Interrelations between the use of fitness wearables and healthy consumer behavior

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ABSTRACT

Fitness wearables are growing in popularity and are often used for a specific health-related reason. The purpose of this device is collecting data about one self and is the subject of many discussions relating to the influence on health behavior change. Research on health behavior change is not new, but taking health promoting technology into consideration here is. This paper consists of a critical literature review which leads to the conceptualization of theory-based techniques prevalent in fitness wearables into a new model called the Wearable Technology and Health Behavior (WTHB-) model. The WTHB-model depicts the cohesion of the theoretical elements and their relation to healthy consumer behavior. These theoretical elements have proven to be effective in health behavior change studies and are often interrelated. Alongside the critical literature review an explorative study was conducted to gain more insight into the use(rs) of fitness wearables and the health behaviors of users. A survey of fifteen questions was sent out through social media which lead to a total of 499 respondents. Descriptive statistics revealed information about the users of these wearables, but also how they use them. Also, several aspects of healthy consumer behavior were tested among all respondents; health consciousness, physical activity, nutrition and smoking. It is found that there is a positive relation between the use of a fitness wearable and healthy consumer behavior. This study lays some groundwork for further research, the most important being the research into the direction of the relationships found and the identification of possible causalities.

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Keywords

Fitness wearables, healthy consumer behavior, behavior change techniques, health behavior, quantified self, internet of things

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1. INTRODUCTION

1.1 Background

The fitness hype is growing and maintaining a healthy lifestyle is becoming more important for consumers. Consequently, several industries are changing; the demand for healthier products is growing (Divine & Lepisto, 2005), smartphone owners engage more in actively seeking health-related information apps (Smith, 2011) and nearly 1 in 10 smartphone users have downloaded a health-related app (Cowan et al., 2013; Fox, 2010). Quantified self (SQ), also called lifelogging, is the term used for the phenomenon of using technology to collect data about ones health and wellbeing (Kim, 2014; Patel, Asch, & Volpp, 2015). Wearable devices also contribute to the phenomenon of SQ and they are seen as the next generation of portable electronics (Yang, Yu, Zo, & Choi, 2016). These wearables are part of the so-called 'Internet of Things' which describes the idea of everyday objects being connected to the internet and to each other (Xia, Yang, Wang & Vinel, 2012; Wortmann and Flüchter, 2015).This represents the vision of the internet entering the real world (Yang, 2013).

It is difficult to exactly define the term fitness wearable. It can be seen as part of personalized health technology, worn as a watch, which generally refers to wearable devices that monitor health-related activity and provide feedback at the individual level, usually through a corresponding app or mini-display on the device (Allen & Christie, 2016). Basic features of such devices are tracking steps, calories, distance and floors climbed, monitoring heart rate, and tracking and monitoring sleep and sleep stages (Fitbit.com, 2017). Wearable technology can influence many fields, including health and fitness (Tehrani, Kiana, & Michael, 2014). With the amount of users still growing, many researchers have studied the effects of this technology in a clinical setting (Chiauzzi, Rodarte, & DasMahapatra, 2015; Varshney, 2007; M. Schickler et al., 2016), but very little attention has been paid to the non-medical use of fitness wearables while commercial use is still increasing. The wearable market exceeded $2 billion in 2015 and is expected to exceed $4 billion in 2017 (Smith, 2011).

1.2 Problem definition

Health behavior entails the action taken by an individual to maintain, attain or regain good health and to prevent illness (Mosby, 2009). Examples of common health behaviors are exercising regularly and eating a healthy and balanced diet (Mosby, 2009). With these devices promoting health behavior change it is important to look deeper into the knowledge and strategies behind their function in order to understand its effectiveness (Lyons, Lewis, Mayrsohn, & Rowland, 2014). The gap between collecting data about oneself and changing behavior is large and little research has been able to bridge that gap (Patel et al., 2015). So, whether wearable devices directly influence behavior change is a complex consideration. The theories and techniques used in health behavior change interventions has been applied to internet-based interventions and app-based interventions, but do not appear to be used sufficiently (Webb et al.,2010; Middelweerd, Mollee, Wal, Brug, & Velde, 2014). The presence of these theories and techniques in wearables has also been studied (Mercer, Li, Giangregorio, Burns, & Grindrod, 2016; Sullivan & Lachman, 2017; Lyons et al., 2014), but is limited in explaining how and why this is effective. Gaining knowledge into the effectiveness of the use of evidence-based techniques in fitness wearables could help the development of the technology. It also beneficial to look for ways to use these techniques for sustained use of the wearables, since 50% of customers dispose their wearable within six months of use (Dolan, 2015).

Besides the health behavior change itself, there is another side to consider. A change in health behavior in this context also means moving towards healthy consuming, since certain consumer products affect health outcomes. For example: With the increasing technical knowledge of food-production, came the introduction of low-cost, energy-dense food. Consumption of energy-dense food together with limited energy expenditure (burning energy) facilitates weight-gain in adults (Caballero, 2007). Healthy consumer behavior thus can be described as consuming in a way that is beneficial, or at least not harmful, for your health. Examples of healthy consumer behavior are reducing alcohol consumption, reducing smoking and improving eating behavior**.**

Marketing efforts and price incentives have an effect on food purchasing patterns (Caballero, 2007; Yoo et al., 2006), but behavioral determinants such as motivation, abilities and environmental opportunities also plays an important role (Turrell, & Kavanagh, 2006). The gap between collecting data about ones health and engaging in healthy consuming provides an interesting angle for several parties. Parties benefiting from further research are (i) producers and marketers of products related to health outcomes, (ii) developers of health promoting programs, (iii) developers of fitness wearables.

The first part of this paper consists of a critical literature review on theory-based techniques prevalent in health promoting technology such as wearable devices and their application to health behavior change. Based on the findings of the literature review, the Wearable Technology and Health Behavior (WTHB-) model is conceptualized to link the found theoretical elements and their contribution to healthy consumer behavior. The second part of the paper consists of an explorative survey conducted to gain more insight into the interrelations between the use of fitness wearables and healthy consumer behavior.

The research question addressed is "*What are the interrelations between the use of a fitness wearable and healthy consumer behavior?*" and will be answered by the help of three sub-questions:

I. What are fitness wearables and their use?
II. What is healthy consumer behavior and that of users of fitness wearables?
III. To what extent does the health behavior of users of fitness wearables differ from that of non-users?

These questions aim at providing some groundwork for further research into the effects of fitness wearable use, health behavior and the strength and direction of found relations. Also, this study provides groundwork for improving existing health behavior research by involving technology. From a societal point of view, this study contributes to a clear understanding of the use of fitness wearables which is helpful in improving the effectiveness of such devices to maintain newly obtained health behavior on the long-run.

2. LITERATURE REVIEW

2.1 Theories and concepts

In order to understand the different theories and concepts mentioned in this paper, this sub-chapter will explain these theories and concepts. This enables a clear understanding of the study as well as the conceptualization of WTHB-model.

2.1.1 Fitness wearable

Fitness wearables can be seen as part of personalized health technology which generally refers to wearable devices, worn as

a watch, that monitor health-related activity and provide feedback at the individual level, usually through a corresponding app or mini-display on the device (Allen & Christie, 2016). So, a fitness wearable can be defined as a wearable device that tracks health-related personal statistics and provides personalized feedback in order to improve one's health behavior.

