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Technological Determinism vs. Social Shaping of Technology. The Influence of Activity Trackers on User's Attitudes

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Abstract: Technology and its influence upon society have turned into a controversial topic in today's fast-developing world, where advances in innovation are continuous, fast, and complex. The relationship between technology and society has become an increasing interest for many researchers, trying to explore and clarify this connection. This article focuses on the psychological impact of technology, expressed through activity tracking devices, upon user's attitudes towards pursuing an active lifestyle. To conduct the analysis, users' registered behavioral changes after engaging with technological devices are explored, by examining academic literature reports studies, supplemented by experimental material written by the users themselves on publicly available websites. The study proposes a deductive research design, by constructing its analysis on a relevant theoretical framework, that of Technological Determinism theory, which advocates that technology can influence society, however without being affected by humans. Nevertheless, the results of the research show that the relationship between technology and society is not that linear, as influences coming from the social environment usually interact and impact the way technology is used. This determines the consideration of an additional theoretical concept to the analysis, that of Social Shaping of Technology, and changes the dynamics of exploring the topic. Conclusions demonstrate that the relationship between user and technology can be characterized as a double-way approach, with complex and ambiguous attributes, where both forces interact and can lead to positive and constructive behavioral outcomes but also to critical and hard to control mental conditions.

Keywords: wearable technology; activity trackers; technological determinism; social shaping of technology; user behavior.

Introduction

Activity trackers have become a rising trend among many categories of users, including sports enthusiasts but also individuals looking for a healthier lifestyle. Apart from calorie counting and heartbeat monitoring, activity trackers nowadays incorporate complete characteristics, such as reminders, activity feedback, and easy customization that made them become part of many users' everyday life. This is how, besides targeting increasing levels of physical performance, activity measuring devices are now able to psychologically impact the user and influence behaviors. Considering their vast complexity, wearables are relatively simple to set up and comfortable to wear, making them quite easy to be adopted by the consumer (Karahanoglu and Erbug, 2011). This determined many companies to start producing wearable devices to gain market share in an oversaturated consumer electronic industry (Page, 2015).

The fitness tracking market is steadily increasing and is expected to reach \$62,128 million by 2023, with a compounded annual growth rate of 19.6% (Loomba & Khairnar, 2018), forecasts which make this topic an area worth analysis. Wearable technology includes wearable computers that involve the integration of electronics under the form of an accessory, such as a bracelet or headphones, but also smart textiles, including electronics

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woven in the textile (Page, 2015). Activity trackers belong to the first type of wearables and are the category targeted in this research paper.

Their dynamic operating system and high-end fitness features can add considerable value to user's self-development, however, it has been observed that such trackers can sometimes irritate and annoy the user (Johnson, Bardhi, & Dunn, 2008). User's different perceptions about the meaning of an active lifestyle can lead to different needs and to considerable discrepancies in the way technology is embraced and evaluated, therefore understanding both positive and negative user experiences is critical for determining the relationship between user and technology.

It has been noted that, at present, a great number of studies that show the impact of technology are mainly commissioned by vendors (Shin & Jarrahi, 2013), a fact that can determine an unrealistic and unclear perception about certain devices. Therefore, our study proposes an exploration of whether technology directly influences the consumer, by adopting a double way perspective of both positive and negative outcomes wearables can bring, from the point of view of the user.

Literature review

Wearable technology overview

Wearable technologies are represented by smart electronics or computers integrated into various accessory types such as watches or clothing, used while on the body (Wright & Keith, 2014). They offer the advantage that, compared to smartphones or laptops, are lightweight, are easy to carry, and offer the possibility to be used during motion (Hein & Rauschnabel, 2016). Wearables are expected to act as an extension to the human body, and even to the mind, as it proposes a novel way of connecting and interacting with own self (Dunne, 2004).

Such devices, which include fitness trackers, smartwatches, heart rate monitoring tools, and GPS tracking devices, firstly became a fitness trend in 2016. They were ranked first place as a fitness trend in 2016 and 2017, however, they dropped to third place in the following year (Thompson, 2018). Not for long, as according to a worldwide survey conducted by Thompson (2019) among about every continent, wearable technology regained its popularity in 2019 and 2020, surpassing group training and HIIT (high-intensity interval training) and became once again the no 1 trend among fitness trends. The positive evolution of the devices indicates an increasing focus and demand of the population for self-monitoring devices. It has to be mentioned that a trend can be defined as "a general development or change in a situation or in the way that people are behaving" (Cambridge Dictionary, n.d., 2019) and is likely to maintain its positions within the industry for several years. This shows the major potential of wearable technology to influence behaviors and impact users' mentality in the long term.

Relationship between consumer behavior and activity trackers

Consumer behavior can be defined as the process of understanding one's needs and wants through the selection, purchase, usage, or disposal of products, services, experiences, and ideas (Solomon et al., 2006). Studies of consumer behavior focus on what individuals think of products, how they use them, and what attitudes they express towards products and advertising (Hawkins & Mothersbaugh, 2010). In other words, consumer behavior encapsulates a complexity of fields, such as psychology, sociology, anthropology, and economics (Galalae & Voicu, 2013).

