni welcomes you and warns you that using the app can help everyone to contain the epidemic and return to normal life soon as possible. Then it explains what the characteristics of Immuni are:

- "*Immuni* takes care of you" warning you if you have come into contact with a positive user. This allows the user to isolate themselves, speeding up the return to normal life for everyone.

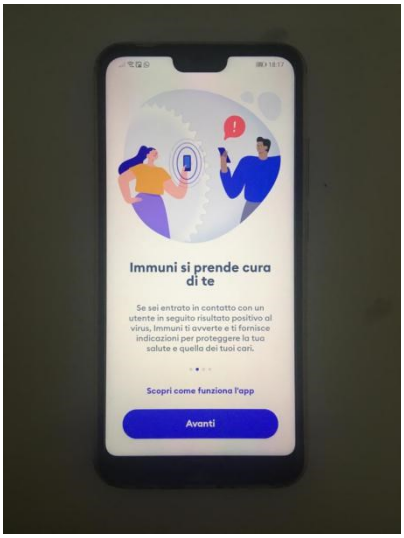

Image no. 4

- "Let's slow down the epidemic together": here we find again the image of windows, hence the danger of new closures, through which a man and a woman look out. In this case, the roles are reversed: a man holds a child in his arms and a woman works at a desk in front of a computer. The roles are reversed, but the concept of family remains that of man, woman and child.

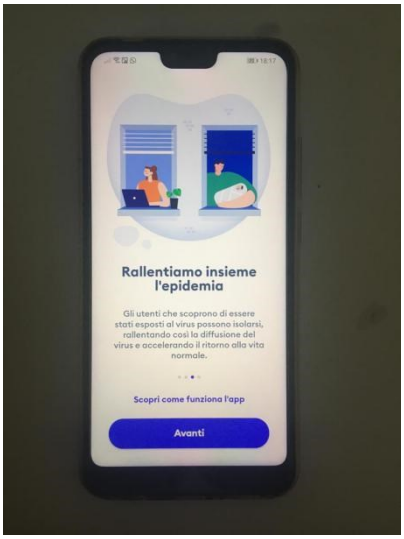

Image no. 5

- "Your privacy is protected": the last issue deals with privacy, and in particular it explains how the privacy of its users is protected, specifying that data is stocked on Italian servers managed "by public entities and controlled by the Ministry of Health".

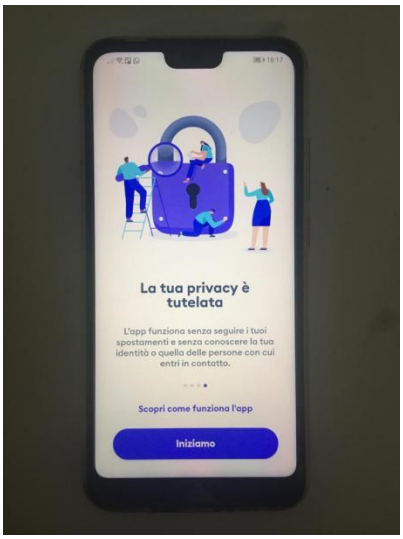

Image no. 6

Then it asks you what region and province you live in. It asks you to activate "COVD-19 exposure notifications", allowing the app to access

Bluetooth (Fig. no. 7-8), but also geolocation. The data information specifies that "the geolocation service must be active to allow the exchange of causal codes via Bluetooth. However, "Immuni does not access your geolocation": this can be verified by consulting the list of permissions required by the app. The app therefore has no access to the user's geolocation but needs to exploit GPS technology to communicate with the operating system, as we can read on image no. 8.

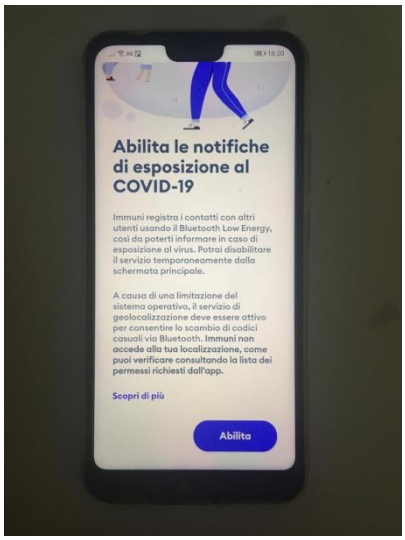

Image no. 7

Image no. 8

Once the user has read and accepted the terms of use, the app runs in the background: provided, of course, that the Bluetooth and GPS of the smartphone always remain active. If Bluetooth and GPS are not active, the app notifies the user that the risk exposure cannot be tracked. The user is no longer required to do any active practice, but s/he should provide the unique code found in the "settings" section (see image no. 9) if he or she should test positive for COVID-19. It should be noted that the application also protects the privacy of citizens by denying the possibility of taking screenshots, which is a relevant aspect and not taken for granted, especially

with reference to the unique code generated to be communicated only to health workers in case of a positive test result for COVID-19.

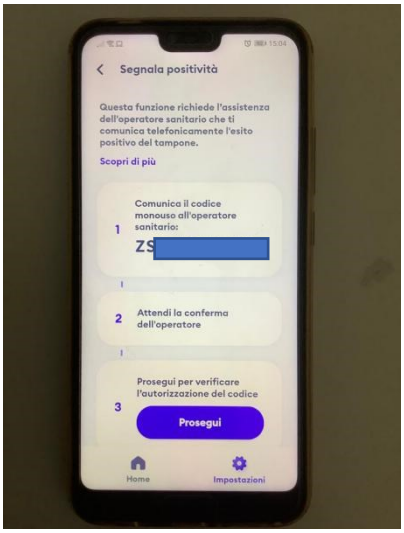

Image no. 9

It is up to the user who tested positive to share the random code generated by the app. This can only be communicated to a healthcare professional who certifies the positive result of the swab and enters the unique code into the digital tracking system. *Immuni* periodically checks the codes collected as positive on the server and compares them to those saved on each user's smartphone, distinguishing exposure to the positive contact by date, duration and signal strength.

From this preliminary investigation of the script, *Immuni* appears to be an extremely user-friendly app, in line with all European privacy regulations. But the data tells us that *Immuni* was a flop: few downloads took place and very few people who tested positive notified this through the app that was supposed to ensure effective and error-free contact tracing.

In this respect, users who have downloaded the application (excluding updates and reinstallations) are only 9.777.739. There are only 3660 positive users who have uploaded their keys. Notifications of possible risk exposure generated by the application are only 74943. But the reporting is biased as

all notifications for iOS devices and only a third of those sent from Android are detected. The data are provided by the Ministry of Health and refers to 11 November 2020 when we had over 35000 infections per day.

All data is available in CSV and JSON format on GitHub: a free basic service commonly used to host open-source projects.[46]

Moreover, *Immuni* is interoperable at European level. For the moment, it is compatible with the apps developed by Germany, Ireland, Spain, and Latvia (Image no 10).

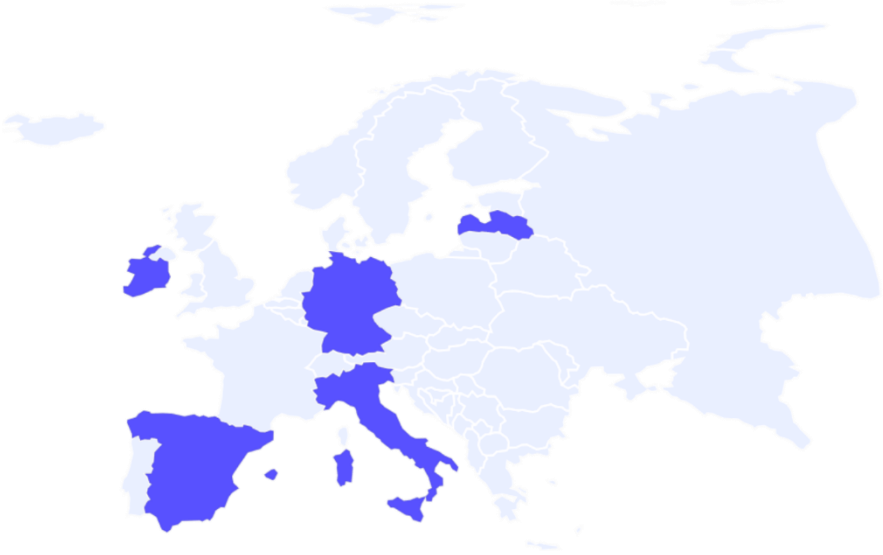

Image no. 10

1.4. Immuni and institutional limits

The app, which works in compliance with European and governmental regulations, is not supported by organisational and healthcare practices. As we have seen, only a healthcare worker in charge of reporting the positive swab result can enter the key code provided by the user into the server.

[46] https://github.com/*Immuni*-app/*Immuni*-dashboard-data/tree/master/dati

Local health authorities, however, often only communicate the result of the swab, sometimes not even that (as we will see thanks to the ethnographic testimony below).

It is true that *Immuni* has only been downloaded by 9,777,739 people, so few times since the data do not consider uninstallations and underuses (just keep Bluetooth and GPS off and the app does not work in the background), but the few notifications sent suggest that health workers do not input the key or that they do not even ask the infected person if he/she has the app.

Immuni is only becoming an app that could quarantine those who use it, which could even turn into a lengthy bureaucratic quarantine. The user who receives the notification of exposure to an infected person has to put himself in trust quarantine for 14 days, with the possibility of reducing this to 10 days if he or she undergoes a molecular swab, prescribed by his or her family doctor. On the contrary, if symptoms appear, he or she must notify his/her family doctor who can prescribe a molecular swab, which can have a long waiting time[47].

The protocols drawn up at national level lose efficiency when they encounter regional differences, clashing with the autonomy that the regions have gained through the amendment of Title V of the Constitution, which delegates powers and competences in health matters to the regions. All this has brought to the forefront the question of the efficiency of the NHS, which has been marked by years of cuts and reductions in healthcare spending, in some cases in favour of privatisation. In this context, the Regional Health Systems (RHS) are the main sources responsible for public health protection, with strong differences at a territorial level, especially as regards the public/private relationship (Giarelli and Vicarelli 2020). For example, in

[47] https://rep.repubblica.it/ws/detail/intervista/2020/10/22/news/intervista_luca_ferrari_immuni-271512665/

Lombardy a mixed public/private system has been built, effectively dismantling health care on a local and territorial basis. Other regions, such as Calabria, which has been managed by the extraordinary commissioner for 10 years, found themselves unprepared to manage the pandemic crisis because of the undersized health workers and the low number of intensive care units, especially in relation to the number of inhabitants.