2.1.2 Behavior change techniques

A behavior change technique is a process that has the ability to influence psychological determinants (Kok et al., 2015). Examples of psychological determinants are attitude, self-efficacy and habit. These techniques are used in interventions to promote behavior change (Webb, Joseph, Yardley & Michie, 2010).

2.1.3 Goal-setting theory

The goal-setting theory (Latham & Locke, 1979) is based on the idea of conscious human behavior being goal-driven (Latham & Locke, 1991). Three goal properties were determined in order to increase performance. Goals have to be; difficult, but attainable, specific and proximate (Latham, & Locke, 1991; Locke, Shaw, Saari, & Latham, 1981). Goals that are more difficult require more effort (Shilts, Horowitz & Townsend, 2004) and are found to increase performance (Latham & Locke, 1991). Specific goals are found to increase performance as well (Cullen, Baranowski & Smith, 2001), since they contribute to a clear strategy to accomplish the goal. Finally, proximate goals mean short-term goals. Short-term goals set immediate targets and are less likely to be postponed, therefore proximate goals are also associated with an increase in performance (Bandura & Simon, 1977).

2.1.4 Self-regulation theory

This theory was proposed by Baumeister et. Al (1994). Self-regulation is the ability to regulate one's behavior (Baumeister, & Vohs, 2007) in controlling what one thinks, says and does. The four components of this theory are: standards, motivation, monitoring and willpower. Standards mean setting a targeted behavior as bringing behavior in line with some standard. Vague, inconsistent or conflicting standards can inhibit effective self-regulation (Baumeister, & Vohs, 2007). Motivation can be described as the motivation to meet a standard or achieve a goal, or in other words: the motivation to regulate oneself (Baumeister, & Vohs, 2007). Monitoring means keeping track of behavior in order to compare behavior to the set standard (Baumeister, & Vohs, 2007) and when individuals stop monitoring themselves one might lose control (Baumeister, & Heatherton, 1996). Willpower can be described as self-regulatory strength and is seen as a limited resource (Baumeister, & Vohs, 2007). This element is also often compared to a muscle, which gets tired after multiple use and can be trained (Brug, Kremers, Lenthe, Ball & Crawford, 2008). Limited willpower does not necessarily hinder self-regulation efforts, since motivation can overcome this deficit (Baumeister & Vohs, 2007).

2.1.5 Self-efficacy theory

The self-efficacy theory was initiated by Bandura. Self-efficacy refers to beliefs in one's capability of acquiring and using skills to accomplish a certain goal (Bandura, 1977). Individuals are more likely to engage in activities in which they have high self-efficacy (van der Bijl, & Shortridge-Baggett, 2001), meaning activities in which they believe are capable of executing or learning to execute.

2.1.6 Intrinsic and extrinsic motivation

Motivation is a way of explaining behavior and is seen as what drives people to act in a certain way or developing the intention to act in certain way. Intrinsic motivation refers to doing something because an individual finds it inherently satisfactory (Ryan, & Deci, 2000). Extrinsic motivation contrasts with intrinsic motivation, because it refers to doing something because of some external value (Ryan, & Deci, 2000). An example to illustrate the difference is the motivation to go to work. An intrinsic motivation for going to work is because someone enjoys working, while an extrinsic motivation is the salary one gets for working.

2.2 Healthy Consumer Behavior

According to Mosby (2009) health behavior entails the action taken by an individual to maintain, attain or regain good health and to prevent illness. Examples of health behaviors are exercising regularly and eating a healthy and balanced diet (Mosby, 2009). The world health organization recommends at least 150 minutes aerobic physical activity of moderate-intensity or at least 75 minutes of vigorous-intensity throughout the week for adults aged from 18 to 64 (World Health Organization, 2017). Adults who engage in more physical activity are more likely to maintain their weight, less vulnerable to depression and less likely to get type 2 diabetes (World Health Organization, 2017). Nonetheless, more than 80% of adults do not meet the guidelines for physical activity (ODPHP, 2017) Many governments also provide their inhabitants with dietary guidelines in order to promote a healthy and balanced diet (ODPHP, 2017; Ministry of Health, Welfare and Sport, 2017) and researchers widely studied the effects of consuming on health outcomes. For example, regular consumption of fruit and vegetables lowers the risk of cardiovascular disease (Joshipura et al., 2001), but around 75% of the Dutch population does not meet the recommended intake of fruit, vegetables and fish (CBS, 2015). Despite the availability of extensive information and guidelines on health common causes of chronic health conditions are obesity, heavy drinking and smoking (Sturm, 2002;CBS, 2016). Healthy consumer behavior can be defined as consuming in a way that is beneficial, or at least not harmful, for your health and can therefore be seen as a specific health behavior. Examples of healthy consumer behavior are reducing alcohol consumption, reducing smoking and making healthier food choices. These findings indicate that moving towards healthy consumer behavior leads to a change in health behavior, since healthy consumer behavior can be considered as a specific health behavior.

2.3 Fitness Wearables and Their Use

Fitness wearables contribute to the movement of quantified self and are part of the so-called internet of things. The latter describes the goal of these technologies; working their way into individuals' daily lives (Tehrani et al.,2014). Basic features of such devices are tracking steps, calories, distance and floors climbed, monitoring heart rate, and tracking and monitoring sleep and sleep stages (Fitbit.com, 2017). Wearable technology can influence many fields, including health and fitness (Tehrani et al.,2014). In a worldwide survey by Thompson (2016) wearable fitness technology was number one in the top 20 fitness trend described in the report (Thompson, 2016), which confirms its growing popularity. Commercial fitness wearables are most used for tracking daily physical activity, but can also monitor dietary intake (Schwartz, & Baca, 2016). A research by Patel, Park, Bonato, Chan, & Rodgers (2012) evaluated four wearable devices in the 2015 top ten of best fitness trackers on user satisfaction, user friendliness, and accuracy. While this research gives a clear overview of the perceived quality of selected wearables, it does not say anything about effects on health outcomes. Research suggested that monitoring physiological data on the long-term can positively contribute to

the diagnosis and treatment of chronic diseases (Patel et al., 2012), but does not include any findings for commercial use.

2.4 Techniques in Wearables to Achieve Health Behavior Change

Earlier research has developed standardized definitions of behavior change techniques (BCTs) in behavior change interventions by constructing a theory-linked taxonomy of 26 BCTs that are generally applicable (Abraham & Michie, 2008). This taxonomy was later refined and resulted in a 40-item taxonomy of BCTs to change physical activity and healthy eating behaviors, which was called the CALO-RE taxonomy (Michie, Ashford, Sniehotta, Drombowski, Bishop & French, 2011). The effectiveness of health behavior change interventions has found to be linked to the use of BCTs (Glanz, Rimer, & Viswanath, 2008; Abraham & Michie, 2008; Webb et al., 2010; Noar & Mehrotra, 2011).