When first launched on the market, activity trackers incorporated the characteristics of *product innovation*. According to Rogers (2003) innovation represents an idea, practice, or object identified as a novel by the consumer. Innovative products can stimulate user's

interest and to generate increases in sales and accelerate customer acquisition (Freeman & Soete, 2008). The argument brought by Lunney et al., (2016) explains this phenomenon. He stated that the adoption of fitness wearable technologies is directly connected to the *perceived health outcomes* such activity trackers can bring to the user. For instance, when acquiring a fitness tracker, users mostly expect improvements in everyday physical activity and better monitorization over health status.

Additionally, according to a study developed among students and employees with graduate-level of education and middle to high range of income, located in Wuhan, China, factors such as *compatibility, innovativeness, effort expectancy, performance expectancy, and social influence* are areas that determine the adoption and usage of such devices. Respondents also confirmed that these are characteristics that influence them to further recommend the device to others. (Talukder et al., 2019)

Moreover, it is believed that consumer behavior can be highly determined by *feedback and rewards*, which can lead to improvements in physical activity levels (Sullivan & Lachman, 2017). Interestingly, research demonstrated that messages formulated in a positive manner are more effective upon user's perception compared to the negatively framed ones, for instance 'Walking can improve health' can be more constructive than 'Not walking enough can worsen health' (Notthoff & Carstensen, 2014 cited in Sullivan & Lachman, 2017). Considering the above information, consumers and their attitudes are likely to be influenced by external factors, in our case expressed through technological devices and their encapsulated features. This phenomenon will be further explored in the research paper and will be correlated to a well-known technology-related theory, introduced, and discussed in the following paragraphs.

Research design

Technological determinism

To determine the relationship between technology and users' behavior, the paper bases its analysis on the theoretical framework provided by the Technological Determinism Theory (TD), which questions the degree to which the force of technology can determine and shape the trends in social changes, in terms of human's way of thinking and acting (communicationtheory.org, n.d.).

The theory has its roots in World War II when it was first formally enunciated. It is built on the idea that technology is an exogenous force, having its existence, with no determinants coming from social concerns or pressures, however being able to determine social structures (Walton, 2019). TD can be considered a significant and pronounced perspective, by placing great emphasis on the shaping tendency of technology (Dafoe, 2015; Adler, 2006).

Technological determinists pledge for a *linear relationship* between technology and society and advocate that the evolution of technology is 'unproblematic or pre-determined and follows his own path, influencing society, however with no influences executed by humans (Edge, 1988). The following diagram has been drawn up to illustrate the way the study aims to approach the phenomenon proposed under the theoretical framework considered:

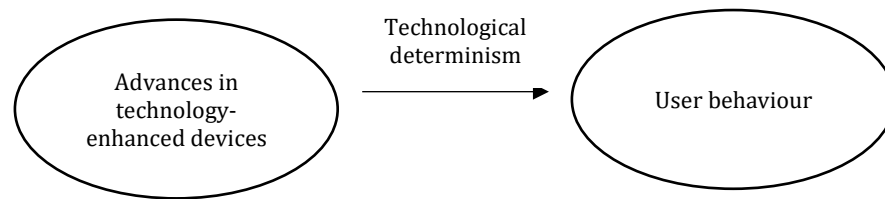


Figure 1. The approach of the research topic
(Own representation, 2021)

Criticism

By pledging for the idea that technology is unidirectional, fully determining society and its conduit, TD theory faced several critics over the years. Many theorists consider that the way individuals interact with technology is not just a one-way approach, contradicting deterministic assumptions. In the real-life the relationship is nonlinear (Bratianu & Vasilache, 2009). Conflicting ideas show complex perspectives upon the technology-society relationship, arguing that TD oversimplifies technology's relationship with humans. A summary of the most relevant contradicting concepts and theories have been outlined in table 1:

Table 1. Critics of Technological Determinism

Contradicting idea	Author	Description
Too extremist theory	Chandler (2000)	Criticizes TD, by stating that the theory presents technology as too powerful over society, thus leading to a helpless state of the population. Technology is presented as driving society in a too extreme way. He states that other factors such as political and economic factors or simply just general attitudes can influence the development of society.
Democratic rationalization	Andrew Feenberg (1992)	In the article ' <i>Subversive Rationalization: Technology, power, and democracy</i> ', the author argues that the development of industrial society depends on politics. He emphasizes the idea that technical decisions are rationally constrained as being 'groundless' and criticizes two theses, nonlinear progress, and thesis of determination. Feenberg (1992) adopts a constructivist approach, stating that individuals can engage social factors to influence choices and determine technological evolution, characterizing such a society as 'subversive rationalization' (Feenberg, 1992, p. 301).
SCOT (Social Construction of Technology)	Pinch and Bijker (1984)	The theory, also known as the SCOT method, states that individuals are able to provide meanings to technological artifacts according to various factors, such as their relevant social group. Sociocultural and political factors are considered to determine technological development. In their paper ' <i>The Social Construction of Fact and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other.</i> ' (1987), they use the example of the Penny-Farthing Bicycle to highlight that over time, technology was evaluated according to each group's standards. In the case of the bicycle, moral conflicts were different according to each social group. Women cyclists encountered barriers such as wearing skirts on a High Wheeler while sports cyclists did not.
	Williams and Edge	SST contradicts TD by stating that the design and implementation of technologies are shaped by social and economic forces, but also by technical considerations.