Moreover, the network of non-hospital territorial garrisons - in which primary care physicians are the main protagonists - shows strong differences between regions. These differences depend on the different policies implemented to purchase personal protective equipment and swab kits or serological tests, but also to organise the territorial network capable to process the results (Giarelli and Vicarelli 2020). The fact also remains that the SSRs do not communicate with each other, so that, for example, prescriptions from a general practitioner in Calabria have no validity in the Lazio region. In this case, the citizen has to resolve bureaucratic quibbles that are sometimes insurmountable if s/he wants or has to undergo a molecular swab. It should be specified that the molecular swab is the only instrument that can certify the negative status of a patient, and in most regions (including Lazio) it can only be prescribed by a general practitioner.

In this context, the *Immuni* app becomes just another tool of uncertainty for citizens who, following a notification of exposure, find themselves deciding whether to place themselves in fiduciary quarantine or to continue working, since not everyone has a job that allows extended absences or smart-working (or perhaps homeworking).

1.5. Auto-ethnography: stories of isolation, bureaucratic quarantine, swabs and work requirements

The following two stories are the result of an auto-ethnography and aim to show the alignments and misalignments of the *Immuni* app placed within sociomaterial public health practices essential to combat the ongoing epidemic.

Story one

> Rome, Monday 2 November 2020, 1:30 pm. The phone rings. It's the lab where my partner had taken the antigen swab a couple of hours earlier. "Positive, high viral load, we advise you take a molecular swab", they say. Immediately after lunch, the long bureaucratic process begins and the endless waits on the phone... After hours of waiting, we receive an answer on the Covid emergency toll-free number. The first operator he manages to speak to says that all he has to do is to take a molecular swab, that must be prescribed by his general practitioners (GP), to certify that he was Covid-19 positive.
>
> What about me? Your cohabitant and partner? I just must do my isolation and, if any symptoms appear, I have to call the toll-free number to warn them.
>
> At this point we notify our respective general practitioners. I must point out that we live in Lazio, but at the time of the events we had the general practitioner in our respective regions of birth. Our doctors advise us that the prescriptions have different codes from region to region, and therefore have no value in a region other than the GP's home region. So, we call the toll-free number of the Lazio region again, which this time advises us to call the *Guardia Medica* after 8 p.m. (they might be able to give a prescription for those coming from outside the

region). Meanwhile, we start making calls to close contacts: friends, two of whom have gone into trust isolation.

At 8:00 p.m. we call to the medical guard. The doctor says he receives many calls with this request, but he cannot prescribe swabs, he says: "call the toll-free number the next day". The next day starts another endless morning of calls and waiting. Internet does not help to clarify doubts, anxiety and perplexities about procedures, that only work on safety protocols, but that lose all validity and efficiency in daily micro-situations. Finally, someone answers the switchboard. It is almost 12:30 pm. Speaking is a lady who tells us that the GP can prescribe the swab if he/she considers it appropriate, even if our residence is not in Lazio and that we have to call back with the prescription to book a swab.

My partner then calls his GP. I call mine. Mine is immediately cooperative, her secretary prescribes me the swab even if I live in another region. She prescribes it and sends me the dematerialised prescription. On the other hand, my partner's doctor is vague about what to do, saying that he does not know if he can prescribe the molecular swab to his patient who lives in another region: he will never send him the dematerialised prescription.

My partner wants to do things right, also because all our friends are anxious, they do not know what to do, and they keep hoping it's just a false-positive. Of course, he is anxious for me too. He wants to send me away, but even there, it makes no sense for me to leave, where should I go? We do not know which of the two is actually positive, maybe one of them could be asymptomatic. Around 4 pm we call the toll-free number again, this time the questions change. The lady on the other side asks why he took an antigenic swab:

"For work"

"Result?"

"76".

"Sir you have a very high viral load, you don't need to do the molecular swab, we classify a result above 10 as Covid positive, so I will report it to the ASL"

"Do you have symptoms?"

"Yes, a bit of coughing and this afternoon my temperature rose to 37.5"

"Okay, do you live alone?"

"No, I live with my partner."

"Fine, you have to stay in separate rooms, wear the masks, eat at different times, sanitize everything you touch, and sanitize the bathroom every time. Give me your details and those of your partner".

"I understand, I am F.G (invented name). Excuse me for asking, but how do I behave at the end of the 10 days of isolation?"

"You must stay 10 days in isolation and then repeat the molecular swab, always with the doctor's prescription, calling the ASL, your partner must stay 14 days in isolation since your last close contact, if symptoms appear you must notify us so that we can start the procedures for booking the molecular swab. In the meantime, you should call your doctor and have the treatment prescribed".

"All right, thanks. What about contact tracing? Should I give you a list of the people I have seen these days? I also have the ***Immuni*** **app**, should I give you the code?"

"You must notify all the people with whom you have been in contact with the past 48 hours prior to the onset of symptoms. While as far as *Immuni* is concerned, I don't know, I am now searching on the Internet".

"All right, thank you."

After the call to the switchboard, he called the ASL to find out how to change doctors, and to ask for confirmation about the protocol to be adopted and how to deal with close contacts because a friend of ours was having problems at work: they required an official document from

the ASL to confirm that one of her close contacts had tested positive for Covid-19.

After waiting half an hour on the phone, someone answers:

"Good morning, I did an antigenic swab yesterday and I tested positive with a high viral load. At the switchboard (after several calls) they told me that with this viral load they would report me directly to the ASL as positive and that therefore it was not necessary to proceed with a molecular swab."

"Wait, you are Mr.?"

"I am F.G."

"Look, there is only one of your notification made in March after returning from abroad, I now am inserting your data in the system too".

[But how?... Do not the systems communicate?]

"All right. I also called you to find out if I am resident here in the Lazio region, because in theory the procedure was completed a few days ago."

"Sir, you are a resident here, you can ask for a general practitioner, but I suggest you delegate someone. In this period everything is slowed down, if you do it by e-mail it will take much longer for them to reply to you".

"All right, thank you. What about the contact list? And for the *Immuni* app?"

"With regard to the contacts you must notify the people with whom you have been in contact with the last 48 hours, before the symptoms appear. As far as the ***Immuni* app is concerned, it is not our responsibility**."

He hung up and checked the *Immuni* app, in fact only a healthcare professional can enter the number into the system and thus report positivity. He tried to contact the laboratory where he made the antigenic swab, but the infinite expectations, physical and mental fatigue

prevailed: devices captured by the Immuni app will never know that they meet a person who has tested positive for Covid-19.

It is Tuesday, two days have passed since the antigenic swab and 3 since the appearance of the first symptoms. I have self-declared, I asked my partner to give my details to the toll-free number, but they did not ask for my number. So no one will call me to find out how I was, if symptoms appeared. We made contact tracing, we self-declared, everything was delegated to our individual responsibility.

Story two

Not everyone can go into trust quarantine without labour repercussions.... many jobs are incompatible with smart working and often the simple trust quarantine has no health insurance cover. So what to do? The only thing to do is to wade through a thousand bureaucratic quibbles, hoping to find understanding from your bosses. This is what happened to a friend of mine (who we shall call M.). She works in the film industry, as a technician in the "photography" sector. She was starting a film on Monday 2 November. She had not worked for months, even before the lockdown, because that's how this job works: you don't work for months, but when you start a new project you earn a lot.

We were together on Saturday 31 October, so when F. warns her of her positivity, M. warns her bosses. Thus, began her fiduciary quarantine. The production company suspends her contract: 'unpaid absence' they call it. On the tenth day they give her an antigenic swab. They cannot do a molecular one, because a prescription from the general practitioner is necessary. But M. does not have a GP here in Rome, she has her residence in Sicily, and even in this case the prescription of a doctor from another region is not valid. So what should she do? She has to

wait at home, and hope that no symptoms appear if she wants to continue working.

To make things a little more complicated, her flatmate warns her that he is coming home (he was at his girlfriend's house) because he is positive. Another element of indecision is added to the situation. But for the moment the only solution is to let the 10 days stipulated in the protocol pass, because the isolation must be passed in the same place where it started, after which she would do the molecular swab at the expense of production. That was the plan. She divides up all the things in the kitchen, one part for her and the other for him, and spends the day locked in her room.

But at this point the situation gets complicated, she now lives with a positive. So, should she report it at work? Should she wait for some sort of call from ASL to figure out her fate? At this point, she decides to call the ASL to self-report her situation, also because her work keeps insisting on some kind of document certifying her situation. ASL just says her that she must stay in isolation, have no contact with the positive and disinfect everything, after 10 days she can take a swab and then go back to work.

That's it, so M. does not alert the production. But there is so much fear. Disinfecting everything is always a bet when you live in a small apartment with a shared bathroom. But they tell her to do it and she does it. She needs to work. The 10 days go by. In the workplace they give her a quick swab. Negative... She goes shopping, comes back to life and thinks about getting a B&B until her flatmate gets negative. But she had made an appointment at a private clinic to take an antigenic swab, and she thought she would go anyway since clinics have very long waiting lists and she did not want to leave them with a hole.

After a couple of hours, the response arrived. “Positive” “So? What to do?” This is a qualitative antigenic tampon. It just says yes/no.

> Positive/negative. It needs a molecular. But how? M. decides to go to the Drive-In in Fiumicino. Fiumicino Drive-In is the only one where you can go without a booking. She tries... she goes there with the prescription from Sicily region. When she gets there, they tell her that they could not accept that prescription. They tell her: "try asking a friend of yours, maybe you will find someone with a good heart who will give you a correct prescription". She calls her mother, who tells her that in the meantime her GP has contracted an illness, he is in the emergency room, but he makes himself available and says that he can talk on the phone with the healthcare professionals... the typical clientelism of the South that does not work here.
>
> So, she calls her partner who has the residence, so also the GP, in Rome. He calls the doctor who gives him a prescription for his girlfriend declaring that she has the residence in Rome... she cannot stand the weight of the bureaucracy anymore, she lies... she says she lives here in Rome to get a swab to be sure she is not positive and to be able to go back to work without infecting other people... The result of this swab is "Negative". She goes home, and books a room in a B&B.
>
> The next day she went back to work.