Just as regular health interventions, internet-based interventions also benefit from a broader use of theory and involvement of more BCTs (Webb et al.,2010; Middelweerd et al., 2014). In a study, focused on the use of behavior change theories in physical activity apps, it was found that app developers are not sufficiently incorporating health behavior change theories (Cowan, et al., 2013). Other reviews also acknowledge that health promoting apps do not implement these evidence-based recommendations enough (Chomutare, Fernandez-Luque, Årsand, & Hartvigsen, 2011; West, et al., 2012). Although the incorporation of BCTs is small, there have been found some BCTs in health promoting apps. BCTs related to self-monitoring, goal-setting and feedback were most prevailing in apps promoting physical activity (Middelweerd et al., 2014; Payne, Lister, West, & Bernhardt, 2015).

Weight-loss mobile apps appear to use a narrow range of BCTs, using mainly goal-setting and self-monitoring (Pagoto, Schneider, Jojic, Debiasse, & Mann, 2013; Azar, et al., 2013). Studies suggest that health researchers and app developers should work together in order to enhance effectiveness of health promoting apps (Payne et al., 2015; West et al., 2012; Noar & Mehrotra, 2011; Kratzke & Cox, 2012; West et al., 2013).

According to research, wearable fitness technology also incorporates BCTs related to self-monitoring, goal-setting and feedback (Mercer, Li, Giangregorio, Burns, & Grindrod, 2016; Sullivan & Lachman, 2017; Lyons, Lewis, Mayrsohn, & Rowland, 2014). The presence of BCTs in wearable fitness technology has proven to increase physical activity and/or increase weight loss (Mercer et al., 2016; Lyons et al., 2014). Mercer et al. (2016) rated seven wearable activity trackers by using CALO-RE taxonomy ratings which showed that 9 techniques were present in every tracker and the mean number of BCTs incorporated in the wearable activity trackers was 16.3/40 (SD 4.6). The devices that were reviewed tended to focus on techniques for goal-setting, self-regulation and social support. However, a study by Lyons et al. (2014) using a 93-item taxonomy also recognized that several techniques associated with successful interventions for physical activity were rarely used or even absent. These techniques include practice, action planning, and problem solving (Lyons et al., 2014).

2.5 Application of Theories and Techniques to Achieve Healthy Consumer Behavior

BCTs are theory-linked, which means that they are closely related to the behavioral determinants conceptualized in behavioral theories. Earlier mentioned BCTs which have found to be prevalent in wearable fitness technology are conceptualized in several behavioral theories and have proven to be effective in a number of health behavior change studies.

Goal-setting is an important concept in theories such as Goal-Setting theory (Latham, & Locke, 1991) and Self-Regulation theory (Baumeister, & Heatherton, 1996), where conscious human behavior is believed to be regulated by the individual's goals. Latham, & Locke (1981, 1991) found that goals that are specific, proximal and difficult yet attainable, increased task performance. Cullen, Baranowski, & Smith (2001) reviewed the goal-setting process and procedures, and their use in dietary interventions. A four-step process was constructed including recognizing a need for change, establishing a goal, monitoring goal-related activity and self-rewarding for goal attainment (Cullen, Baranowski, & Smith, 2001). In study by Schnoll, & Zimmerman (2001) evaluating the effectiveness of incorporating two self-regulation strategies in enhancing dietary self-efficacy and dietary fiber consumption college students (n=113) were randomly assigned to one of four treatment conditions: goal setting, self-monitoring, goal-setting and self-monitoring, and no goal-setting and no self-monitoring. Students who set goals were found to consume 91% more fiber than the students who did not set goals (Schnoll, & Zimmerman, 2001). Goal-setting has also proven to be effective in physical activity studies. Annesi, (2002) studied the effect of a goal-setting protocol on exercise maintenance of 100 members of an Italian fitness club and found that the goal-setting group showed greater attendance and less drop-out rate than the control-group.

Feedback is closely related to goal-setting, as it enhances goal achievement (Latham, & Locke, 1991; Bandura, & Simon, 1977) and contributes to goal-commitment. It is found that combining feedback with goal-setting has a positive effect on performance (Neubert, 1998). This positive effect is induced by delivering information to evaluate previous behaviors and performance (Neubert, 1998) and comparing this to the set goals in order to discover any goal discrepancy. Specifically outcome feedback increases performance and has a stronger effect on self-efficacy and self-regulation (Kluger, & DeNisi, 1996; Neubert, 1998). According to Bandura (1977) performance outcome is the most important source of self-efficacy.

Self-monitoring is also included in the Goal-setting theory (Latham, & Locke, 1991) and Self-regulation theory (Baumeister, & Heatherton, 1996). The effectiveness of self-monitoring could be enhanced by increasing the knowledge on performance outcomes (Johnson, & White, 1971). In a study by Bandura, & Simon, (1977) it was found that self-monitoring alone was not effective when no explicit goals were set, meaning that people are inclined to evaluate their performance once the right standards are set. Therefore, it can be said that self-monitoring is often associated with goal-setting and feedback (Munson & Consolvo, 2012), which in turn also explains the connection to self-efficacy. The belief in one's ability to perform a certain behavior that enables the accomplishment of a certain goal is an interplay of several different elements. Butryn, Phelan, Hill, & Wing (2007) found that consistently self-weighing resulted in successfully maintaining achieved weight loss.

Social support is based on an important concept in the Self-determination theory where three psychological needs are identified: autonomy, relatedness and competence (Ryan, & Deci, 2000). Relatedness facilitates social support and reflects a need to belong, which is created by interpersonal attachment (Baumeister, & Leary, 1995). The need to belong includes wanting frequent interaction with the same person and

interaction based on caring and concern (Baumeister, & Leary, 1995). The perceived support of significant others has been associated with improvements in eating behaviors (Steptoe, Perkins-Porras, Rink, Hilton & Cappuccio, 2004). In a study by Wing, & Jeffery (1999) focusing on the benefits of social support for weight loss maintenance it was found that the participants recruited with friends and the addition of social support resulted in 66% maintaining their weight loss, while participants recruited alone without addition of social support only resulted in 24% maintaining their weight loss. Social support has also been studied in an internet-based environment, where social support is exchanged by encouragement and motivation, information and shared experiences, and resulted in an increase in weight loss efforts (Hwang et al., 2010). A study by Anderson, Winett & Wojcik, (2007) found that the positive effect of social support on participants' eating behavior was largely indirect through self-efficacy and self-regulation.

Motivation is an important factor in many behavior change theories such as Self-regulation theory (Baumeister, & Heatherton, 1996) and Self-determination theory (Ryan, & Deci, 2000). In the latter, three psychological needs were identified which can be seen as antecedents of motivation. Although motivation is not included in the CALO-RE taxonomy (Michie et al., 2011), it is an important concept in health behavior change and reflects why individuals attain and/or maintain behavior change in the first place. It is found that when behavior is being controlled by external forces intrinsic motivation decreases, because of the autonomy need being threatened (Ryan, & Deci, 2000; Harackiewicz, 1979). Research has found that in the short-term people will perform a targeted behavior for an extrinsic value, however in order to sustain behavior change in the long-term these new behaviors must be internalized (Seifert, Chapman, Hart & Perez, 2012), meaning people need to become intrinsically motivated first. Ceasing to provide extrinsic motivators before internalizing the new behavior might cause a person to stop performing a specific targeted behavior.