SST (Social Shaping of Technology)	(1996)	Compared to SCOT, SST does not base its analysis on a particular technological field, but from a certain social context where technical changes occur. The authors characterize this analysis as processing 'inwards'.
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Source: Chandler, 2000; Feenberg, 1992; Pinch and Bijker, 1984; Williams and Edge, 1996.

Research method

The proposed study was designed to test the validity and applicability of a theoretical framework in a proposed empirical context, showing its characteristics of having a *deductive research design*. This type of approach is based on testing an already existent theory (Streefkerk, 2019).

The analysis studies users' behavior towards pursuing an active lifestyle when influenced by fitness trackers, and based on the relevant theory, constructs the approach around the driving main research question: '*Does technology control us?*' and adds the extended research sub-question as: '*Can activity trackers positively impact user's behavior or negatively influence such behaviors?*'

Data collection

Multiple sources of data collection are recommended for a researcher to improve convergence and validation of a study, a minimum of two being suggested, that includes both primary and secondary data sources (Yin, 1994). However, in the context of the ongoing *pandemic of COVID-19*, data collection has become a sensitive process to conduct, as both individuals and organizations are harder to reach. This is mentioned as, for the topic proposed, the study would have normally collected data through primary research methods, such as interviews. However, considering the current unstable situation, the study proposes a slightly different approach to the topic, as it gathered information based on the collection of already existent data. By engaging well-known research techniques, that of *secondary data analysis*, relevant information was collected and interpreted for the proposed perspective.

User's experiences resulting from engaging activity trackers in their everyday life were examined through *academic literature reports* studies, supported and supplemented by experimental material brought by *website informal articles* written by the users themselves. In other words, website articles worked in conjunction with academic articles to bring valuable proof for determining the real technological impact upon the individual and critically assess both positive and negative outcomes of technology. The research realized through secondary data analysis used a technique based on engaging and reanalyzing data that was previously collected and investigated by other researchers (Punch, 2005).

Data analysis

The information gathered was narrowed down and *thematic analysis* was conducted. User's perceptions and experiences with technology can be diverse, hard to measure, and sometimes ambiguous. This is the reason why the *thematic analysis* was considered appropriate for analyzing such a vast perspective, a method that examines the data, codes it and turns codes into themes, which can be further compared. Additionally, common themes between different research studies can be better identified, such as ideas and patterns that appear repeatedly (Caulfield, 2019). This procedure fits perfectly with a large amount of data sets explored for our research and made it possible for two major key themes to be established, that of *positive and negative behavioral changes*, and four sub-themes under each of these.

The proposed research faced several ethical barriers when deploying the study. As the analysis focuses on psychological human reactions, this being an extremely sensitive area for an individual, ethical issues stipulated by each source were highly examined. This was realized by a detailed investigation of each website's Terms & Conditions and respecting and applying their norms and rules. Also, for safety and ethical reasons, the identity of subjects engaged in both informal and academic articles was not disclosed during the study, as this may have violated personal privacy.

Results

The following section shows an analytical investigation of positive and negative registered outcomes of user's mental well-being when using activity tracking devices. For the analysis, the studies have taken into consideration devices that incorporate almost the same features and characteristics (counting steps, calories burned, floors climbed, and feedback), therefore their effects can be compared. Therefore, users have used either a classic pedometer or devices produced by famous activity tracking companies such as *Fitbit*, *Jawbone*, and *Nike*. A *context-based approach* is proposed for a clear and reliable exploration of the effects of self-monitoring technology upon user's perceptions and reactions. This analysis is based on secondary data analysis.

The positive behavioral impact upon the user

According to research (Karapanos et al., 2016; Wu et al., 2016; Asimakopoulos et al., 2017; Donnachie et al., 2017; Fritz et al., 2013), positive behavioral changes can be reached as a result of engaging technology in user's everyday routine. Ryan and Deci (2000) established the Self-Determination Theory (SDT), organized around three fundamental needs, essential for an individual to self-develop and integrate into a social environment: *competence, autonomy, and relatedness*. All these factors support and increase *motivation and user engagement*, which, in this paper, will be considered as a separate indicator due to its complexity and vast influencing factors.

Therefore, considering the theory above, the following psychological needs have been recognized as being accomplished as a result of using wearable devices and will represent our criteria for further analysis: *Motivation & User engagement, Relatedness, Autonomy, Competence*.

According to Ryan and Deci (2000), forces coming from the social context, feelings of empowered autonomy, and increased competency support the development of intrinsic motivation and enhance self-determinism with respect to extrinsic motivation. The presented research analysis engages such forces to explore how technology can positively impact user's behavior.

