Segmentation of activity trackers: Is it better to segment on age or physical activity?

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ABSTRACT,
The aim of this paper is to determine whether activity trackers should be segmented on physical activity or age. First of all, a literature review was conducted in order to identify different characteristics of activity trackers that manufactures use to make their product more appealing. Additionally, an online survey was conducted in which respondents stated their age and physical activity, after which they scored the importance of various characteristics of an activity tracker. Results reveal that a segment based on age is superior to a segment based on physical activity. Which might imply that manufacturers of activity trackers can differentiate between different age groups, to better fit consumers' needs.

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Keywords
Activity trackers, fitness trackers, segmentation, age, physical activity, market research, features.

1. INTRODUCTION

A fitness tracker – or activity tracker – as it is referred to by most, is a tracking device, which is capable of tracking its user's activity (e.g. step count) and other physiological information (e.g. heart rate). The tracked data is stored on a server and is visualized in ways that allow users to assess progress and gather feedback over time (Shih, Han, Poole, Rosson, & Carroll, 2015). The size of the global market for fitness trackers was approximated at $17,907 million in 2016, and is expected to grow to $62,128 million by 2023, registering a compound annual growth rate of 19.6% during the forecast period (Loomba & Khairnar, 2018).

In the period of 2013 to 2018 the activity tracker market was in its hypergrowth mode (Wei, 2014), otherwise known as the growth stage. The growth stage is the second stage in the product life cycle model, which models the product sales based on time. Typically, this cycle has four to six stages, which indicate the stage of life of a product: introduction, growth, maturity and decline respectively (Rink & Swan, 1979). Nowadays, the product is in the maturity stage of the life cycle, as the growth stage has come to an end. In this stage, there are several key traits on which companies need to focus, which include, but are not limited to: increasing competition, decreasing prices, and increased promotions (Rink & Swan, 1979). Since, in the maturity stage, the demand will begin to slow down, distributors will cut down their product stockings and the profits will start to flatten (Rink & Swan, 1979). Hence, companies will find themselves in a tough spot. Therefore, it is important for companies to keep improving themselves, so that they can sustain their growth. There are three different strategies to make this happen. First of all, companies can either try to innovate the market. Second of all, they can alter the marketing mix, or lastly, they can modify the product, so that it fits better to the customers' needs (Rink & Swan, 1979).

This study focusses on the latter strategy, modifying the product, so that it fits better to the customers' needs. A useful tool for better fitting the needs of the customers is the Segmentation-Targeting-Positioning-approach or STP-approach (see figure 1.). Segmentation refers to the consideration of

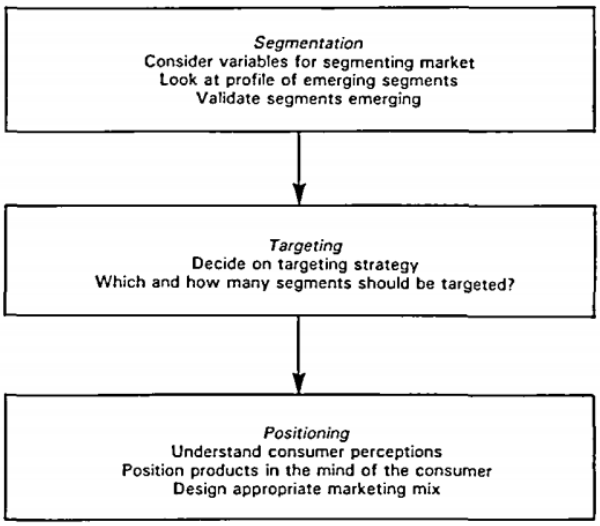

Figure 1. STP-approach. (Venkatesh & Davis, 2000)

variables to differentiate between different customer groups (Dibb & Simkin, 1991). Targeting refers to the decision making process about which segments to enter and the appropriate strategy to target those segments. Positioning refers to the translation of the needs and wants of the targeted customers into a tangible mix of product, price, promotion, distribution and service levels with maximum appeal (Dibb & Simkin, 1991). There are already quite some studies that investigate the differences between different activity trackers (Evenson, Goto, & Furberg, 2015; Gandhi & Wang, n.d.; Kaewkannate & Kim, 2016), or studies that only look into one aspect, instead of multiple aspects (Liszewski, 2018; Mansukhani & Kolla, 2017; Zhou & Piramuthu, 2014), but there are no studies about segmentation of activity trackers. Therefore, this study focusses on the first part of this model: the segmentation.