2.6 The Conceptualization of the Wearable Technology and Health Behavior Model

Based on the found BCT's in health promoting technology and their theoretical constructs the Wearable Technology and Health Behavior (WTHB) model has been proposed. The elements conceptualized in this model have proven to be effective in several different health behavior change studies. The aim of the WTHB-model is to depict the cohesion between the theoretical elements prevalent in fitness wearables and healthy consumer behavior through self-regulation. The relations in the WTHB-model depict a large part of the answer to the main research question: "*What are the interrelations between the use of a fitness wearable and healthy consumer behavior?*". The Self-regulation theory of Baumeister et al. (1994) provides the foundation for the proposed model and is extended by the inclusion of other theories used in behavior change research.

2.6.1 Healthy Consumer Behavior

Healthy consumer behavior can be defined as consuming in a way that is beneficial, or at least not harmful, for your health and can therefore be seen as a specific health behavior. Health behavior entails the action taken by an individual to maintain, attain or regain good health and to prevent illness (Mosby, 2009). Findings indicate that moving towards healthy consumer behavior leads to a change in health behavior, since healthy consumer behavior can be considered as a specific health behavior.

2.6.2 Self-regulation

Self-regulation is an important element in healthy consumer behavior, because regulating one's own behavior is needed when attempting to make healthy decisions. Self-regulatory behavior has proven to be an important predictor of healthy nutritional behavior (Anderson et al., 2007), therefore self-regulation is seen as the precedent of healthy consumer behavior in the proposed model, see figure 1. Based on previous findings, four elements have been identified to contribute to self-regulation.

2.6.3 Health Behavior Goals

Goals represent a desired end-state an individual would like to reach. In theory this element is identical to goals in the Goal-setting theory. It provides the individual with a direction for regulating one's behavior. It has been found that these goals need to be *difficult*, yet attainable, *specific* and *proximate* (Latham & Locke, 1991; Cullen et al., 2001; Bandura & Simon, 1977). Setting goals has been effective in several health behaviors such as eating behavior and physical activity (Cullen et al., 2001; Schnoll, & Zimmerman, 2001; Annesi, 2002). Besides 'goals' functioning as a distinct element in the model, it also relates to self-efficacy by interconnecting with different precedents of self-efficacy.

2.6.4 Self-efficacy

Self-efficacy is not a term used in the Self-Regulation theory, however research does suggest that high self-efficacy beliefs contribute to self-regulatory behaviors (Anderson et al., 2007). Since self-efficacy is an interplay of several elements, including self-monitoring, it is not logical to ignore self-efficacy as a vital element of the proposed model. Since the other elements have been identified as BCT's in fitness wearables and have proven to play an important part in self-efficacy, they are conceptualized as precedents of self-efficacy. *Health feedback*, especially outcome feedback, has found to have a positive effect on self-efficacy (Bandura, 1977; Kluger, & DeNisi, 1996; Neubert, 1998), but also closely relates to goal-setting (Latham, & Locke, 1991; Bandura, & Simon, 1977; Neubert, 1998) .*Self-monitoring of health outcomes* interconnects with health feedback through facilitating the increase of knowledge about performance outcomes (Johnson, & White, 1971). This interconnection also influences goal-setting and vice versa. Self-monitoring allows an individual to collect information about one's behavior and performance outcome, while feedback reflects on this information in order to detect differences in the current state and the desired end-state (Bandura, & Simon, 1977; Johnson, & White, 1971; Munson & Consolvo, 2012). Finally, *social support*, affects self-efficacy through the support of significant others in enhancing the beliefs of one's ability to perform the behavior in order to reach a specific outcome (Anderson, et al., 2007). Research has supported the effectiveness of social support in health behavior change (Steptoe et al., 2004; Wing, & Jeffery, 1999; Hwang et al., 2010).

2.6.5 Motivation

Motivation is a concept which is widely researched and applied in different fields. It is an important precedent for self-regulation, see figure 1, as making healthy decisions is less easy when one is not motivated to do so. The literature identified *extrinsic* motivation to only be effective on the short-term, while *intrinsic* motivation has proven to be effective on the long-term (Ryan, & Deci, 2000; Seifert et al., 2012). While extrinsic motivation is being triggered by external values,

intrinsic motivation interconnects with other elements of the model also.

2.6.6 Willpower

Willpower appears to refer to the limited resource that self-regulation is depending on and resembles a strength. However, Baumeister & Vohs (2007) have suggested that motivation is able to compensate up to a certain point when there is a deficit of willpower, see figure 1.

2.6.7 Usage of a Fitness Wearable

A fitness wearable can be defined as a wearable device that tracks health-related personal statistics and provides personalized feedback in order to improve one's health behavior. Commercial fitness wearables are most used for tracking daily physical activity, but can also monitor dietary intake (Schwartz, & Baca, 2016). Such a device allows users to set goals by setting certain activity targets for example (Fitbit, 2017; Garmin, 2017). Also, users are able to connect with other users and engage in challenges or group targets (Fitbit, 2017; Garmin, 2017; Samsung Gear Fit, 2017). The corresponding mobile applications often informs the users of the user's progress and sends push-notifications to motivate the user (Samsung Gear Fit, 2017).

2.7 Relations Between the Use of Fitness Wearables and Healthy Consumer Behavior

Based on the findings, some important interrelations come to light. One of the found BCT's was self-regulation, which was found to be an important predictor of healthy nutritional behavior (Anderson et al., 2007). Healthy consumer behavior here is to great extent similar to healthy nutritional behavior, because both behaviors require regulating one's behavior in order to make healthy decisions and consumer behavior involves nutritional behavior as well. Therefore, it becomes clear that self-regulatory behavior is closely related to healthy consumer behavior, see figure 1. An important precedent of self-regulation is goal-setting, which is conceptualized in the self-regulation theory as standards (Baumeister, & Heatherton, 1996). Again this theoretical element is found in fitness wearables as well and considering its effectiveness in health behavior change studies it can be concluded that there is a relation between goal-setting and self-regulation, see figure 1. Also, goal-setting is found to interconnect with self-efficacy (Zimmerman, 2001; Bandura 1977), see figure 1. Even though self-efficacy was not an original element in the self-regulation theory (Baumeister et al., 1994), it has been found that self-efficacy beliefs contribute to self-regulation (Anderson et al., 2007). Considering the meaning of self-efficacy beliefs it is not an unlogical to assume that regularly performing self-regulatory behavior could contribute to self-efficacy beliefs as well, indicating that this relation could work both ways, see figure 1. Also, self-efficacy relates to several precedents which were also identified as BCT's; feedback, self-monitoring and social support (Mercer et al., 2016; Lyons et al., 2014). These techniques have proven to be effective in improving health behavior (Neubert, 1998; Butryn et al., 2007; Steptoe et al., 2004) and therefore relate to self-regulation through self-efficacy, see figure 1. These techniques, as well as goal-setting and motivation, are also related to the usage of a fitness wearable itself, since functional elements of the wearable provide this (Fitbit, 2017; Garmin, 2017; Samsung Gear Fit, 2017), see figure 1. For example: collecting personalized health statistics is a form of self-monitoring and setting step-targets is a form of goal-setting. This brings us to another important precedent of self-regulation; motivation. Regulating one's behavior towards healthy consumer behavior is less easy when one is not motivated to do so. As several other elements in the model, motivation has also found to be closely related to self-efficacy, see figure 1. Again, an important consideration is that these relations can work both ways. Not only does the wearable relate to for example social support through connecting with other users, connecting with other users might also relate to increased use of the wearable for example. This could probably apply to other relations in the model as well. Finally, willpower is the only element that does not seem to directly relate to the use of fitness wearables. However, considering the findings on this theoretical element in theories such as the self-regulation theory (Baumeister & Vohs, 2007) there is enough substantiation to include this in the model. Despite the inclusion of this element in the model, a deficit in willpower does not affect self-regulation negatively per se, since motivation has found to have the ability to compensate for this up to a certain point (Baumeister & Vohs, 2007), see figure 1.