These two autobiographic stories make visible the associations between humans and non-humans. As human beings we are inevitably entangled together with objects and living beings (Haraway 2016). We are all caught up in local and global connections where objects, humans and livings, produce relational effects. Following the trajectory of an infected person describes a network that crosses territorial and regional boundaries. In this sense, the swab and *Immuni* produce relational and ethical, economic and affective effects. *Immuni* does not work, or rather it is not supported by sociotechnical organizational practices. The script designed by the app is

supported by an IT infrastructure, not supported, however, by health practices at the regional level. This is replaced by a tracing work delegated to citizens which translates into lists of friends and acquaintances met in the previous days to which to send a messages or a e-mail.

At the same time, the practice of swamps forces citizens to regulate their position: the idea of freedom of movement is trapped by bureaucratic quibbles that become immediately visible in situations of evident emergency. This is how, the Lazio region, by not accepting the prescription of an Italian citizen not enrolled in the health system of the Lazio Region, classifies our situation as irregular. This highlights at the same time the atavistic problems of a national system that does not protect mobile (Elliott and Urry 2013) and non-standard housing situations. Mobile lives are invisible in this case; invisible are all those people who share their house with others (often strangers), or those (often young) people who cannot or do not want to establish residence in the place where they live for work or study, in some cases because their lives are too mobile, in others because they have jobs that are too unstable and not recognised and/or protected at an institutional level.

Of course, SSR provides for the possibility to apply for a temporary GP for certain types of citizens (students, workers with regular contracts, and so on). However, these are precarious and unstable solutions that require continuous updates dictated by contractual changes, clashing with the chaotic pre-Covid lives that often led us to postpone the often cumbersome and long bureaucratic formalities. Such a structured SSN makes visible all the inefficiencies that could be filled by loyal cooperation between the State and the Regions (Giarelli and Vicarelli 2020).

As social scientists we are concerned with investigating the consequences and effects of the pandemic. For obvious reasons this chapter cannot be a conclusion, but a starting point for promoting STS as a non-anthropocentric approach capable of making visible the connections between humans and non-humans.

Concluding remarks

Investigating datafication and digital health platforms

This dissertation has taken shape from research interest in studying health grounded in the process of datafication of everyday practices with the theoretical lens of medical sociology, feminist science and technology studies, as well as science and technology studies. I have addressed such issues through two empirical settings: (1) an analysis of health platforms and related apps developed by Google and Apple, and apps for menstrual cycle; (2) thirty semi-structured interviews with women engaged in wellness monitoring through wearables and menstrual tracking apps.

Against this background, in *Chapter One* and *Chapter Two* I set out the theoretical frames, analytical sensibilities and research questions that have animated this study. The analysis has been carried out to stimulate a debate between new materialism approach, feminist criticism and biomedicalization theory. The articulation of this debate in relation to the phenomenon of self-tracking represents a first contribution to the sociological analysis of self-tracking practices and health platforms, a topic that is still relatively young compared to other media and sociological studies on digital surveillance. While the data from self-tracking technologies can be used to surveil and control people (Kitchin and Dodge 2011; Lyon 2002; Zuboff 2019), a materialist approach to the analysis of such technologies can lead to a

problematisation of knowledge practices and ways of thinking enacted by materiality (Lupton 2018; Pink and Fors 2017; Sumartojo et al. 2016; Viseu and Suchman 2010).

With *Chapter three* I have explicated the methodological choices I made in order to attend the research questions that orient this study. The interdisciplinary literature, that I drew on to address the two different empirical fields, has prompted the use of multiple methods to capture the heterogeneous nature of the issues under consideration.

Employing feminist sensibilities has brought me to acknowledge performative character of social inquiry and methods. This has to do with the turn towards an onto-epistemology perspective that informs feminist research (Barad 2007). As Barad (2007) points out, subject-object, knower and known, observer and observed are ontologically inseparable, engaged in practices of knowing. In this study, the recourse to different methods – such as the script's description of health platforms and apps, and semistructured interviews – served as heuristic tool to accomplish two goals: to investigate the assumptions and knowledge inscribed in the materiality of technologies, as well as to reflect upon the sociomaterial practices of knowing enacted through self-tracking devices.

More specifically, in the first field site, I question health platforms and health-related apps as sociomaterial objects that inscribe ideas, worldviews, gender relations and constraints, political and economic issues, translated into matter by layout and content, icons and languages, i.e. graphs, statistics, chronological reports, graphical interfaces and so on. I problematised the relationships between the preventive biomedical knowledge and the technologies that become matter across the process of datafication of bodily functions and behaviours in order to prevent illness and achieve a healthy

lifestyle. In doing so, I have sought to trace some issues in dialogue with feminist approaches and the sociology of medicine to discuss the non-neutral nature of the technique (Oudshoorn, Rommes and Stienstra 2004), such as the tendency to dichotomize gender differences in health while ignoring the wide range of sexual and gender identities (Bird *et al.* 2010; Lorber and Moore 2002; Keller 1982).

In the other field site, which presents interviews with women who use wearables and apps for their menstrual period, I give a voice to the users to investigate the ways in which they are engaged in the process of datafication. In doing so, I sought to bring STS sensibilities by emphasizing the performative character of research methods (Mol 1999; Law 2004, 2009). Particularly, I proposed interviews as a research method produced by the enactment among researcher, participants, theory and data (Mazzei 2003). I carried out the interviews with the aim of questioning the practices of using sociomaterial objects that encourage a datafication of wellbeing and body.

Against this backdrop, in the following paragraph I will discuss concluding remarks about empirical findings drawn in the second part of this dissertation.

Questioning materiality and problematizing biomedicalization

In order to study the model of biomedical prevention grounded in the development of ICTs, that work as extensions of the body, in *Chapter Four* and *Chapter Five* I have started from the analysis of such technologies that are increasingly pervasive in the monitoring of corporal functions.

Chapter Four questions platforms of health constructed by Google and Apple and the ways in which they materialize biomedical knowledge and

gender issues. Such line of inquiry aligns with those analyses that, according to the literature (Clarke 1990; Clarke *et al.* 2010), underscore biomedicalization as a process focused on technoscientific innovations and aimed to transform bodies and identities. Starting from these considerations, I moved within those processes that pinpoint digital technologies, health-related apps and wearables as biomedical objects used to shape people's behaviours. In doing so, I drew on those perspectives that have raised the self-tracking technologies in the society of platforms (Van Dijck *et al.* 2018), to investigate biosensing devices according to new possibilities for self-knowledge of the body on one hand, and the incorporation of gendered knowledge and behavioural management on the other.

Following this line of investigation, the de-scription of Google Fit and Health Apple revolves around the objective of interrogating the potential user imagined by the two Big Tech giants. Investigating the "script" or "scenario" allows to take into account the potential users imagined by the developers, i.e. the symbolic representation of the body as a social space to be translated into the technical content of the objects (Akrich 1992). Consequently, objects embed relationships between humans and non-humans, practices of knowing, ways of ordering the world and even moral judgments. They assign and delegate competencies, actions and responsibilities to potential users.

The study of the two health platforms has revealed how the design can prescribe different users. Apple Health targets a user loyal to their expensive products, one user who trusts in the Apple experience that is synonymous with privacy, security and knowledge of the end user. Google addresses a generalised user with technology that is user-friendly that has plural purposes in order to accommodate pluralistic user experiences.

Google configures a prosumer (Ritzer 2014) by playing with users' needs to track health which is increasingly an individual responsibility (Sanders 2016; Sharon 2017).

At the same time, they convey a representation and classification of the concept of gender that encourages or inhibits specific uses. The design of health-related apps promotes a knowledge of the body without gender health matters, as evidenced by the fact that the feature to track the menstrual cycle was only introduced in late 2019. The design is the same whether one identifies as 'female', 'male', or 'other'. Gender is just one personal detail among others to be added in order to make one's account personal. In this sense, the app looks to construct a 'genderless' design. The appropriation of biomedical knowledge is delegated to the users, who again, become responsible for monitoring their own well-being according to sexual differences, gender fluidity, gender identity and sexual orientation.

This interpretation is supported by the introduction of the menstrual cycle tracking option only after several controversies. However, menstrual monitoring remains unrelated to the rest of digital wellness management. The data do not take the days of the cycle into account when drawing up health reports. It is the user who has to take the arrival of the cycle into account to understand possible correlations.

Giving the option to track menstruations would have undermined the supposed neutrality of the app's design – identical for the female and male sex –; and when the tracking option was introduced the data collected on menstruation is not processed as a tool to promote reflexivity on people's health. Based on these considerations, in *Chapter Five* I question how women's biomedical knowledge is genderized through health-related apps

referring to a controversial topic in both medical research and public debate, namely PSM (Rittenhouse 1991; Clark 1990; Rodin 1992; Romans *et al.* 2012).

In doing so, the gender scripts of a number of apps for menstrual tracking as genderized objects have been analysed (Oudshoorn, Rommes and Stienstra 2004; Oudshoorn 2004). The world of the apps market is extremely heterogeneous. We can find downloaded-oriented apps or start-ups that start from the development of an app to create a platform for gender health (as in the case of Clue). The gender script configures ideal users using algorithms and quantifying PMS or, in general, menstrual experience. In this sense, cycle-related data, statistics and predictions are legitimised by biomedical knowledge, often becoming the foundation on which developers build the scientific quality of their technoscientific objects (Kitchin 2014; Van Dijck *et al.* 2018). However, data are not objective, but carry normative and value models, performed by the technical characteristics of the measurement apparatuses that collect and process the information.