One common way of segmenting the market is on the basis of age (Tian, 2014; Moutinho, 2000; Dibb & Simkin, 1991). Activity trackers are quite technological, and since older people have more difficulties keeping up with technological development (Arning & Ziefle, 2009) it may be wise to segment based on age. Furthermore, the main purpose of an activity tracker is to measure ones physical activity, hence segmentation on the basis of physical activity may lead to interesting results. Since, more active people are more invested in being active, and therefore, have other needs in comparison to less active people. Thus, this research consists of two similar studies; the first one focusses on the correlation between age and the characteristics of an activity tracker, and the other focusses on the correlation between physical activity and the characteristics of an activity tracker. Hence, the following research question is set up:

RQ: What are the differences in importance of characteristics in activity trackers between age-based segments and physical activity based segments?

This research is separated into three parts: The first part consists of the theoretical framework and the literature review, where various characteristics of activity trackers will be examined. In the second part the research design is explained in detail, in order to provide an accurate overview of the research procedure, and the results are presented. Lastly, the conclusion, limitations and suggestions for future research will be addressed in the discussion section.

2. LITERATURE REVIEW

2.1 Theoretical framework

In order to answer the research question a theoretical framework is created, in order to simplify what needs to be researched. Through the systematic literature review that was conducted, several characteristics of activity trackers were found. In the survey, these characteristics will be scored by the participants. Furthermore, as stated earlier, the participants will be segmented based on their age and physical activity. Afterwards, the results of the survey are assessed, to see if there are significant correlations between age and physical activity towards the different characteristics of activity trackers. This resulted in the following theoretical framework (figure 2.). In

the section below, the theoretical framework will be explained thoroughly.

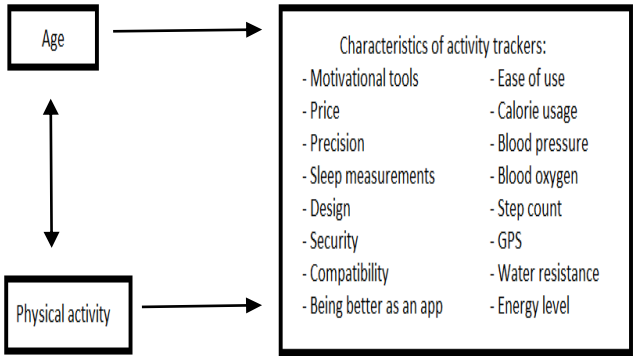

Figure 2. Theoretical framework

2.2 Segmentation

2.2.1 Age

Age differences have been of significant interest to psychology researchers and practitioners for over 6 decades (e.g. Girard, 1993; McCarty & Shrum, 1993; Minton & Schneider, 1980; Rhodes, 1983). However there has been relatively little research on the influence of age on technology adoption decisions (Morris & Venkatesh, 2000). There is some evidence that age has an important influence on technology usage (Morris & Venkatesh, 2000). Evidence suggests that age differences in information processing have an impact on older people's performance of computer-based tasks (Morris & Venkatesh, 2000). Also, increased age has been shown to be associated with difficulty in processing complex stimuli (Plude & Hoyer, 1986). Hence, this suggests that, older people have more need for the ease of use of a tracker, than younger people Furthermore, older people hold more negative attitudes towards computer technology than younger people (Czaja & Sharit, 1998). Thus, different ages can lead to different needs in an activity tracker.

2.2.2 Physical activity

Research has shown that age, sex, health status, self-efficacy, and motivation are associated with physical activity (Bauman, Reis, Sallis, Wells, Loos, & Martin, 2012). Since motivation is associated with physical activity, it may be wise to segment on the basis of physical activity, because more active people already have enough intrinsic motivation (Bauman et. Al. 2012), hence these people do not need the motivational tools embedded in some activity trackers, whereas these tools might be useful for non-active people. Hence, the physical activity level of one leads to different needs regarding an activity tracker.