Motivation & User engagement

Ryan and Deci (2000) defined motivation as a feeling to "be moved to do something" (pp. 54). According to the SDT, motivation can be divided into two major groups, according to their source: intrinsic and extrinsic motivation.

Intrinsic motivation brings enjoyable and satisfactory feelings, being determined by internal rewards, while extrinsic motivation is influenced by external prods and pressures, but also by external rewards. From the two, intrinsic motivation is considered to be the most important and pervasive as human beings were created to be naturally exploratory, active, and curious, without requiring external stimulus. (Ryan & Deci, 2000)

The tracker is usually connected to a mobile application that shows the summary of the user's daily physical activity like the number of steps, the number of calories burned, or miles walked. Satisfactory numerical representations act as an external factor that

motivates the user; therefore extrinsic motivation is created by the device. Psychologically speaking, by being rewarded with a high number of steps, floors climbed, or calories burned, users feel fulfilled and empowered, and the sense that their effort was 'worth it'.

Research conducted by Karapanos et al., (2016), considering 133 analyzed responses of Fitbit, Jawbone Up and Nike Fuelband users from the U.S.A, with an average ownership time of 8 months, emphasize increasing motivation when engaging fitness devices. According to Gartner Inc., the world's leading research and advisory company, the abandonment rate of wearable devices was very high among the U.S., U.K., and Australian citizens, between June to August 2016, with 30% of users giving up using their tracker because it was considered not useful, boring or because it broke (Gartner, 2016). However, the study proposed by Karapanos et al., (2016) reveals that sustained use of such a device can bring increasing motivational levels, rather than 'creeping rejection'. People felt benefits even months or years after engaging with the device.

Over time, there has been noticed a decrease in the frequency of checking the device, from 3.8 to 2.7 on average, on a 5-point scale.

It has been noticed that participants to the study bought the device having different motivating factors, therefore two groups have been identified:

1. *Purposive group*: bought the tracker to achieve a healthier lifestyle; aimed at measuring physical activity; tried to overcome barriers such as lack of motivation.
2. *Explorative group*: receive the tracker as a gift; bought the tracker to help friends or family members.

The study reveals that purposive users had the tendency to check the device more often compared to the explorative ones, showing that influences from the user were executed towards the technology, as self-determination and self-motivation changed the way the tracker affected their lifestyle.

While some participants reported that '*numbers are just numbers*', and that the data was incomplete, some others noted that the device provided them with the 'initial push' necessary to become more active. Reduced frequency of checking for feedback is explicable as some respondents noted an increase in the sense of accomplishment after using the device, and that now they feel 'it's all up to them'. This makes us state that the tracker successfully achieved its main purpose, that of increasing an individual's healthy habits, by increasing its motivation.

We can observe that, even though initially, data provided by the devices acted as an external motivator, providing a psychological reward for the user, in time, a process of integration can be witnessed. According to Ryan and Deci (2000), if the initial external reward does not execute too much control over the user, an orientation shift, from extrinsic to intrinsic motivation can be experienced. Under this theory, participants in our analyzed study started to intrinsically experience the benefits of staying active, integrated them, and converted them into habits, rather than a reward. (Karapanos et al., 2016)

Generate relatedness

Relatedness covers multiple spheres, such as receiving social support, social exchanges with the family circle, social integration, popularity and even online belonging to a community (Karapanos et al., 2016). It has been noted that, when exposed to a social group, individuals are more likely to increase their ambition to reach targeted goals (Cialdini, 2001). Being part of a social group with the same objectives creates connections and support between users, factors which, in the long-term, contribute to human behavioral changes. (Wu et al., 2016)

To support these arguments, the previously analyzed experiment conducted under the form of a diary study by Asimakopoulos et al., in 2017 is proposed. A high number of participants reported needs to connect and interact with other users, for recognition

purposes or exchanges of experience. Additionally, users stated that the need for affiliation, more precisely relatedness with family and friends was noticeable, showing the importance of *direct social support*. This is also suggested by 72% of Jawbone users that shared their numbers verbally, while the rest preferred to do it online. A strong impact of the network effect can be noticed if we mention that many individuals reported being motivated by feeling part of an *online community* platform, such as Fitbit Community (2020), a place where people exchange product reviews, tips, and fitness goals.

Further research is proposed under analysis, that of the real-life experiences of 133 users of Fitbit, Jawbone Up and Nike Fuelband conducted by Karapanos et al., (2016). When participating in experience-sharing through online communities, participants enjoyed feeling a *sense of belonging* to a social group. Knowing that they are not '*the only one having a bad day*' (participant 33, 2016, p. 12) creates a sense of support, security, and intimacy with similar people. This is explicable if we consider that human beings enjoy sharing information with users that have the same goals (Ledger & Macaffrey, 2014).

We can, however, notice that, in the proposed research studies, individuals' relationship with their activity tracker is not that linear, as the experience of engaging with wearables was usually *socially mediated*. Influences coming from online communities, relatives, and friends are observed to exercise power and impact behaviors.