In order to explore the performative character of design and data, I have analysed the adaptations between norms, values and knowledge prescripted and imagined by the designers and the biomedical knowledge related to the menstrual cycle. A grid has been constructed with the aim of comparing the labels of symptoms and moods with the medical categories of premenstrual syndrome, established by the DSM-V to obtain a diagnosis of PMDD (see Grid no. 1x in appendix). It has been necessary to add the "Other" category (Grid no.2x) in order to capture labels that cannot otherwise be overwritten to the medically categorised symptomatology. In some cases, apps do not use medical classification, but in turn classify symptoms and moods using very vague and ambivalent labels (see Grid no.2x in

appendix). Actually, some apps suggest monitoring a very long list of symptoms using sexist labels, as in the case of My Menstrual Calendar – i.e., "Reserved", "Flirtatious", "Smug", "Devilish", "Silly" – and WomanLog – i.e. "Jealous", "Sensual", "Clumsy".

Each app manages symptoms through different categories that highlight different levels of biomedicalization that tend to translate everyday experiences of physical symptoms, biological functions and moods by overlapping them with biomedical knowledge of PMS. They try to add symptoms to the pre-existing list of symptoms to capture the attention of the greatest number of users looking for customisable apps.

In the domain of digital health, the gender script of menstrual-related apps suggests the need to assemble personalized knowledge based on self-tracking practices translated into data (Andrejevic 2014; Boyd and Crawford 2012). Menstrual-related apps make predictions about periods, PMS and fertile windows. They exploit women's subjective experience in order to create a genderized space in which lay and experiential knowledge is hybridised by the biomedical knowledge about PMS and the menstrual cycle. The analysis of the genderization of the materiality sheds light on the issues that feminist critique has long discussed about the patriarchal control over female body. The politics of knowledge construction are critical here, further complicated by the ways in which the process of design is normatively prescribed to justify moral assumptions about biological differences. A similar analysis allows us to challenge those arguments that contribute to stigmatize some conditions such as menstrual period, menopause, or pregnancy as menstruation, menopause, as well as pregnancy as special events to be treated through a biomedicalisation of the female body. At the same time it allows to emphasis those cases where biomedicalization becomes a

resource for recognising cycle-related problems such as endometriosis or PMDD.

Engagement in practice between suggested and inscribed knowledge

In *Chapter Six* I have questioned the ways by which women understand her bodies into human-app-assemblages. The analysis captures the knowing-in-practices of women that use biosensing technologies to manage their lifestyle.

The proposed analysis tries to indagate how the body learns "to be affected" through material configurations processed by the technologies used in every-day life, and how these are incorporated into practices of embodied knowledge. The analysis discusses embodied knowing-in-practices categorized into two forms of engagement, that is the effect of overlapping intra-actions between humans and biosensing devices: a functional engagement and an affective engagement.

The analysis of such engagements between humans and apps shows as bodies learn in sociomaterial assemblages in which, reciprocally, the body shapes how practices are done through technologies, and practices produce new responses performing the body in both social and material ways (Lynch and Cohn 2016; Fox 2017). The result is that self-tracking practices emerge as part of ongoing intra-actions across a range of everyday knowing-in-practices that combine diverse types of knowledge *suggested by* and/or *inscribed in* technologies.

The two forms of engagement assume diverse nuances in thinking about the body in non-clinical spaces. The extracts of the first form analysed describe an engagement focused on an underutilization of apps and wearables (Kline and Pinch 1996). They do not use the technologies as configured by the script, using the presence of the researcher as an ally to understand the knowledge inscribed in it, as Jasmina's testimony shows us. The extracts of the second form describe the process through which knowledge inscribed in the app becomes a way to think about well-being, fertility, ovulation, motherhood, PMS and gender stereotypes. In this case, the data visualisation of daily steps or heartbeats, ovulation and fertility windows combine a daily experience whereupon the body is continually reconfigured as part of the lived experience.

With regard to this point, it is important to note that the interviewees emphasise the difficulty of trusting in *suggested* knowledge. Algorithms and sensors that record the heartbeat or measure the hours of sleep, or predict ovulation days are invisible, which makes it difficult to believe that an algorithm or a sensor can describe biological functioning and graphically represent how one's body reacts to external stimuli. Moreover, the interviewees point out that the practice of monitoring all the information required by the app on a daily basis is very time-consuming, yet self-tracking practices allow them to reflect on some connections otherwise taken for granted. Here, we can see how the boundaries between humans and non-humans are co-constructed and tied to entangled agencies.

This interpretation is also sustained by the examples presented in the section on affective engagement with the matter of wearables and apps. Although self-tracking technologies *suggests* knowledge and practices, women play with them maybe for just a few moments or periods or,

alternatively, for specific necessities, such as when Ada was trying to get pregnant or when Teresa was trying to measure her running progress. Particularly, Ada knew that she would maybe have obtained the same result without the use of apps for menstrual tracking, but it became an ally in the acknowledgement of her ovulation phase. However, Ada used the apps just to keep track of some elements such as the sexual intercourse close to the hypothetical days of ovulation, because it is easier to monitor them with smartphone than with the paper calendar. Otherwise, she did not monitor biological functions that could suggest and predict the actual fertile days. So, it happens that, although self-tracking technologies are designed to act in synergy with the body in order to produce reliable data (Viseu and Suchman 2010), the extracts analysed reveal the mutual translation between what the app suggests monitoring and what the woman actually tracks.

Here, we can see the relational agency that emerge as an effect of the intra-actions between women and apps, given that apps predispose plural configurations that makes woman able to track some hormonal changes or the interrelations between heartbeat and sleep quality, as showed by Sofia's experience. At the same time, women engage with technologies only to record information considered useful in the economy of their everyday lives, as when Giuseppina uses her wearables just to receive notifications of e-mails and incoming calls. It is important to draw attention to the constant renegotiation between how biosensing technologies should be utilised and how they are used in real-life experiences. Here, we can see the process by which the agencies of subjects and objects act symmetrically, producing social relations inscribed into human-app assemblages (Barad 2007; Law and Mol 1995; Lupton 2018).

Affective engagement with materiality is able to render the body sensitive to recognise certain bodily signs, which emerge as the result of intra-actions between expert knowledge inscribed in biosensing technology and lay knowledge embedded in human corporeality. As Maia said, the knowledge inscribed in the app suggests that tracking certain symptoms produces a kind of personal empowerment that leads to recognising the correlation between pain and mood changes and the arrival of menstruation. Furthermore, affective engagement in the datafication of period can be embedded into the *non-use* of some functions in order to enact practices of resistance, as Chiara explains, to the biomedical assumptions inscribed in the app. She tracks just the beginning and the end of menstruation because she complains about the definition of PMS, since recording symptoms and mood is a way of sustaining sexism and taboos around the female period.

A materialism perspective provides to see the body as flows of heterogeneous elements that are multiple, comprised of sociomaterial parts and processes (Sumartojo *et al.* 2016). Materiality is able to render the body sensitive to the differences of the world. We are immersed in assemblages in which we learn to use the body to become sensitive to matter.

The body feels and it moves. It is not finishing with the skin, but it encounters, tastes, hears, and smells other material elements (Gherardi 2019). It is affected by the 'effects' of knowledge, which is embedded and embodied within knowing-in-practices whereby the body is performed by entanglements of relational and dynamical agencies (Suchman 2008). In this background self-tracking technologies come to be matter in the form of measurement apparatuses (Barad 2007) drawing up data in a matrix of expert knowledge and behavioural management on one hand, incorporation of knowing-in-practices on the other.

Even if self-tracking practices produce data that women voluntarily collect in a fragmented way contrary to the real developers' design, they can be a resource for governments and markets (Kitchin and Dodge, 2011; Kitchin 2014). The body is transformed into digital data through practices that enact forms of self-surveillance (Zuboff, 2019) within power relations that exist in sociomaterial assemblages of humans and non-humans.

In the digital society, the power of Big-Tech is based on surveillance, incorporated in the governance of citizenry, and internalised by actors. Analysing self-tracking practices means observing how policymakers and health authorities could monetize their users and create discrete categories (Lyon 2002). For example, health platforms can sell the personal data to third parties such as insurance companies that can monitor the health status of users/patients and decide on the insurance premium. Or even fertility, ovulation and menstrual cycle data, produced through an app, can be used not only by employers, but also by governments, to monitor pregnancy status and also estimate the duration of maternity leaves for female workers.[48]

However, subjects are not just surveilled. The spaces of everyday life become expanded laboratories in which individuals take part in the dynamic of power relations through a range of different practices (Coletta *et al.* 2018). Here, self-tracking practices enact different meanings intertwined with digital measuring apparatuses. These entanglements come back in the form of matter as the product of overlapping intra-actions between humans and nonhumans, in which digital technologies are situated into practices that perform embodied knowing.

[48] Particularly the press is beginning to emphasise that app's developers could sell data to second and third parties. For an overview, it is interesting to cite the articles available on the subject:
https://www.washingtonpost.com/technology/2019/04/10/tracking-your-pregnancy-an-app-may-be-more-public-than-you-think/?noredirect=onandutm_term=.7833e7e2ec3f
https://www.internazionale.it/video/2019/07/23/app-mestruazioni-marketing

Adopting a materialist approach suggests analysing self-tracking practices as experiences of embodied knowing in which the body learns to be affected by intra-actions in more-than-human worlds. This allows us to pay attention to the complexity and heterogeneity of uses, under-uses and non-uses, rather than trapping the experiences of bio-sensing devices within discourses that only emphasise data surveillance issues. The nostalgic longing for a supposedly better past might be a response rooted in the dominant and patriarchal culture (Braidotti 2019). In contrast, adopting a feminist criticism allows us to see the challenges imposed by the ongoing crisis of conventional values as an opportunity to imagine possible future in order to rethink a corporality fully crossed by more than human worlds.

Health, platforms and technologies in time of pandemic

The interdisciplinary approaches of STS and FTS presented in this dissertation take up the challenge that the health emergency has posed to social scientists. As illustrated, for decades STS studies have been intertwined with other languages and disciplines such as computer science, biology, physics, architecture, engineering etc. The Covid-19 pandemic has not only confronted social scientists with the need to be open to dialogue with other scientists but has also made visible the inevitable interconnection between science, technology and politics (Viteritti 2020).

Against this background, this dissertation has questioned the development of the *Immuni* app as the effect of socio-technical elements. With this aim, *Chapter 2020* describes the story of *Immuni*'s failure. The app is part of efforts to promote technical surveillance solutions – from drones, to apps,

to biomedical recognition devices – to monitor people's movements and track virus carriers.