2.3 Characteristics of activity trackers

2.3.1 Embedded motivational tools in a tracker

Activity trackers enable self-monitoring towards daily or long term goals; you can set a goal to walk for a certain distance over time for instance. Knowing this, a tracker is able to tell the user how much the user still needs to walk in order to achieves his or her goals (Evenson et al. 2015). This is one of the many ways, trackers can provide feedback (Evenson et. al. 2015). Next to that, the activity trackers also celebrate milestones, which can be used as a tool to get more motivated as well (Gandhi & Wang, n.d.). Furthermore, self-regulation strategies, such as self-monitoring, goal-setting, reinforcements, and self-corrective actions have been shown to increase physical activity participation in a variety of populations (Bandura, 1991). In the activity trackers a lot of these actions which improve physical activity are embedded as well.

Motivation is associated with physical activity (Bauman et. al. 2012). Hence, it plays an important role in physical activity. It can be argued that, because of this, people will buy a fitness tracker, because it might help them to get more motivated to exercise. Also, the trackers embedded goal-setting, self-monitoring systems and the celebration of milestones are aspects which might be useful to people. Physically active people are already motivated to exercise, so it can be argued that less active people have more use for this feature. Therefore, the following hypothesis is formed:

H1: There is a difference in the importance of motivational tools in an activity tracker segmenting on physical activity, and there is no difference when segmenting on age.

2.3.2 The price of a tracker

In the last few years smartphones penetration in the US market has grown to 69%. Since the demand of smartphones has grown so much, many internal sensors have become fully commoditized, which has driven the price down fundamentally (Gandhi & Wang, n.d.). For instance, the MEMS accelerometer, which is a sensor that functions as a pedometer, became 4 times as cheap in the period of 2010 to 2014. Activity trackers use this and multiple other sensors as well for various other measurements, meaning the cost of making them became a lot cheaper. Hence, the barrier of buying a tracker becomes lower (Gandhi & Wang, n.d.).

The price of a fitness tracker plays a part in the customer's decision to buy a tracker as well, and with the trackers becoming more and more affordable, price is an important aspect for all customers, regardless of their segment. However, since physically active people are more invested in being active than non-active people, it can be argued that active people care less about the price than non-active people. Next to that, younger people have on average less money to spend, than older people (Furnham, 1999). Hence, it is assumed that younger people find the price of an activity tracker more important, in comparison to older people. Therefore, the following hypothesis is formulated:

H2: There is a difference in the importance of the price of a tracker segmenting on age, and there is a difference segmenting on physical activity.

2.3.3 The accuracy of the measurements of a tracker

Another point on which customer's base their decision to buy a fitness tracker on is the accuracy of the tracker. Since the fitness tracker measure a lot of data, it is important that measurements are precise. The sensor alignment is a critical step in this process of achieving highly accurate measurements (Grewal, Weill, & Andrews, 2007; Noureldin, Karamat, & Georgy, 2013). If these sensors are not aligned correctly, the measurements calculated through the various algorithms will not mean anything to the customer (Titterton & Weston, 2004; Groves, 2013). Smartphones have become indispensable in today's environment, and therefore producers of activity trackers can copy the technology which is used in smartphones, which has caused the price to drop as well (Gandhi & Wang, n.d.).

The measurements of an activity tracker need to be as accurate as possible. Measurements which are not accurate are of no use to the consumer. However, not all customers want the same accuracy. Someone who is invested in their physical activity and is actively working with the data, probably wants the highest accuracy possible. On the other hand, someone who is not active, will probably think that the accuracy of the measurements is not as important. Hence, the following hypothesis is derived:

H3: There is a difference in the importance of the accuracy of the measurements segmenting on physical activity, and there is no difference segmenting on age.

2.3.4 The measurements of sleep in a tracker

According to Driver & Taylor (2000), exercise is the most important sleep-promoting factor. However, they also point out that it is plausible that those who sleep better are less tired and fatigued during the day and therefore, more willing to engage in regular exercise. Thus, sleep and exercise influence each other through complex, bilateral interactions that involve multiple physiological and psychological pathways (Chennaoui, Arnal, Sauvet, & Léger, 2014). Hence, one might say it is handy to log ones sleeping patterns. Nowadays, most fitness trackers have already embedded sensors which measure sleep. In their research, about sleep measurements of activity trackers, Mansukhani & Kolla (2017) found that the most common activity trackers who measure sleep, have a sensitivity for sleep ranging from 92% to 97.8%, which is quite impressive.

A lot of activity trackers can measure sleep nowadays, but how does it affect the customer's propensity to buy? Since sleep and exercise have a bilateral relationship, it is valuable to know how well you sleep, so that you can reflect on your physical activity in combination with your sleep. It can be argued that more active people will think it is more important to be able to measure sleep, since they are more interested in being active and healthy as non-active people. Hence, the following hypothesis is formed:

H4: There is a difference in the importance of sleep measurements segmenting on physical activity, and there is no difference segmenting on age.