3. METHODS

In this part, an explorative study will gain more insight into the use(rs) of fitness wearables and healthy consumer behavior. This is done based on a quantative research method and tries to reveal differences in health behavior of users and non-users of fitness wearables. This method will contribute to the answer of

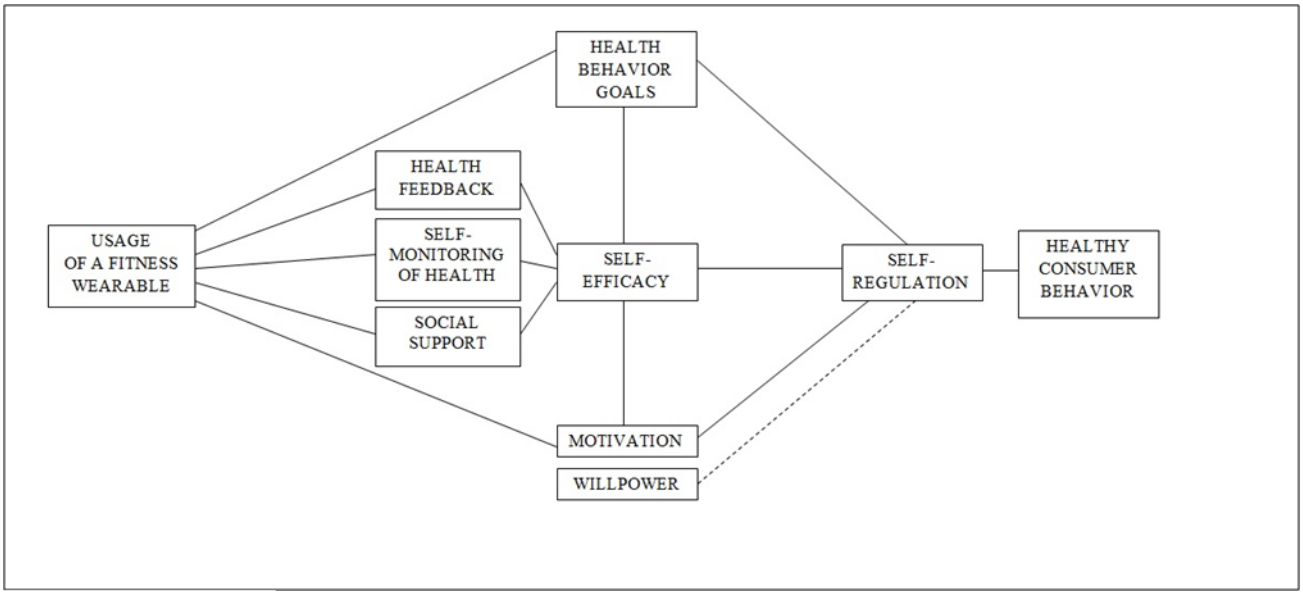

Figure 1.

the first and second sub-question, which were already partly answered in the literature review, and provide a clear answer to the third sub-question based on the findings of the survey.

3.1 Research Design

3.1.1 Data Collection

A survey of fifteen questions was conducted and spread through different social media channels (Facebook, Instagram etc.). Respondents under eighteen were excluded from participation. No further exclusion criteria were set. In order to attain an equal division of users and non-users of fitness wearables, the survey was also spread through specific Facebook groups consisting of users of fitness wearables sharing their experiences and results. This equal division is allowing more reliable test results. An extra effort to motivate people to participate was adding a prize which was revealed at the end of the survey.

3.1.2 Analysis

A part of the explorative research was done by looking at the descriptive statistics of the data. This included frequency tables and cross-tabulations. In order to determine whether there is a statistically significant difference between users and non-users of fitness wearables in their health behavior, the independent samples t-test was used.

3.1.3 Measures

In order to identify the users and non-users of fitness wearable, and therefore defining the variable usage, a general question about technology use was asked and respondents were then labeled as "*non-user*" or "*user*". Respondents had to choose on or more technologies they were using or none at all. One of the options was "*Fitness Wearable (Fitbit, Samsung Gear Fit, Garmin etc.)*". When this option was selected, the respondents were offered some extra questions regarding the use of this technology in order to gain more insight into the use of fitness wearables. Several aspects of the use were measured; reason for use, ease of use, function use and frequency of use. *Reason for use* was measured by asking the users why they started using the wearable. While the majority of the options were non-health related reasons, one was a health related reason: "*I wanted to improve my health (lose weight, exercise more, etc.)*". *Ease of use* of the wearable was measured by offering answers rating from "*Extremely easy*" to "*Extremely difficult*". Also, the *function use* was measured by asking the respondents which function they use most often. The answers included the most general functions of the fitness wearable, being: "*Hart monitor*", "*Sleep monitor*", "*Activity tracker*", "*Calorie tracker*" and "*Speed tracker*". All functions have in common that they collect personal statistics, resulting in people checking these personal statistics. Therefore, the *frequency of use* by checking these statistics was measured as well. Answers rated from "*Less than once a month or never*" to "*Several times a day*".

Healthy consumer behavior was measured by choosing several nominal variables which represent certain health behaviors; health consciousness, physical activity, nutrition and smoking. These questions were asked to every respondent in order to compare behavior between groups. *Health consciousness* was the first aspect of behavior that measured. Respondents were asked how healthy they considered themselves, including answers rating from extremely positive to extremely negative. The data was ranked from 1 (1= "Extremely unhealthy") to 7 (7= "Extremely healthy"), in order to make the comparison of means less confusing. *Physical activity* was measured by asking the frequency of gym attendance, because a gym membership requires a monthly fee and which members can choose to use as much as they prefer. Respondents were able to choose one of the following answers "*I don't have a gym membership*", "*Once a month or less*", "*Once a week or less*" or "*Several times a week*". *Nutrition* was measured by focus on nutritional attributes, willingness to pay extra for healthy nutritional attributes and consumption of alcohol. The first question regarding nutrition included answers rated from an extremely negative to an extremely positive answer, while the second question was ranked the opposite way. Again, for the analysis the answers of the willingness to pay question were valued 1 (1 = "Definitely not") to 5 (5= "Definitely yes"). The last question included answers rating frequency of alcohol consumption from "*I don't drink alcohol*" to "*Every day*". Lastly, the health behavior *smoking* was measured the same way as alcohol consumption with the same ratings in the answers.