Reassurances by governments and companies about the effects of these technologies on civil liberties and user privacy were not well received by citizens, who perceived the technologies developed and used for surveillance and contact tracing as invasive. The lockdown in March and the various restrictions in recent months have had the effect of renegotiating common sense (Affuso *et al.* 2020). Social networks and digital platforms have become the space that enables sharing, emotional and working relationships. The great migration towards digital platforms has not led to a rethinking of the logic of intermediation. The pre Covid-19 space and time has simply been translated into digital form, even though the digital has another time and space, made up of data flows.

Digital platforms have become the new everyday space in which we move. We move from one platform to another, depending on the institution we belong to and the type of social exchange: distance learning, work calls, video calls with friends and parents. The Big Five process these online interactions that are generating a huge amount of data and thus economic value. They offer an intermediary service that make the platforms, that works thanks our personal data, much more indispensable (Van Dijck *et al.* 2018). The most recurring questions when it comes to digital tracing is: why do we easily grant our data to the Big Five, but oppose the use of smartphones to track our contacts?

Answering this question is beyond the scope of this dissertation. The aim here is to reflect on the situated nature of surveillance technologies. In recent months, data have established blocks and restrictions on personal freedoms. At the policy and healthcare level, accountability practices have

been implemented to make the process of datafication as transparent as possible: from the number of swabs processed daily, to the number of intensive care beds available, to the number of daily deaths and so on. This numerical synthesis has required great interdisciplinary efforts to create operational definitions in order to make comparable, so interoperable, databases that comes from very different institutions and contexts.

Citizens are undoubtedly more aware of what is meant by datafication and digitalisation of processes. However, digitalisation generates new forms of discrimination due to the digital divide, or the lack of Internet connection, or not having a smartphone or other devices that allow for the connection speed required by the new platforms. As social researchers, we need to reveal the political, social and economic character of the data. Since they are constructed in different contexts with different methodologies, what they tell us also depends on the measuring apparatuses that are embedded in the data collection.

As mentioned in chapter 2020, the Italian contact tracing app is an open-source software, and it is transparent about the use of data. Moreover, Bending Spoon - the company that developed the app -, in agreement with the government, is implementing accountability practices on the data produced by the app itself by making public the *Immuni*'s numbers in CSV and JSON formats on both a temporal and regional basis: from the number of downloads to the notifications of exposure to infection sent. Then why is it a story of failure?

Actually, the app for tracking virus carriers is in addition to other surveillance technologies, already embedded in daily activities, that allow monitoring citizens' movements and biometric information – such us facial recognition and fingerprint –, feeding into the data that government already

has: from the data produced by Google Maps, to the data from drones monitoring traffic, as well as technologies used to monitor flows on mobility systems like subways, buses, planes and trains. In this surveillance system, *Immuni* nurtures a perception of control and surveillance, which arose during the first lockdown, when it was necessary to justify any movement by producing a self-certification. In addition, the requirement to keep active Bluetooth and GPS constantly reminds the user that their contacts are being monitored and tracked. *Immuni* only works if the user decides to keep on Bluetooth and GPS, options that are often only activated when necessary, sometimes for privacy reasons, other times to save battery power. The fact that the app only works when these communication protocols are active is a reminder that you can choose to implement practices to resist digital surveillance.

Following the trajectory of the *Immuni* app allows us to describe the intra-actions between Big Tech and governments, healthcare and citizens, along with local and political interests. This is a story of failures, as well as of re-configuring knowledge(s):

- The collaboration between Google and Apple has made their operating systems interoperable, making new futures possible for the development of apps that use Bluetooth to transfer data between devices with different operating systems.
- Technical concepts such as API and interoperability have become topics of public discussion, shaping new expertise, skills and knowledge. Again, the pandemic has made visible how controversies are the rule and not the exception in the process of techno-scientific production.

- Science has left the labs, making the technoscience engagements – namely, interconnections between science, technology, politics and society – increasingly evident.

Chapter 2020 wants to leave questions open. The most important challenge is to be able to imagine a new future by adopting a non-anthropocentric point of view. As humans we are elements that intra-act together with other livings, animal, material, social, and technical elements in a process of mutual constitution of non-linear, hybrid and non-sequential relational effects. We are part of the space together with sociomaterial objects that are increasingly digitalising our practices and our experiences of embodiment. Social sciences should be able to adopt analytical categories and theoretical perspectives in order to make visible connections, associations and engagements between humans and non-humans, livings and non-livings in a pandemic period that has made it necessary to rethink the intertwining of science, technology, social, nature and politics.

REFERENCES

Affuso, O., Agodi M. C., Ceravolo F.A. (2020) *Scienza, expertise e senso comune: dimensioni simboliche e sociomateriali della pandemia*, in "AIS", No. 16, Egea, pp. 57-68.

Agenda Digitale, *Coronavirus, app e sistemi per tracciare i positivi: come funzionano (nel mondo, in Italia)*, in https://www.agendadigitale.eu/sicurezza/privacy/coronavirus-i-sistemi-per-tracciare-i-positivi-come-funzionano/, retrieved December, 2020.

Akrich, M. (1992) *The De-scription of Technical Objects*, in W.E. Bijker and J. Law (eds.) *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Cambridge, MA: MIT Press.

Akrich, M. and Latour, B. (1992) *A Summary of a Conveninet Vocabulary for the Semiotics of Human and Nonhuman assemblies*, in W.E. Bijker and J. Law (eds.) *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Cambridge, MA: MIT Press.

Allen, A. L. (2008) *Dredging up the Past: Lifelogging, Memory, and Surveillance*, in "The University of Chicago Law Review", 75 (1), pp. 47–74.

American Psychiatric Association (2013) *Diagnostic and Statistical Manual of Mental Disorders*, APA, Washington DC.

Andrejevic, M. (2013) *Estranged free labor*, in "Digital labor: The internet as playground and factory", pp. 149-164.

Andrejevic, M. (2014) *Big data, big questions| the big data divide*, in "International Journal of Communication", 8, 17.

Ashton, J., and Seymour, H. (1988) *The new public health* (Vol. 1), Milton Keynes, Open University Press.

Endicott, J. et al. (1999). Is premenstrual dysphoric disorder a distinct clinical entity? *Journal of Women's Health and Gender-Based Medicine*, 12 (5).

Barad, K. (1999). Agential realism: Feminist interventions in understanding scientific practices. In M. Biagioli, *The Science Studies Reader*, 1-11.

Barad, K. (2003) *Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter*, in "Signs", Journal of Women in Culture and Society, 28(3), pp. 801-831.

Barad, K. (2007), Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning, Duke University Press.

Beer, D. and Burrows, R. (2013) *Popular Culture, Digital Archives and the New Social Life of Data*, in "Theory, Culture & Society", 30(4), pp. 47-71.

Berg, M., and Harterink, P. (2004) *Embodying the patient: Records and bodies in early 20th-century US medical* practice, in Body & Society, 10(2-3), pp. 13-41.

Better Health Commission (1986) *Looking Forward to Better Health: Volume One*, Canberra, Commonwealth of Australia.

Biancheri, R. (2014), *Genere e salute tra prevenzione e cura*, in "Salute e Società, n.1.

Bird, C. E., Conrad, P., Fremont, A. M. and Timmermans, S. (eds.) (2010) *Handbook of Medical Sociology*, Nashville, Vanderbilt University Press.

Bossewitch, J. and Sinnreich, A. (2013) *The End of Forgetting: Strategic Agency Beyond the Panopticon*, in "New Media & Society", 15(2), pp. 224-242.

Bowker, G. C. and Star, S. L. (1999) *Sorting things out: Classification and its consequences*, MIT press.

Boyd, D. and Crawford, K. (2012) *Critical Questions for Big Data: Provocations for a Cultural, Technological, and Scholarly Phenomenon*, in "Information, Communication & Society", 15(5), pp. 662-679.

Braidotti, R. (2013) *Metamorphoses: Towards a materialist theory of becoming*, John Wiley & Sons.

Braidotti, R. (2019) *Materialismo radicale. Itinerari etici per cyborg e cattive* ragazze, Meltemi.

Butler, J. (1990) *Gender trouble. Feminism and the subversion of identity*, New York, Routledge.

Callon, M. (1984) *Some elements of a sociology of translation. Domestication of the scallops and the fishermen of St Brieuc Bay*, in "The Sociological review", 32, pp. 196-233.

Cambrosio, A., Bourret, P., Rabeharisoa, V. e Callon, M. (2014) *Big data and the collective turn in biomedicine. How should we analyze post-genomic practices?*, in "Tecnoscienza: Italian Journal of Science & Technology Studies", 5, 1, pp. 11-42.

Cambrosio, A., Keating, P., Schlich, T. e Weisz, G. (2006) *Regulatory objectivity and the generation and management of evidence in medicine*, in "Social Science & Medicine", 63, 1, pp. 189-199.

Cartwright, L. (1995) *Screening the body: Tracing medicine's visual culture*, U of Minnesota Press.

Cavoukian, A. (2009) *Privacy by design: The 7 foundational principles*, in "Information and privacy commissioner of Ontario", Canada, 5.

Clarke, A. E. and Shim, J. K. (2009) *Medicalizzazione e biomedicalizzazione rivisitate: tecno-scienze e trasformazioni di salute, malattia e biomedicina*, in "Salute e società", pp.1000-1035.

Clarke, A., E. (1998) *Disciplining Reproduction: Modernity, American Life Sciences, and the Problems of Sex*, Berkeley, University of California Press, http://ark.cdlib.org/ark:/13030/ft8d5nb4tm/.

Clarke, A.E. (1990) *Controversy and the development of reproductive sciences*, in "Social Problems", 37 (1), pp. 18-37.

Clarke, A.E., Shim, J.K., Mamo, L., Fosket, J.R., Fishman, J.R. (2003), *Biomedicalization: Technoscientific Transformations of health, illness, and U.S. biomedicine*, in "American Sociological Review", 68, pp. 161-194.

Cockburn, C. (1992) *The circuit of technology: Gender, identity and power,* in Hirsch, E., & Silverstone, R. (eds.) (2003) *Consuming technologies: Media and information in domestic spaces,* London and New York, Routledge.

Cockburn, C., and Omrod, S. (1993) *Gender in the microwave world*, "Gender and technology in the making", pp. 41-74.