Empowered Autonomy

As defined by Connell (in press), autonomy represents one's ability of choice to initiate, maintain and regulate an activity, but also a feeling of connectedness of an individual's goals and values to his/her actions. According to the SDT, autonomy is one of the three essential psychological needs necessary for an individual to personally develop, and can bring extraordinary feelings when is being achieved.

In the research conducted by Karapanos et al., (2016), autonomy occupies an important place out of the ten essential psychological needs considered as being essential by the author. The table below shows the ranking for each need fulfilled by wearable devices, as a result of multiple statistical calculations, however, for a clear understanding, the present study will just consider the mean, which is the statistical average, more precisely all results were added up and divided by the number of results.

Table 2. Mean ratings of human needs adapted.

Need	Mean
Physical thriving	4.17
Competence	4.08
Autonomy	4.03
Stimulation	3.83
Self-esteem	3.79
Meaning	3.43
Popularity	3.15
Relatedness	3.13
Security	3.00
Luxury	2.53

Source: Karapanos et al., 2016.

According to the presented ranking, autonomy occupies *third place*, showing an average of 4.03 on a 5-point intensity scale, indicating a salient need for the user. The results demonstrate that such devices are considered relevant for inducing and increasing user's connectedness with his/her personal goals.

Participants admitted that '*it's a rewarding feeling to accomplish something that I used to think was impossible*' (participant 12, 2016, p.12) showing how the device was able to develop their potential to drive actions towards achieving goals that were once considered as hard to tackle with. It has been observed that self-monitoring helped users explore their

own identity, by providing a deeper understanding of their behaviors in certain circumstances. This led to a stronger potential of prioritizing opportunities and making critical decisions for lifestyle changes. (Karapanos et al., 2016)

Additionally, in a study carried among *28 men, participating in an FFIT program*, using pedometers for 12 weeks, positive behavioral changes have been registered as a result of self-monitoring. An FFIT program implies a “gender sensitized, weight loss and healthy living program” delivered at professional Football Clubs to overweight men (Donnachie et al., 2017, p. 3). Some participants reported that their lifestyle became considerably more active so that the usage of the tracker is no longer considered necessary. While some of the participants admitted that sport is now part of their identity, others keep engaging with the device as *feelings of constantly keeping control* over their fitness level is an important factor for staying active and maintain results, they say. They admitted that observing *‘what you are actually achieving’* boosts their behavior toward keeping active. (Donnachie et al., 2017) When people examine their activity status, feelings of *empowerment and autonomy* are registered, as they can self-organize and have their activity ‘concordant with one’s integrated sense of self’ (Ryan & Connell, 1989)

Developed competence

According to Deci and Ryan (1985), the need for competence can be defined as the necessity to feel capable of realizing certain tasks while avoiding any negative outputs. In other words, competence brings the feeling of being very capable and effective when performing actions rather than registering incompetency feelings (Bratianu, Hadad, & Bejinaru, 2020; Sheldon et al., 2001).

Firstly, we will again consider the ranking of the American participants in the research conducted by Karapanos et al. (2016), after using either a Fitbit, Jawbone Up, or a Nike Fuelband device. Together with physical thriving and autonomy, competence occupies a place in the top three rankings for the most salient needs addressed by the wearable devices proposed. The score registered by the mean on a 5-point intensity scale shows that, on average, people considered the need of competence to have been satisfied at a level of 4.08 out of 5, showing that success was reflected as being associated and supported by competency.

Participants narrated that such devices helped them realize how little physical activity they were performing, a fact which impacted their perception towards their bodies, by increasing awareness, devices acted as a ‘push’ for the user to change behavior and, in time, become more competent. We can notice that human behavior is strongly correlated to goal setting, which motivates and encourages the user to keep going. Users admitted that, even after a long usage time of the tracker, its effects of increasing competency and even self-esteem did not diminish in any way.

We already discovered that according to research conducted by Asimakopoulos et al. in 2017, Jawbone Up and Fitbit trackers were able to increase competency and autonomy feelings and intrinsically develop user motivation. We will now emphasize the competency indicator and explore how these devices increased user’s capability and effectiveness of performing certain tasks. Having the capacity to continuously track everyday movements, but also self-reflect through dashboards and live data resulted in considerable *increases in user’s confidence and competency*.

The negative behavioral impact upon the user

Ryan and Deci (2000) outlined that feelings of autonomy, competence, and relatedness can contribute to the development of intrinsic motivation. As a result of deep analytical research, we have discovered that users can experience such feelings when interacting with technology, however, sometimes this being socially mediated.

As a result of extended analytical examination of some of the previously mentioned articles (Karapanos et al., 2016; Asimakopoulos et al., 2017), but also by assessing additional sources (Etkin, 2016; Coorevits & Coenen, 2016), *negative behavioral changes* produced by wearable devices were classified under four main categories. These were established according to their relatedness to the issue considered, but also according to the information provided by the secondary data resources and will represent further criteria for analyzing user's negative registered outcomes: *Lower intrinsic motivation, Obsessive behaviors, Social issues.*

Lower intrinsic motivation

It has been observed that when quantifying their activity, individuals can register negative outcomes, as continuous feedback about one's behavioral output can act as external rewards and can lead to decreases in the amount of intrinsic motivation. According to findings revealed by Etkin (2016), personal quantification can *decrease the enjoyment* of performing certain tasks and consequently reduce long-term engagement for certain activities. He conducted six experiments, where participants were asked to perform certain enjoyable activities and observed that their outcomes were influenced by the presence of measuring devices. We will further present and critically analyze *Experiment 2*, where subjects were asked to go walking.