4. RESULTS

4.1 Use of Wearables and Health Behavior

4.1.1 Use(rs) of Fitness Wearables

The sample group consists of 499 respondents, of which 41.5% users (n=207) and 58.5% non-users (n=292). Of those 207 users, 80.2% started using the wearable with a specific health goal; they wanted to improve their health. In contrast, 19.8% of the users started using the wearable without a specific health goal. Regarding the ease of use, 68.3% considered their wearable extremely easy to use. Considering the functions respondents use most often, activity tracker was used most by 80.5% of the respondents using a fitness wearable, followed by hart monitor, calorie tracker, speed tracker and sleep monitor most used by 7.3%, 4.9%, 3.9% and 3.4% respectively. These functions collect data and users can track their personal statistics. 35.6% of the users check their personal statistics every day, and 47.8% of the users even check their personal statistics several times a day. In contrast, 3.9% of the users claim to check this less than once a month or never.

4.1.2 Health Behavior of Users of Fitness Wearables

When considering the frequency of gym attendance among users of fitness wearables, it shows that 35.3% goes to the gym several times a week while 49.5% of the users don't have a gym membership. The data also showed that 34.8% of the users pay a lot of attention to nutritional attributes of food products, 48.0% sometimes pays attention to this and 3.9% does not at all. In addition, 36.3% of the users would probably be willing to pay extra for nutritional attributes that are beneficial for their health, and 15.2% would definitely be willing to pay extra while 29.9% is not so sure, answering "might or might not". Regarding alcohol consumption, it was found that 31.4% of the users consumes alcohol once a week or less and 27.0% of the users consumes alcohol once a month or less. In contrast, 20.1% does not drink alcohol at all. Results also showed that 83.3% of the users does not smoke with only 9.3% smoking every day.

4.2 Relation Between Usage of Fitness Wearables and Healthy Consumer Behavior

Independent samples t-tests were conducted to compare the means of certain health behaviors of users and non-users of fitness wearables. There was a significant difference in health consciousness between users ($\mu = 5.534, \sigma = 1.048$) and non-users ($\mu = 5.320, \sigma = 1.051$), conditions: ($t_{474} = -2.207, \rho = 0.028$). Gym frequency of users showed a slightly higher mean ($\mu = 2.32, \sigma = 1.387$) than gym frequency of non-users ($\mu = 2.12, \sigma = 1.288$). However, this difference was not found significant ($t_{419.306} = 1.643, \rho = .101$). Regarding nutrition, the results were mixed. When looking at focus on nutritional attributes, the users scored higher ($\mu = 3.14, \sigma .788$) than the non-users ($\mu = 2.70, \sigma = .895$), which was found to be

significant ($t_{460.502} = 5.648, \rho < .00$). Despite there being a significant difference in the focus on nutritional attributes, the willingness to pay extra for these attributes was not significantly different ($t_{470} = .949, \rho = .343$), with users scoring only slightly higher ($\mu = 3.412, \sigma = 1.095$) than non-users ($\mu = 3.317, \sigma = 1.057$). The last dependent variable for nutrition was alcohol consumption, with users showing a lower mean ($\mu = 2.57, \sigma = 1.087$) in how often they consume alcohol than non-users ($\mu = 2.87, \sigma = .990$). This difference in means of alcohol consumption was found to be significant ($t_{470} = -3.132, \rho = .002$). The last variable, smoking, showed a lower mean for users ($\mu = 1.53, \sigma = 1.265$) than for non-users ($\mu = 2.09, \sigma = 1.589$). The results showed a statistically significant difference in the means for smoking ($t_{468.201} = -4.261, \rho < .00$).

5. CONCLUSIONS

Fitness wearables are health promoting technologies, worn as a watch, and have found to contain certain BCTs in order to attain health behavior change. These techniques are theory-based and have proven to be effective in many health behavior studies. The cohesion of these techniques form important elements in the WTHB-model, since they link the usage of fitness wearables to healthy consumer behavior. The explorative study that was done revealed some interesting information concerning the use(rs) of fitness wearables and their health behaviors. The sample groups were quite large, so it can be said that the sample was representative enough to make conclusions about the general population. As to the use of fitness wearables, it can be said that the majority starts using the wearable for a specific health-related reason, which among other things include losing weight and exercising more. It thus comes to no surprise that the activity tracker function is the most used function of the wearable. Almost one third of the users check their statistics daily and approximately half of the users check their statistics even several times a day. Which is remarkable, because it was found in the literature that half of the customers stop using the wearable after six months, which could mean that even after extensive use this might not be lasting. It also seems that the users of fitness wearables are mostly women and are aged between 18 and 25 or 40 and up. Another thing to consider here is that this does not necessarily say something about the fitness wearable itself, but might also have something to do with health behavior differences among different age groups and gender. When looking at the health behavior of the users it shows some mixed results. Half of the users of fitness wearables do not own a gym membership, while more than one third of the users goes to the gym several times a week. This could indicate that most of the physical activity is already done outside the gym, which becomes apparent by checking one's personal statistics very often. This might indicate that users maybe do not value a gym membership that much when they see how to engage in physical activity in other ways than exercising in the gym. Either way, users either don't attend the gym at all, or do so very often. Also, half of the users sometimes pay attention to nutritional attributes and again one third of the users pay a lot of attention to nutritional attributes. In addition, one third would probably also be willing to pay extra for healthy foods and consumes alcohol less than once a month. Also, the majority of the users do not smoke. Taking this together, it can be said that approximately one third of the users of fitness wearables engage in healthy consumer behavior. This brings us to looking at the health behavior of non-users as well. The results showed that users of fitness wearables considered themselves significantly healthier compared to non-users and also revealed that users pay significantly more attention to nutritional attributes of food products. However, it cannot be said that users of fitness wearables are more willing to pay extra for healthier food products. As far as health consciousness goes, it could be that the wearable serves as a reliable source for one's personal health resulting in users being more sure about their health. When looking at activities that are considered as harmful to your health, such as alcohol consumption and smoking, it can also be said that users of fitness wearables engage significantly less in these health harming activities. Negative health effects of these activities are much more noticeable when personalized health data is collected every day, which might make users more aware of the health outcomes associated with these health harming activities. Taking all this together, the WTHB-model depicts the interrelations between the usage of a fitness wearable and healthy consumer behavior through self-regulation. Adding to that, the explorative study shows that there is a positive relation between the usage of a fitness wearable and healthy consumer behavior.

Table 1 Descriptive statistics for users of fitness wearables; gender and age.