Coletta, C., Heaphy, L., Perng, S.Y. and Waller, L. (2018) *Data-driven Cities? Digital Urbanism and its Proxies: Introduction*, in "TECNOSCIENZA" Italian Journal of Science & Technology Studies, 8(2), pp. 5-18.

Collins, H.M. (1974) *The TEA set. Tacit knowledge and scientific networks*, in "Science Studies", 4, pp. 165-186.

Collins, H.M. (1981), *Stages in the empirical programme of relativism*, in "Social Studies of Science", 11, 1, pp. 3-10.

Connell, R. (1987) *Gender and power*, Cambridge, Polity Press.

Conrad, P. (1992) *Medicalization and social control*, in Annual Review of Sociology, 18(1), pp. 209-232.

Conrad, P. (2005) *The shifting engines of medicalization*, in "Journal of Health and Social Behavior", 46(1), pp. 3-14.

Conrad, P., and Barker, K., K. (2010) *The social construction of illness: Key insights and policy implications*, in "Journal of health and social behavior", 51(1_suppl), pp. S67-S79.

Coreil, J., Levin, J. S., & Jaco, E. G. (1985) *Life style—an emergent concept in the socio-medical sciences*, in "Culture, Medicine and Psychiatry", 9(4), pp. 423-437.

Crabu, S. (2016) *Translational biomedicine in action: Constructing biomarkers across laboratory and benchside*, in "Social Theory & Health", 14(3), pp. 312-331.

Crabu, S. (2020) *Salute, cura e biomedicina*, in P. Magaudda, F. Neresini (eds.) *Gli studi sociali sulla scienza e la tecnologia*, Bologna, il Mulino.

Crawford K., Lingel J., and Karppi T. (2015) *A more measured you: A hundred years of self-tracking from the weight scale to the wearable*, in "European Journal of Cultural Studies", Vol. 18(4-5), pp. 479 –496.

De Vita, L., Sciannamblo, M. and Viteritti, A. (2016) *Re-thinking Intersectionality Through Science and Technology Studies: Trajectories of Women in Technoscientific Fields* in "Rassegna Italiana di Sociologia", 57(3), pp. 503-524.

Dolata, U. (2017). *Apple, Amazon, Google, Facebook, Microsoft: Market concentration-competition-innovation strategies*, No. 2017-01, SOI Discussion Paper.

Elliott, A., and Urry, J. (2013) *Vite mobili*, Il mulino.

Esmonde, K. (2018) *Tracing the feedback loop: A Foucauldian and actor-network-theory examination of heart rate monitors in a physical education classroom* in "Sport, Education and Society", pp. 1-13, doi:10.1080/13573322.2018.1432480

Espeland, W. N., and Stevens, M. L. (2008), *A sociology of quantification*, in "European Journal of Sociology/Archives Européennes de Sociologie", 49(3), pp. 401-436.

European Commission (2020) *Europe 2020: Commission proposes new economic strategy*, Archived 6 March 2010 at the Wayback Machine, retrieved 5 March 2010.

Figert, A. E. (2005) *Premenstrual syndrome as scientific and cultural artifact*, in "Integrative Physiological & Behavioral Science", 40(2), pp. 102-113.

Foucault M. (1975), *I corpi docili*, in *Sorvegliare e Punire*, trad. it. Einaudi, Torino, 1975.

Foucault, M. (1985) *The History of Sexuality Vol. 3: The Care of the Self*, trans. Robert Hurley, New York, Pantheon.

Foucault, M. (1988) *Technologies of the self: A seminar with Michel Foucault*, Univ of Massachusetts Press.

Fox, N. J. (2015) *Personal health technologies, micropolitics and resistance: A new materialist analysis*, in "Health", 21(2), pp. 136-153.

Fuchs, C. (2010) *Alternative media as critical media*, in "European journal of social theory", 13(2), pp. 173-192.

Fuchs, C., Hofkirchner, W., Schafranek, M., et al. (2010) *Theoretical foundations of the web: Cognition, communication, and co-operation. Towards an understanding of Web 1.0, 2.0, 3.*0, in "Future Internet", 2(1), pp. 41–59.

Gherardi, S. (2016) *Sociomateriality in posthuman practice theory*, in Hui, A., Schatzki, T., and Shove, E. (eds.) (2016) *The nexus of practices: Connections, constellations, practitioners*, (pp. 50-63), Routledge.

Gherardi, S. (2019) *How to conduct a practice-based study: Problems and methods*, Edward Elgar Publishing.

Giancola O., Viteritti A. (2015) *Il ruolo delle grandi survey in campo educativo. L'indagine PISA e il governo dell'educazione tramite i numeri*, in "RASSEGNA ITALIANA DI SOCIOLOGIA", no. 3-4.

Giarelli, G., and Vicarelli, G. (2020) *Politiche e sistemi sanitari al tempo della pandemia da Covid-19: una lettura sociologica,* in "AIS", Egea, no. 16, pp. 69-86.

Giddens, A. (1991) *Modernity and self-identity: Self and society in the late modern age*, Stanford university press.

Giddens, A. (1999) *Runaway world: How globalization is reshaping our lives*, London, Profile Books.

Giddens, A. (2013) *The transformation of intimacy: Sexuality, love and eroticism in modern societies*, John Wiley & Sons.

Grint, K., Gill, R. M., and Gill, R. (eds.) (1995) *The gender-technology relation: contemporary theory and research*, Taylor & Francis.

Star, S. L., and Griesemer, J. R. (1989) *Institutional ecology, translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39* in Social studies of science, 19(3), 387-420.

Haggerty, K. D. and Ericson R. V (2000), *The surveillant assemblage*, in "The British journal of sociology", 51(4), pp. 605-622.

Haraway, D. (1988) *Situated knowledges: The science question in feminism and the privilege of partial perspective*, in "Feminist studies", 14(3), pp. 575-599.

Haraway, D. J. (1997) *Modest−Witness@Second−Millennium.FemaleMan−Meets− OncoMouse: Feminism and Technoscience*, New York, Routledge.

Haraway, D. J. (2016) *Staying with the trouble: Making kin in the Chthulucene*, Duke University Press.

Harding, S. G. (1986) *The science question in feminism*, Ithaca, Cornell University Press.

Houppert, K. (1999) *The curse: Confronting the last unmentionable taboo: Menstruation*, Macmillan.

Internazionale, *Chi guadagna con le tue mestruazioni*, in https://www.internazionale.it/video/2019/07/23/app-mestruazioni-marketing, (retrieved August 10, 2019).

Jedlowski, P. (2008) *Il sapere dell'esperienza: fra l'abitudine e il dubbio*, Roma, Carocci.

Jones, S. H., Adams, T. E. and Ellis, C. (eds.) (2016) *Handbook of autoethnography*, Routledge.

Kelion, L. (2020) *Coronavirus: NHS contact tracing app to target 80% of smartphone users*, BBC News, in https://www.bbc.com/news/technology-52294896, retrieved December 2020.

Keller, E. F. (1982) *Feminism and science*, in "Signs: Journal of Women in Culture and Society", 7(3), pp. 589-602.

Kitchin R., McArdle G. (2016) *What makes Big Data, Big Data? Exploring the ontological characteristics of 26 datasets*, in "Big Data & Society", pp. 1–10.

Kitchin, R. (2014) *Big Data, New Epistemologies and Paradigm Shifts*, in "Big Data & Society", 1(1), pp. 1-12.

Kitchin, R. (2020) *Civil liberties or public health, or civil liberties and public health? Using surveillance technologies to tackle the spread of COVID-19*, in "Space and Polity", DOI: 10.1080/13562576.2020.1770587

Kitchin, R. and Dodge, M. (2007) *Rethinking Maps*. *Progress*, in "Human Geography", 31(3), pp. 331-344.

Kitchin, R. and Dodge, M. (2011) *Code/Space: Software and Everyday Life*, Cambridge, MA, Mit Press.

Kline, R. R. (2002) *Resisting development, reinventing modernity: Rural electrification in the United States before World War II*, in "Environmental Values", 11(3), 327-344.

Kline, R., and Pinch, T. (1996) *Users as agents of technological change: The social construction of the automobile in the rural United States*, in "Technology and culture", 37(4), pp. 763-795.

Knorr-Cetina, K. (1981) *The Manufacture of Knowledge. An Essay on the Constructivist and Contextual Nature of Science*, Oxford, Pergamon Press.

Kratzke, C., and Cox, C. (2012) *Smartphone technology and apps: rapidly changing health promotion*, in "Global Journal of Health Education and Promotion", *15*(1).

Latour, B. (1987) *Science in Action. How to Follow Scientists and Engineers Through Society*, Cambridge, Harvard University Press.

Latour, B. (1992) *Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts*, in W.E. Bijker and J. Law (eds.) *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Cambridge, MA: MIT Press, pp. 225–258.

Latour, B. (1998) *Essays on science and society: From the World of Science to the World of Research?*, in "Science", 280(5361), pp. 208-209.

Latour, B. (2004) *How to Talk about the Body? The Normative Dimensions of Science Studies*, in "Body and Society", 10, pp. 205–29.

Latour, B. (2005*) Reassembling the Social: an introduction to Actor-Network Theory*, Oxford University Press.

Latour, B., and Woolgar, S. (1979) *Laboratory Life. The Social Construction of Scientific Facts*, Beverly Hills, Sage.

Law, J. (1987) *Technology and heterogeneous engineering. The case of Portuguese expansion*, in Bijker, W.E., Hughes, T.P. e Pinch, T. (1987) (eds.), *The Social Construction of Technical Systems. New Directions in the Sociology and History of Technology*, Cambridge, MA, The MIT Press.

Law, J. (1992) *Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity*, in "Systems Practice", 5, pp. 379-93.

Law, J. (2004) *After method: Mess in social science research*, Routledge.

Law, J. (2009) *Seeing Like a Survey*, in "Cultural Sociology", 3(2), pp. 239-256.

Law, J. and Mol, A. (1995) *Notes on Materiality and Sociality*, in "The Sociological Review", 43(2), pp.274-294.

Lee, V. R. (2013) *The Quantified Self (QS) movement and some emerging opportunities for the educational technology field*, in "Educational Technology", pp. 39-42.