Experiment 2 is directly applicable to our research topic as 95 college students at a North-eastern University were randomly split into two examination groups: *control and measurement* and asked to perform walking activities. Participants in the measurement group were given the possibility to choose between wearing or not a classic pedometer and all but four opted to wear one. Activity trackers represent a developed version of a pedometer, as, besides many other features, they incorporate the basic and most important characteristic of a pedometer that of counting steps. Therefore, the study engaging pedometers is applicable for our research topic as well.

The results of the second experiment, containing differences in the output and enjoyment level between the two groups can be visualized in the following diagram:

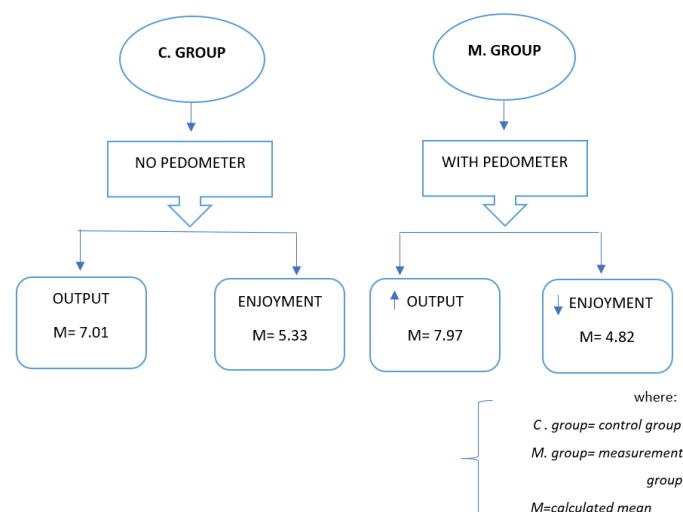


Figure 2. Output and enjoyment differences among control and measurement groups
 (Etkin, 2016. Own representation)

Results show that participants exposed to personal quantification (measurement group) registered better physical performance, resulting in *higher outputs*, however, the *enjoyment* of performing the activity significantly decreased, showing *lower intrinsic motivation levels*. The control group presents *lower performance levels*, clearly expressed through the calculated average, however, the activity was found as being *more fun and entertaining* to complete, acting as inner motivation rather than 'work' that has to be completed. When intrinsically motivated, individuals find pleasure to perform tasks.

According to Etkin (2016), individuals engaging with monitoring tools in their daily habits can register decreases in the enjoyment of performing the actual activity, even though the results may appear satisfactory. This may lead to *increasing frustration and considerably less enjoyment* of achieving certain targets. In time, the activity may be performed just for the achievement of external results, such as positive feedback received on the screen of their tracker. Therefore, even though usually expected to increase performance, measurement tools can lead to harmful situations when results are not realistic as users feel less motivated and less pleased with performing these activities.

Social issues

Even though according to previously presented research (Asimakopoulos et al., 2017; Karapanos et al., 2016), a beneficial relationship between technology and its effect upon social integration has been outlined, feelings of *social exclusion, irritation, or even annoyance* can occur as a result of the social environment created by these wearables.

For a first exemplification, a study targeting users' experiences shared online was chosen. The research gathered data written directly by users, on an online community, that of Reddit website, a well-known collection of forums, where people can share ideas, content and add comments and tips for other members of the community (Widman, 2020). This is considered to be an important cross-user communication channel within groups, which show the insightful perception of the customers themselves. Under the online question: *'Why'd you stop using your fitness wearable device?'*, 153 comments were made available by members, out of which 101 were considered relevant for the analysis. The purpose of the research paper, conducted by Coorevits and Coenen in 2016, is to analyze how individuals actually interact and feel when using their activity tracking devices.

As a result of the analysis of the paper, it has been observed that being part of a social environment that shares the same objectives as you can be motivating and exciting, however, it can also be a reason for *avoiding and even stop using the device*. Some users became annoyed and felt *uncomfortable* to be part of groups that continuously compare and show off their daily step count. The user sharing his feelings above admitted that he quit using the device so people would stop asking such questions. In this case, the tracker *created too much competitiveness* and irritated the individual. However, the device interacted with the effects of being part of a social group and acted as a negative trigger that became a *source of pressure and frustration* as not everyone finds it appropriate to compare and contrast health performances.