Respondents, n(%)	499
Users	207 (41.5)
Non-users	292 (58.5)
Gender of users, %	
Male	11.6
Female	88.4
Age of users, %	
18 – 25	33.8
26 – 32	16.9
33 – 39	14.5
≥ 40	34.8

5.1 Discussion

This paper explored the use(rs) of fitness wearables and health behavior, including theoretical elements which are proven to be effective in changing health behavior and are prevalent in fitness wearables. Besides answering the main question and its sub-questions, this work has also highlighted some important areas that need further research. As previously mentioned, there is a positive relation between the use of a fitness wearable and healthy consumer behavior, but there is no proof for one variable affecting the other or vice versa. The proposed model provides a clear framework, based on theory and evidence, to actually test effects. A quantative study could be conducted based on the CALO-RE taxonomy for example. This would also give a clearer image to what extent there is a positive relationship. It could be that the use of fitness wearables does cause behavior change, but might inhibit behavior change when it is used too much. This consideration is important, because that way the use could be adjusted in order to get the maximum positive outcomes. Besides that, the factors in the proposed model could be tested in order to determine whether there are direct effects that could eventually explain if and how the use of a fitness wearable leads to healthier behavior. Researchers of health behavior and the developers of fitness wearables could come together to improve the effectiveness of this technology in attempting to change behavior. The techniques included in the wearable have theoretical fundaments which most often is not the area of expertise of technology developers and therefore researchers specialized in health behavior could deliver a significant contribution to the development of fitness wearables. Also, this research could be extended by looking at what affects sustained use, so that the retention rate could be lowered. Not

only the development of the product benefits from a collaboration, it could also contribute to health behavior research in general. Since the groundwork for health behavior research was laid in a time where the Internet of Things was not such a huge part of our lives, it has the risk of becoming outdated on certain areas. Research needs to become more up to date and give more attention to technology as an important factor. It also not seems logical to ignore demographic factors in this research. Despite the fact that this paper does not include demographic factors, it could give an even broader view of the use of fitness wearables and behavior. Since it already became clear that most of the users of these devices are women and are in specific age groups, it is most likely that there are more specific socioeconomic factors involved.

Not only is this valuable research for the previous two mentioned parties, it will also be important for producers of consumer products and services that affect health outcomes. Users of fitness wearables could even form a target group and by gaining more insight into their behavior and what affects it products and services can be adjusted to that. Altogether, this paper is valuable on its own as an explorative study but also provides some groundwork for further research.

5.2 Study Limitations

There are some limitations that must be considered when considering the conclusions. Many of the "user" respondents came from a Facebook group consisting of active Fitbit users, meaning (i) that the respondents are likely to use the wearable more often and (ii) this could indicate that the majority of the "user" respondents are using a Fitbit, while other brands might not be included that much. To what extent the type of fitness wearable is of influence is not clear, but the BCTs mentioned in the literature review are found in several fitness wearables.

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8. APPENDIX

8.1 Descriptive Statistics

8.1.1 Usage

Statistics

Usage

N	Valid	499
	Missing	0
Mean		,4148
Std. Deviation		,49319

Usage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non-user	292	58,5	58,5	58,5
	User	207	41,5	41,5	100,0
	Total	499	100,0	100,0	

8.1.2 Goal Oriented Use

Goal Oriented Use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non-Goal Oriented	41	8,2	19,8	19,8
	Goal Oriented	166	33,3	80,2	100,0
	Total	207	41,5	100,0	
Missing	System	292	58,5		
Total		499	100,0		

8.1.3 Ease of Use

Ease of use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely easy	140	28,1	68,3	68,3
	Moderately easy	52	10,4	25,4	93,7
	Slightly easy	9	1,8	4,4	98,0
	Neither easy nor difficult	3	,6	1,5	99,5
	Moderately difficult	1	,2	,5	100,0
	Total	205	41,1	100,0	
Missing	System	294	58,9		
Total		499	100,0		

8.1.4 Function Use

Function use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Hart monitor	15	3,0	7,3	7,3
	Sleep monitor	7	1,4	3,4	10,7
	Activity tracker	165	33,1	80,5	91,2
	Calorie tracker	10	2,0	4,9	96,1
	Speed tracker	8	1,6	3,9	100,0
	Total	205	41,1	100,0	
Missing	System	294	58,9		
Total		499	100,0		

8.1.5 Frequency of Use

Frequency of use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than a month or never	8	1,6	3,9	3,9
	Every month	3	,6	1,5	5,4
	Every week	23	4,6	11,2	16,6
	Every day	73	14,6	35,6	52,2
	Several times a day	98	19,6	47,8	100,0
	Total	205	41,1	100,0	
Missing	System	294	58,9		
Total		499	100,0		

8.1.6 Gym Frequency

Usage * Gym frequency Crosstabulation

			Gym frequency				Total
			I don't have a gym membership	Once a month or less	Once a week or less	Several times a week	
Usage	Non-user	Count	143	18	43	66	270
		% within Usage	53,0%	6,7%	15,9%	24,4%	100,0%
		% of Total	30,2%	3,8%	9,1%	13,9%	57,0%
	User	Count	101	8	23	72	204
		% within Usage	49,5%	3,9%	11,3%	35,3%	100,0%
		% of Total	21,3%	1,7%	4,9%	15,2%	43,0%
Total		Count	244	26	66	138	474
		% within Usage	51,5%	5,5%	13,9%	29,1%	100,0%
		% of Total	51,5%	5,5%	13,9%	29,1%	100,0%

8.1.7 Focus on Nutritional Attributes

Usage * Focus Nutritional Attributes Crosstabulation

			Focus Nutritional Attributes				
			I don't pay attention to nutritional attributes	I pay very little attention to nutritional attributes	I sometimes pay attention to nutritional attributes	I pay a lot of attention to nutritional attributes	Total
Usage	Non-user	Count	33	61	129	46	269
		% within Usage	12,3%	22,7%	48,0%	17,1%	100,0%
	User	Count	8	27	98	71	204
		% within Usage	3,9%	13,2%	48,0%	34,8%	100,0%
Total		Count	41	88	227	117	473
		% within Usage	8,7%	18,6%	48,0%	24,7%	100,0%

8.1.8 Willingness to pay extra for healthy nutritional attributes

Usage * Willingness to pay extra for healthy nutritional attributes Crosstabulation

			Willingness to pay extra for healthy nutritional attributes					
			Definitely not	Probably not	Might or might not	Probably yes	Definitely yes	Total
Usage	Non-user	Count	12	51	78	94	33	268
		% within Usage	4,5%	19,0%	29,1%	35,1%	12,3%	100,0%
	User	Count	14	24	61	74	31	204
		% within Usage	6,9%	11,8%	29,9%	36,3%	15,2%	100,0%
Total		Count	26	75	139	168	64	472
		% within Usage	5,5%	15,9%	29,4%	35,6%	13,6%	100,0%

8.1.9 Alcohol consumption

Usage * Alcohol consumption Crosstabulation

			Alcohol consumption					
			I don't drink alcohol	Once a month or less	Once a week or less	Several times a week	Every day	Total
Usage	Non-user	Count	25	69	95	73	6	268
		% within Usage	9,3%	25,7%	35,4%	27,2%	2,2%	100,0%
		% of Total	5,3%	14,6%	20,1%	15,5%	1,3%	56,8%
	User	Count	41	55	64	39	5	204
		% within Usage	20,1%	27,0%	31,4%	19,1%	2,5%	100,0%
		% of Total	8,7%	11,7%	13,6%	8,3%	1,1%	43,2%
Total		Count	66	124	159	112	11	472
		% within Usage	14,0%	26,3%	33,7%	23,7%	2,3%	100,0%
		% of Total	14,0%	26,3%	33,7%	23,7%	2,3%	100,0%