Leonelli, S. (2020) *Data Science in Times of Pan(dem)ic*, in "Harvard Data Science Review", https://doi.org/10.1162/99608f92.fbb1bdd6, retrieved November 27, 2020.

Li, I., Dey, A. K. and Forlizzi, J. (2011) *Understanding my data, myself: supporting self-reflection with ubicomp technologies*, in "Proceedings of the 13th international conference on Ubiquitous computing", pp. 405-414.

Lorber, J., and Moore, L. J. (2002) *Gender and the social construction of illness*, Rowman, Altamira.

Lupton, D. (1995) *The imperative of health: Public health and the regulated body*, Sage.

Lupton, D. (2013) *Quantifying the Body: Monitoring and Measuring Health in the Age of mHealth technologies*, in "Critical Public Health", 23(4), pp. 393-403.

Lupton, D. (2015) *Quantified Sex: A Critical Analysis of Sexual and Reproductive Self-Tracking Using Apps*, in "Culture, Health & Sexuality," 17(4), pp. 440-453.

Lupton, D. (2016a) *Towards critical digital health studies: Reflections on two decades of research in health and the way forward,* in "Health", 20(1), pp. 49-61.

Lupton, D. (2016b) *The Quantified Self*, New York, John Wiley & Sons.

Lupton, D. (2018) *'I just want it to be done, done, done!' food tracking apps, affects, and agential capacities*, in "Multimodal Technologies and Interaction", 2(2), pp. 2-29.

Lupton, D. (2019) *Data selves: More-than-human perspectives*, John Wiley & Sons.

Lupton, D. (2020b) *The Sociology of Mobile Apps*, Pre-print of chapter for the forthcoming *The Oxford Handbook of Sociology and Digital Media*, edited by Deana Rohlinger and Sarah Sobieraj, New York, Oxford.

Lupton, D. (editor) (2020a) *Doing fieldwork in a pandemic (crowd-sourced document)*, in https://docs.google.com/document/d/1clGjGABB2h2qbduT-gfqribHmog9B6P0NvMgVuiHZCl8/edit?ts=5e88ae0a#, retrieved December, 2020.

Lupton, D., and Jutel, A. (2015) *'It's like having a physician in your pocket!' A critical analysis of selfdiagnosis smartphone apps*, in "Social Science and Medicine", 133, pp. 128–135.

Lynch, R. and Cohn, S. (2016) *In the Loop: Practices of Self-Monitoring from Accounts by Trial Participants*, in "Health", 20(5), pp. 523-538.

Lyon, D. (2002) *Surveillance Studies: Understanding Visibility, Mobility and the Phenetic fix*, in "Surveillance & Society", 1(1), pp. 1-7.

Magaudda, P. and Neresini, P. (eds.) (2020) *Gli studi sociali sulla scienza e la tecnologia*, Bologna, il Mulino.

Mann, S. and Ferenbok, J. (2013) *New Media and the Power Politics of Sousveillance in a Surveillance-Dominated World*, in "Surveillance & Society", 11(1/2), pp. 18-34.

Markens, S. (2016) *Premenstrual Syndrome (PMS)*, in "The Wiley Blackwell Encycopedia of Gender and Sexuality Studies".

Mattozzi, A. (eds.) (2006) *Il senso degli oggetti tecnici*, Roma, Meltemi.

Maturo, A. and Setiffi, F. (2016) *The Gamification of Risk: How Health Apps Foster Self-Confidence and Why This Is Not Enough*, in "Health, Risk & Society", 17(7-8), pp. 477-494.

Mazzei, L.A. (2013) *A Voice Without Organs: Interviewing in Posthumanist Research*, in "International Journal of Qualitative Studies in Education", 26(6), pp. 732-740.

McGaw, A. J. (1996) *Reconceiving Technology: Why Feminine Technologies Matter*, in P. R., Wright, *Gender and Archaeology, University of Pennsylvania*, pp. 52-75.

McGrath, M. J., Ni Scanaill, C., and Nafus, D. (2013) *Sensor technologies: healthcare, wellness, and environmental applications*, Springer Nature.

Michael, M., and Lupton, D. (2016) *Toward a manifesto for the 'public understanding of big data'*, in "Public Understanding of Science", 25(1), pp. 104-116.

Ministero della Salute, *App Immuni: disponibile negli store di Apple e Google,* in http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioNotizieNuovoCoronavirus.jsp?lingua=italiano&menu=notizie&p=dalministero&id=4852, retrieved December, 2020.

Minkler, M. (1989) *Health education, health promotion and the open society: an historical perspective*, in "Health Education Quarterly", 16(1), 17.

Mol, A. (1999) *Ontological politics. A word and some questions*, in "The Sociological Review", 47(S1), pp. 74-89.

Mol, A. and Law, J. (2004) *Embodied Action, Enacted Bodies: The Example of Hypoglycaemia*, in "Body & society", 10(2-3), pp. 43-62.

Moretti, V. and Morsello, B. (2017) *Self–Management and Type 1 Diabetes. How Technology Redefines Illness*, in "TECNOSCIENZA, Italian Journal of Science & Technology Studies", 8(1), pp. 51-72.

Morsello, B. and Moretti, V. (2017) *Your health in numbers. A sociological analysis of two Quantified-self Communities*, in "Salute e società", XVI, 3/2017, pp. 214-227.

Oudshoorn, N. (2011) *Telecare technologies and the transformation of healthcare*, Springer.

Oudshoorn, N., Rommes, E., and Stienstra, M. (2004) *Configuring the user as everybody: Gender and design cultures in information and communication technologies*, in "Science, Technology & Human Values", 29(1), pp. 30-63.

Pantzar, M. and Ruckenstein, M. (2015) *The Heart of Everyday Analytics: Emotional, Material and Practical Extensions in Self-Tracking Market*, in "Consumption Markets & Culture", 18(1), pp. 92-109.

Pattison, S. and Player, D. (1990) *Health education: the political tensions*, in S. Doxiadis (eds.) *Ethics in Health Education*, Chichester, John Wiley and Sons, pp. 63-79.

Perrotta, M. (2013) *Creating Human Life Itself. The Emerging Meanings of Reproductive Cells among Science, State and Religion*, in "TECNOSCIENZA: Italian Journal of Science & Technology Studies", 4(1), pp. 7-22.

Pink, S. and Fors, V. (2017) *Self-Tracking and Mobile Media: New Digital Materialities*, in "Mobile Media & Communication", 5(3), pp. 219-238.

Pitts, V. (2004) *Illness and Internet empowerment: writing and reading breast cancer in cyberspace*, in "Health", 8(1), 33-59.

Polanyi, M. (1966) *The Tacit Dimension*, Chicago, University of Chicago Press.

Pols, J. (2012) *Care at a distance: on the closeness of technology*, Amsterdam University Press.

Repubblica, *Coronavirus, scelta l'app per il tracciamento dei contagi: si chiamerà Immuni*, in https://www.repubblica.it/politica/2020/04/16/news/coronavirus_scelta_l_app_per_il_tracciamento_dei_contagi_si_chiamera_immuni-254235342/?ref=RHPPTP-BH-I254238616-C12-P6-S2.4-T1, retrieved December, 2020.

Repubblica, *Un call center unico per avvisare i positivi. E Immuni funzionerà*, in https://rep.repubblica.it/ws/detail/intervista/2020/10/22/news/intervista_luca_ferrari_immuni-271512665/, retrieved December, 2020.

Rittenhouse, C.A. (1991) *The Emergence of Premenstrual Syndrome as a Social Problem*, in "Social Problems", 38(3), pp. 412-425.

Ritzer, G. (2014) *Prosumption: Evolution, revolution, or eternal return of the same?*, in "Journal of Consumer Culture", 14(1), 3-24.

Rodin, M. (1992) *The social construction of premenstrual syndrome*, in "Social Science & Medicine", 35(1), pp. 49-56.

Romans, S., Clarkson, R., Einstein, G., Petrovic, M., and Stewart, D. (2012) *Mood and the menstrual cycle: a review of prospective data studies*, in "Gender Medicine", *9*(5), pp. 361-384.

Ruppert, E., Law, J., & Savage, M. (2013) *Reassembling social science methods: The challenge of digital devices*, in "Theory, culture & society", 30(4), pp. 22-46.

Sanders, R. (2016) *Self-tracking in the Digital Era: Biopower, Patriarchy, and the New Biometric Body Projects*, in "Body&Society", pp. 1-28.

Schutz, A. (1962) *On multiple realities (1945)*, in "Collected papers I", The Hague, Nijhoff.

Sharon, T. (2017) *Self-tracking for health and the quantified self: Re-articulating autonomy, solidarity, and authenticity in an age of personalized healthcare*, in "Philosophy & Technology", *30*(1), pp. 93-121.

Shedelman, G. (2010) *Technokids? Insulin Pumps Incorporated in Young People's Bodies and Lives*, in J. Edwards, P. Harvey, and P. Wade (eds.) (2010), *Technologized Images, Technologized Bodies*, Oxford, Berghahn Books, pp. 137-160.

Sismondo, S. (2010) *An introduction to science and technology studies* (Vol. 1), Chichester, Wiley-Blackwell.

Stokel-Walker, C. (2020) *Can mobile contact-tracing apps help lift lockdown? BBC Future*, in https://www.bbc.com/future/article/20200415-covid-19-could-bluetooth-contact-tracingend-lockdown-early, retrieved December 2020.

Suchman, L. (2008) *Human-Machine Reconsidered* (draft), Published by the Department of Sociology, Lancaster University in http://www.lancaster.ac.uk/sociclogy/soc0401s.html (retrieved March 2020).

Sumartojo, S., Pink, S., Lupton, D. and LaBond, C. H. (2016) *The Affective Intensities of Datafied Space*, in "Emotion, Space and Society", 21, pp. 33-40.

Tang, Q. (2020) *Privacy-preserving contact tracing: current solutions and open questions*, in arXiv preprint.

Thompson, C. (2005) *Making parents: The ontological choreography of reproductive technologies*, MIT press.

Tones, K. (1993) *Changing theory and practice: trends in methods, strategies and settings in health education*, in "Health Education Journal", 52(3), pp. 125-139.

Turner, B. S. (1995) *Medical power and social knowledge*, Sage.