An interpretive real-case study conducted among stakeholders and employees at the financial institution WellnessCo., situated in the south of the U.S.A., brings additional evidence for the possible negative impacts of wearable technology towards behavioral changes of the user. The study interviewed 25 key stakeholders and also distributed an open-ended survey to 130 employees to measure the impact of a Fitbit device in a wellness program. The experiment at Wellness Co. took the form of a physical program measuring the achievements of participants so that the employees that were unable to physically perform were not included in the investigation. Such individuals however reported feelings of *exclusion from the social group*, due to their inability to perform certain tasks. (Giddens et al., 2019)

Findings disclosed in the proposed real-case studies indicate that wearable devices have the ability to establish a sense of community, a situation that can create both positive and

negative consequences. Being part of a social context can be motivating and exciting, however, it can create *feelings of exclusion* and affect an individual's mental well-being when not able to be part of the social environment created. Additionally, it can create discomfort, annoyance, and irritation when too much pressure and challenges are executed by the social group. This shows the powerful force of society to impact behaviors and interact with technology's intended purposes.

Obsessive behaviors

Obsessive behaviors including intrusive feelings of breaking social norms manifested as intense stress for performing specific actions (sunrisehouse.com, 2019), have been reported as a consequence of interacting with wearable technology and are further illustrated through a series of applicable real-case studies.

Users' opinion available on the online forum Reddit is once again relevant to illustrate the relationship between technology and user's behavior. By targeting the same question "*Why'd you stop using your fitness wearable device?*", members of the forum reported having *major obsessive behaviors* for checking their wearable tracker, so that enjoyment and motivation were not experienced anymore. Users found themselves *distracted and interrupted from* performing their daily activities to check the device for progress and targets. The tracker was considered to damage user's activities in a way that it hardened goal achievement, by being an annoying distractor and obsession rather than a motivating factor. (Coorevits & Coenen, 2016)

Obsessive behaviors have also been registered in the case of a *29-years old female* working in Atlanta, Georgie, whose name cannot be disclosed in order to protect privacy. The person found herself participating in an interval class, where each person's activity statistics were displayed on a public screen. She experienced inferiority feelings when not being able to be 'on top of the class', describing her behavior as obsessive for exercising and reaching goals. (Cox, 2019) According to Stacey Rosenfeld (n.d., cited in Cox, 2019), a psychologist in Miami, Florida, persons with obsessive tendencies have to set clear boundaries regarding the frequency of using such a device. She suggests tracking data only while performing physical activities and setting from the beginning a small number of times dedicated to checking data each day. It is however noticeable that the social environment of which the woman was part determined her to lose control over her behavior and exceed limits, making sport an obsession rather than a healthy habit. (Cox, 2019)

In a press article written by the user herself, the experience of constantly wearing a Fitbit easily became an obsession. What seemed at the beginning the perfect device to keep control over her weight, food intake and calories, became, in time, an enemy constantly obsessing her. She found herself obsessively typing in the food and exercise amount executed through the day, doing burpees and jumping jacks if a calorie surplus was registered. She admitted having lost control and even linked her obsession with the device with characteristics correlated to Obsessive-Compulsive Disorder and general anxiety. A fast and powerful control took over by the technology upon the user can be noticed in the case of the female user, who found herself controlled by the device showing just simple numbers on a digital screen. The technology ended up psychologically influencing the user, by becoming a health obsession, where surpassing a certain calorie number would have been a disaster. (statepress.com, 2016)

Discussion

The main focus of the article was to determine the influence of activity trackers upon user's behavior towards pursuing an active lifestyle. Up until this point, we have discovered that technology can impact human behavior, however, this relationship is not as linear as our theoretical framework stated at the beginning. The dynamics between user and technology are complex and ambiguous, as technology was observed as not being

the only factor affecting human change. Context and psychological issues interfere in this relationship and can change the way user and technology interact and influence each other.

The research considered real-life experiences and experiments regarding the impact of wearable technology which revealed that the relationship between user and tracking devices is not that 'straightforward' as it may have seemed at the beginning. On one side, activity trackers have demonstrated to positively impact user's behavioral changes, by contributing to the accomplishment of essential human needs, categorized by following the SDT. However, research studies showed that such devices can go beyond this purpose, leading to negative impacts upon one's mental state, where technology is not the sole factor influencing this phenomenon. Many times, social context is demonstrated to be able of shaping the way technology impacts the user, in both positive and negative senses.

The study, therefore, considers the relation between wearable technology and user's experiences, organized around the TD theory. According to this theory, technology executes forces and influences user's behavior. It has been however demonstrated that the adoption and usage of technology can depend on the social context, which can encourage or discourage certain technologies, resulting in impacting the effects of technology usage (Adler, 2006). This phenomenon, known as the *Social Shaping of Technology (SST)*, has been developed as a result of long-critics brought to the TD Theory. SST argues that there are 'social, institutional, economic and cultural factors' able at shaping the direction but also the rate of innovation, as well as the form, content, and outcomes of technology. SST pledges for the idea that society is able to shape the development of technology (Williams & Edge, 1996, p. 868).