8.1.10 Tobacco use

Usage * Tobacco use Crosstabulation

			Tobacco use					
			I don't smoke	Once a month or less	Once a week or less	Several times a week	Every day	Total
Usage	Non-user	Count	170	14	16	23	44	267
		% within Usage	63,7%	5,2%	6,0%	8,6%	16,5%	100,0%
	User	Count	170	4	5	6	19	204
		% within Usage	83,3%	2,0%	2,5%	2,9%	9,3%	100,0%
Total		Count	340	18	21	29	63	471
		% within Usage	72,2%	3,8%	4,5%	6,2%	13,4%	100,0%

8.2 Comparing Means

8.2.1 Usage - Health Consciousness

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Health Consciousness	Non-user	272	5,3199	1,05069	,06371
	User	204	5,5343	1,04754	,07334

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Health Consciousness	Equal variances assumed	,003	,958	-2,207	474	,028	-,21446	,09719	-,40544	-,02348
	Equal variances not assumed			-2,208	438,083	,028	-,21446	,09715	-,40540	-,02353

8.2.2 Usage - Gym frequency

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Gym frequency	User	204	2,32	1,387	,097
	Non-user	270	2,12	1,288	,078

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Gym frequency	Equal variances assumed	12,017	,001	1,660	472	,098	,205	,124	-,038	,448
	Equal variances not assumed			1,643	419,306	,101	,205	,125	-,040	,450

8.2.3 Usage – Focus on Nutritional Attributes

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Focus Nutritional Attributes	User	204	3,14	,788	,055
	Non-user	269	2,70	,895	,055

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Focus Nutritional Attributes	Equal variances assumed	7,930	,005	5,551	471	,000	,438	,079	,283	,594
	Equal variances not assumed			5,648	460,502	,000	,438	,078	,286	,591

8.2.4 Usage - Willingness to pay for nutritional attributes

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Willingness to pay extra for healthy nutritional attributes	User	204	3,4118	1,09502	,07667
	Non-user	268	3,3172	1,05653	,06454

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Willingness to pay extra for healthy nutritional attributes	Equal variances assumed	,088	,767	,949	470	,343	,09460	,09973	-,10137	,29057
	Equal variances not assumed			,944	428,893	,346	,09460	,10021	-,10237	,29157

8.2.5 Usage - Alcohol consumption

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Alcohol consumption	User	204	2,57	1,087	,076
	Non-user	268	2,87	,990	,060

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Alcohol consumption	Equal variances assumed	6,853	,009	-3,172	470	,002	-,305	,096	-,493	-,116
	Equal variances not assumed			-3,132	414,512	,002	-,305	,097	-,496	-,113

8.2.6 Usage - Tobacco use

Group Statistics

	Usage	N	Mean	Std. Deviation	Std. Error Mean
Tobacco use	User	204	1,53	1,265	,089
	Non-user	267	2,09	1,589	,097

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Tobacco use	Equal variances assumed	45,435	,000	-4,135	469	,000	-,560	,136	-,827	-,294
	Equal variances not assumed			-4,261	468,201	,000	-,560	,132	-,819	-,302

8.3 Survey Questions

Questions	Answers	Values	Label
1. What is your age?	• 18 – 25 • 26 – 32 • 33 – 39 • 40 and up		Age
2. What is your gender?	• Male • Female	1 = "Male" 2 = "Female"	Gender
3. Are you using one of these technologies?	• Smart light bulbs • Fitness wearable (Fitbit, Samsung gear fit, Garmin, etc.) • Wireless mobile phone charger • WiFi or Bluetooth speaker • None of these	0 = "Non-user" 1 = "User" *if option 2 is selected*	Usage
4. What was your motivation to start using a fitness wearable?	• It was a gift • It looks good • Many people I know are using it • I wanted to improve my health (lose weight, exercise more, etc.) • For fun • Other	0 = "Non-goal Oriented" 1 = "Goal Oriented" if option 4 is selected	Goal oriented use

5. How easy to use is your fitness wearable?	• Extremely easy • Moderately easy • Slightly easy • Neither easy nor difficult • Slightly hard • Moderately hard • Extremely hard	1 = "Extremely easy" 2 = "Moderately easy" 3 = "Slightly easy" 4 = "Neither easy nor difficult" 5 = "Slightly hard" 6 = "Moderately hard" 7 = "Extremely hard"	Ease of use

6. Which function of the fitness wearable do you use most often?	• Hart monitor • Sleep monitor • Activity tracker • Calorie tracker • Speed tracker		Function use
7. How often do you check your personal statistics while using a fitness wearable?	• Less than once a month or never • Every month • Every week • Every day • Several times a day		Frequency of use
8. How healthy do you consider yourself?	• Extremely healthy • Moderately healthy • Slightly healthy • Neither healthy nor unhealthy • Slightly unhealthy • Moderately unhealthy • Extremely unhealthy	1 = "Extremely unhealthy" 2 = "Moderately unhealthy" 3 = "Slightly unhealthy" 4 = "Neither healthy nor unhealthy" 5 = "Slightly healthy" 6 = "Moderately healthy" 7 = "Extremely healthy"	Health Consciousness
9. What mobile applications are you using?	• Task reminder • Internet provider application • Weather application • Fitness application • None of these		*
10. Are you willing to pay extra for a premium fitness app?	• Definitely yes • Probably yes • Might or might not • Probably not • Definitely not		*
11. How often do you go to the gym?	• I don't have a gym membership • Once a month or less • Once a week or less • Several times a week	1 = "I don't have a gym membership" 2 = "Once a month or less" 3 = "Once a week or less" 4 = "Several times a week"	Gym frequency
12. How much attention do you pay to nutritional attributes(sugar, fat, fiber, protein etc.) of food products?	• I don't pay attention to nutritional attributes • I pay very little attention to nutritional attributes	1 = "I don't pay attention to nutritional attributes" 2 = "I pay very little attention to nutritional attributes" 3 = "I sometimes pay attention to nutritional	Focus on nutritional attributes

	• I sometimes pay attention to nutritional attributes • I pay a lot of attention to nutritional attributes	attributes” 4 = “I pay a lot of attention to nutritional attributes”	
13. Are you willing to pay extra for nutritional attributes of food products that are beneficial for your health?	• Definitely yes • Probably yes • Might or might not • Probably not • Definitely not	1 = “Definitely not” 2 = “Probably not” 3 = “Might or might not” 4 = “Probably yes” 5 = “Definitely yes”	Willingness to pay extra for healthy nutritional attributes
14. How often do you drink alcohol?	• I don’t drink alcohol • Once a month or less • Once a week or less • Several times a day • Every day	1 = “I don’t drink alcohol” 2 = “Once a month or less” 3 = “Once a week or less” 4 = “Several times a day” 5 = “Every day”	Alcohol consumption
15. How often do you smoke?	• I don’t smoke • Once a month or less • Once a week or less • Several times a day • Every day	1 = “I don’t smoke” 2 = “Once a month or less” 3 = “Once a week or less” 4 = “Several times a day” 5 = “Every day”	Tobacco use

* The data from these questions were not used