Turow, J. (2012) *The daily you: How the new advertising industry is defining your identity and your worth*, Yale University Press.

Van Dijck, J. (2014) *Datafication, Dataism and Dataveillance: Big Data Between Scientific Paradigm and Ideology*, in "Surveillance & Society", 12(2), pp. 197-208.

Van Dijck, J., Poell, T., De Waal, M. (2018) *The platform society: Public values in a connective world*, Oxford University Press.

Veal, A.J. (1993) *The concept of lifestyle: a review*, in "Leisure Studies", 12(4), pp. 233-52.

Viseu, A. and Suchman, L. (2010) *Wearable Augmentations: Imaginaries of the Informed Body*, in J. Edwards, P. Harvey, and P. Wade (eds.), *Technologized Images, Technologized Bodies*, Oxford Berghahn Books, pp. 161-184.

Viteritti, A. (2012) *Scienza in formazione. Corpi, materialità e scrittura in laboratorio*, Milano, Edizioni Guerini e Associati.

Viteritti, A., (2020) *Frammenti di un discorso sociologico. Ovvero come la pandemia mette alla prova le scienze sociali*, in "AIS", Egea, No. 16, pp.237-255 (available at: https://sociologiaitaliana.egeaonline.it/it/21/archivio-rivista/rivista/3448053/articolo/3448147)

Wajcman, J. (1991) *Feminism confronts technology*, Penn State Press.

Walker, A. (1995) *Theory and methodology in premenstrual syndrome research*, in "Social Science & Medicine", 41(6), pp. 793-800.

Washington Post, *Tracking your Pregnancy: An App may be More Public than You* think, in https://www.washingtonpost.com/technology/2019/04/10/tracking-your-pregnancy-an-app-may-be-more-public-than-you-think/?noredirect=on&utm_term=.7833e7e2ec3f, (retrieved May 10, 2019).

Wearing, B., Wearing, S. (1992) *Identity and the commodification of leisure*, in "Leisure Studies", 11(1), pp. 3-18.

Wolf, G. (2009) *Know Thyself: Tracking Every Facet of Life, from Sleep to Mood to Pain*, in http://archive.wired.com/medtech/health/magazine/17-07/lbnp_knowthyself?currentPage=all (retrieved January 20, 2018).

Zampino, L. (2019) *Self-tracking Technologies and the Menstrual Cycle: Embodiment and Engagement with Lay and Expert Knowledge*, in "Tecnoscienza: Italian Journal of Science & Technology Studies", 10 (2) pp. 31-52.

Zuboff, S. (2019) *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power: Barack Obama's Books of 2019*, Profile Books.

Sitography:

http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioNotizieNuovoCoronavirus.jsp?lingua=italianoandmenu=notizieandp=dalministeroandid=4852

https://developer.apple.com/documentation/healthkit

https://developers.google.com/fit

https://github.com/Immuni-app/Immuni-dashboard-data/tree/master/dati

https://github.com/Immuni-app/Immuni-documentation/tree/master/Design

https://github.com/Immuni-app/Immuni-documentation/tree/master/Design

https://github.com/pepp-pt

https://health.google/partners/

https://helloclue.com/

https://web.uniroma1.it/stitch/

https://www.agendadigitale.eu/sicurezza/privacy/coronavirus-i-sistemi-per-tracciare-i-positivi-come-funzionano/

https://www.agendadigitale.eu/sicurezza/privacy/coronavirus-i-sistemi-per-tracciare-i-positivi-come-funzionano/

https://www.apple.com/ios/health/

https://www.apple.com/researchkit/

https://www.cnbc.com/2019/01/08/tim-cook-teases-new-apple-services-tied-to-healthcare.html

https://www.Immuni.italia.it/

https://www.Immuni.italia.it/

https://www.Immuni.italia.it/

https://www.Immuni.italia.it/

https://www.macitynet.it/gli-strumenti-apple-e-google-per-tracciare-covid-19-arrivano-la-prossima-settimana/

APPENDIX

Physical Symptoms							
		Apps' classification					
		Clue	**Flo**	**iGyno**	**Menstrual Calendar**	**Maya**	**Wom-anLog**
MEDICAL CLASSIFICATION	**Feeling Tired**	Stength	Feeling Tired	Tired-ness	Tiredness	- Tired-ness - Weak-ness	Feeling Tired
	Oedematous sensation		Edema	Edema		Edema	- Edema - Edema (ankles) - Edema (hands) - Edema (face)
	Tender Breasts	Breast Sensibil-ity	Tender Breasts	Breast Sensi-bility	- Breast Sensibility - Tender Breasts	Breast tender-ness	-Breast ten-derness - Breast pain -Breast Sensibility
	Headache	Head-ache	Head-ache		Headache	Cephal ea	
	Bloating		Bloat-ing	Weight gain	Weight gain	Weight gain	
	Muscle pain		- Back pain - Ab-domina Pain - Peri-neal pain	Back pain	- Wryneck - Shoulder pain - Back pain - Lower back pain - Sore body - Muscle pain	Pain	- Abdominal pain - Groin pain - Sacrum pain - Pain dur-ing ovulation - Neck pain - Shoulder pains - Body pains - Muscu-lar/joint pains - Ovulation pain (right side) - Ovulation pain (left side) - Back pain
Emotional Symptoms							

MEDICAL CLASSIFICATION							
	Irritability		Irritabil-ity	Irritabil-ity	Irritability	Aggres-sivity	Irritability
	Feeling nerv-ous and anxious				Tense		
	Mood swings	Mood swings	Mood swings	Crying jags	Lunatic	Mood swings	Tears
	Sadness	Sad	Sad			Sad	
	Depression		De-pressio n	Depres-sion	Depres-sion	Depres-sion	Discomfort
	Hypersomnia						
	Insomnia	Quality of sleep	Insom-nia	Insom-nia	Insomnia	Insom-nia	Insomnia
	Difficulty con-centrating				Difficulty concen-trating	Diffi-culty concen-trating	-Difficulty concentrat-ing - Forgetful-ness

App analysis grid no. 1x

Other						
Apps' classification of Physical and Emotional Symptoms	**Clue**	**Flo**	**iGyno**	**My Menstrual Calendar**	**Maya**	**WomanLog**
	Cramps	Calm	Acne	Migraine	Mucus	Acne
	Ovulation	Energetic	Anxiety	Dizziness	Acne	High blood pressure
	Happy	Happy	Appetite	Acne	High blood pressure	Iron defi-ciency anaemia
	Great de-sire	Lively	Constipation	Fever	Low blood pressure	Anxiety
	Sex	Anxious	Cramps	Spasms	Constipation	Appetite
	Hair	Guilt	Food crav-ings	Chills	Cramps	Abscess
		Obsessive thoughts	Diarrhoea	Itching	Diarrhoea	Increased thirst
		Apathetic	Spin	Skin rash	Dizziness	Low blood sugar
		Confused	Indigestion	Hot flashes	Fever	Chills

		Very self-critical	Throw-up	Night sweats	Gas	Heartburn
		Cramps	Tension	Typical symptoms	Itching	Brittle hair
		Acne	Confusion	Pelvic pain	Throw-up	Oily hair
		Birthmarks		Cervical	Premenstrual syndrome	Cheilitis
		All good		Open cervix	Excessive sweating	Dry mouth
		Constipation		Cervical mucus	Sensuality	Cystitis
		Diarrhoea		Flow	Anxiety	Colic
		Water retention		Bleeding	Tranquillity	Convulsions (epilepsy)
		Throw-up		Irritation	Security	Cramps
				Constipation	Confusion	Cramps
				Diarrhoea	Hunger attacks	Thigh cramps
				Throw-up	Excitement	Diarrhoea
				Abdominal cramps	Frustration	Dehydration
				Dyspepsia	Happiness	Nosebleed
				Meteorism	Increased libido	Rash/haemorrhage
				Hunger	Laziness	Fever
				Eager	Jealousy	Hay fever
				Ovulation pain	Serenity	Regular stools
				Confused	Bad mood	Flatulence
				Despondent	Stress	Menstrual flow
				Reserved	Weight loss	HSV infection
				Cheerful		Frequency of urination

				Mild		Clumsy
				Bored		Mild incontinence
				Anxious		Indigestion
				Angry		Leg inflammation
				Sleepy		Ovarian inflammation
				Grumpy		Heat flashes
				Determined		Libido
				Flirtatious		High blood sugar
				Smug		Earache
				Happy		Toothache
				Disappointed		Sore throat
				Devilish		Lack of sexual desire
				Distrustful		Lack of orgasm
				Dynamic		Vaginal mycosis
				Distracted		Runny nose
				Hard		Throw-up/vomiting
				Emotional		Body odour
				Exhausted		PMS (premenstrual syndrome)
				Happy		Palpitations
				Confident		Dry skin
				Frustrated		Vaginal discharge
				Furious		High blood pressure

				Relaxed		Itching
				Playful		Painful sexual intercourse
				Embarrassed		Vaginal dryness
				Sullen		Sinusitis
				Impatient		Drowsiness
				In love		Sneezing
				Innocent		Aphthous stomatitis
				Insensitive		Night sweats
				Insecure		Fainting
				Isolated		Cough
				Libidinous		Brittle nails
				Inspired		Dizziness
				Silly		Cravings (spicy food)
				Sick		Cravings (sweet)
				Jealous		Craving (salty)
				Melancholic		Birthmarks (fruit)
				Mischievous		Craving (vegetable)
				Neutral		Mental fog
				Industrious		Fatigued
				Normal		Bored
				Proud		Anxiety
				Worried		Angry
				Panic		Sleepy

				Sexy		Adven-turous
				Satisfied		Calm
				Surprised		Confused
				Hopeful		Creative
				Stunned		Curious
				Strange		Painful
				Stressed		Depressed
				Tense		Sweet pas-sion
				Shy		Excited
				Tormented		Happy
				Sad		Frustration
				Shameful		Jealous
				Lively		Playful
				Homesick		In love
				Influence		Insecure
				Illness		Intractable
						Irritable
						Illness
						Nothing
						Boredom
						Fearful
						Sad
						Invigorated
						Sensual

						Dreamer
						Sensitive
						Satisfied
						Defeated
						Hopeful
						Unbalanced
						Forgetful

App analysis grid no. 2x