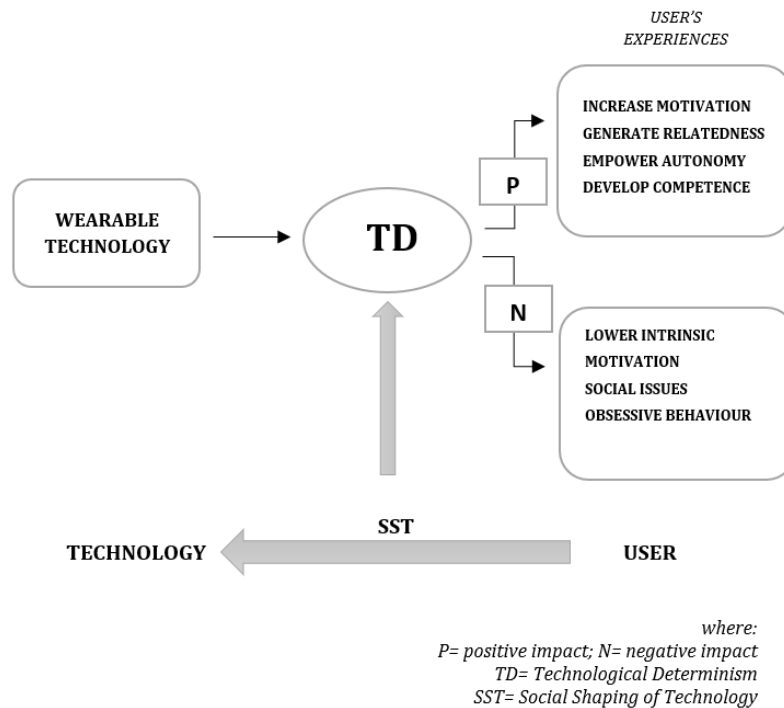


Figure 3. The impact of activity trackers on user's attitudes towards pursuing an active lifestyle
(Own representation, 2021)

The study, therefore, introduces a *double-way approach* to the relationship between technology and society, aimed at enriching the research and obtaining a deeper and more critical analysis of the influence between the two. This results in additional research questions added to the paper, aimed at better exploring the topic: *Is the way individuals experience technology socially mediated? Can social context interact and influence the effects of wearable devices upon user's behavior?* The diagram illustrated in Figure 3

indicates the new approach of the study and represents the result of the empirical analysis conducted in this research paper. At this point, the study slightly remodels the way of approaching the topic and examines how two influential forces, technology, and society, interact and determine each other. This served as a basis for issuing a critical discussion of the research topic and results, presented in the following paragraphs.

- We have discovered that wearable devices can create a series of benefits able to determine the user to register *positive behavioral changes*. This has been validated by actual user's experiences that showed that visual representations and live data can create positive experiences. This relationship has been analyzed by looking at categories established by the SDT: *relatedness, competency, and autonomy*, resulting in increased *levels of motivation and user engagement*. This answers our research questions and also validates the conditions engaged by the TD theory, which states that technology can impact and shape human behavior, in this case in a positive sense.

- In some of the cases, we have witnessed an *integration of the benefits* provided by such devices, showing the ability of users to shape the usage of technology according to their own needs. The following sequence has been observed:

1. *Users engage with wearable technology;*
2. *Users embody the benefits provided by the wearable technology;*
3. *Users reject the technology.*

All of the research questions proposed by the paper are addressed by showing that technology can go beyond what it is mainly sold for, being able to influence the consumer at both physical and psychological levels, shaping mentalities and attitudes towards pursuing an active lifestyle. The paper shows consistent proof that the interaction between user and technology is often more than a one-way approach, social context, but also personal background being essential factors in establishing this relationship. The path of technology can interfere with the exercising power of the social environment to which the user belongs, being able to either *motivate the user*, increase its *autonomy, competence but also relatedness*, or negatively affect the user, by *decreasing inner motivation, create annoyance, pressure, obsessions or exclusion from social groups*.

Conclusion

To conclude, the present study aims at bringing consistent value to the current knowledge of the relationship between wearable devices and users, by focusing on the psychological effect of technology. As a result of in-depth analysis, a series of findings can be summed up. Firstly, the results show that, in some circumstances and according to the theoretical framework, technology can determine human behavioral changes. Being either positive or negative, technology can bring considerable joy and excitement to the user, but also anxiety and pressure.

The findings of the study, however, show that social factors can interact with technology and influence the way it is engaged. Supported by additional theoretical concepts, that of SST, influences coming from the social environment are considered as having a high impact upon user's motivation and engagement. It has been noticed that individuals can become more motivated when integrated into social groups but also demotivated when excluded from such groups. This shows the potential of humans to shape the meaning of technology and its usage in a context.

As an endpoint, by addressing the main research question '*Does technology control us?*', but also a series of extended questions, the relationship between society and technology can be established as being complicated and complex, sometimes ambiguous, and hard to define. The dynamics of the results show that a binary distinction between the two forces is very difficult to hold so that a one-way approach of this relationship would be incorrect to confirm. It seems like social context usually interacts with technology and changes the

way it impacts users, as individuals' routines proved of being able to shape technologies. Findings, therefore, show a two-way relationship, where both technological and social environments execute forces, being able to influence and impact each other.

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