2.3.5 The design of a tracker

The design is also an important factor when buying an activity tracker. In their study about the barriers of getting a fitness tracker Harrison, Marshall, Bianchi-Berhouze, & Bird (2015), found that most participants graded the aesthetics and the physical design of the trackers as important and sometimes acted as barriers to usage. They found that the participants who had been given an ugly tracker either hid it or did not wear it at all. Participants said the tracker was "pretty ugly" and "doesn't look cool" (Harrison et al. 2015).

The design of an activity tracker is also important for the customers. Customers do not want to wear something on their wrists that looks ugly. However, it is assumed that more active people think the practical aspects are more important, than the not practical aspects of a fitness tracker, like the design. Also, as pointed out earlier, design is part of the hardware of the technology, which means it is more observable than software (Rogers, 1983). Therefore, it is likely that it has a higher adoption rate than software features (Rogers, 1983). This leads to the following hypothesis:

H5: There is a difference in the importance of the design of a tracker segmenting on physical activity, and there is no difference segmenting on age.

2.3.6 The security of the data in a tracker

Since wearable fitness trackers have gained widespread acceptance among the general population, there is a concomitant need to ensure that associated privacy and security vulnerabilities are kept to a minimum according to Zhou & Piramuthu (2014). In their paper they discuss different vulnerabilities about the security and privacy of fitness tracking devices. In general increased acceptance of activity trackers using an individual's personal information has a negative side to it, because with the increased acceptance, fitness trackers became a much more appealing target for hackers (Zhou & Piramuthu, 2014). Next to that, fitness trackers are designed to use social networks which are inherently open and do not provide much protection in visible communication, therefore the security of the fitness trackers is of high importance. Furthermore, data-security researchers have found several vulnerabilities in fitness trackers (Peppet, 2014).

Although, the privacy of data may be important for customers, and fitness trackers are becoming a more appealing target for hackers, it is assumed that customers do not really take this into account, when buying an activity tracker. Since it is assumed that the customers will think, that their data is not of much use for hackers. Therefore the following hypothesis is formulated:

H6: There is no difference in importance of the security of trackers segmenting on age, and there is no difference segmenting on physical activity.

2.3.7 The compatibility of a tracker with a smartphone

Nowadays, there are a lot of different kinds of fitness trackers, a great deal of these trackers have the ability to be synced with either your smartphone or your computer (Kaewkannate & Kim, 2016). According to Kaewkannate & Kim (2016) the trackers user interface [UI] should be simple, clear, and quick to navigate for users' comfort, therefore, a lot of companies design an app for the smartphone, since the wristbands are typically very small, it is hard to make those simple, clear, and quick to navigate.

Nowadays, almost everyone owns a smartphone, and since the trackers UI needs to be simple, clear and quick to navigate (Kaewkannate & Kim, 2016), it's assumed that most people would think it's important that an activity tracker is compatible with a smartphone. However, younger people have on average more knowledge about the internet of things, in comparison to older people. Therefore, in this research its assumed that younger people think the compatibility of a tracker is more important in comparison to old people. Based hereon, the following hypothesis is formulated:

H7: There is a difference in the importance of the compatibility of a tracker segmenting on age, and there is no difference segmenting on physical activity.

2.3.8 The relative advantage of a tracker over an app

Furthermore, there are also smartphones who can do all (or a lot) of the tracking which is done by the fitness tracker, by themselves (Kaewkannate & Kim, 2016). Since, producers of activity trackers can use a lot of the technology used in smartphones (Gandhi & Wang, n.d.), you could assume that an

application can be as good as an activity tracker, however you have to keep in mind that smartphones differ towards activity trackers in that they are not designed solely for tracking, whereas activity trackers are. Therefore, it is likely that activity trackers do a better job in calculating the measurements.

Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes (Rogers, 1983). An activity tracker being better than an app on your smartphone is basically the same. Rogers (1983) argues that the higher the relative advantage the higher the rate of adoption. Therefore, it is assumed that most people will think it is very important that the activity tracker is better than an app on your smartphone. If consumers do not see any relative advantage, they are less likely to buy a tracker. Also, a fitness trackers sole purpose is to measure health and physical activity, it can focus on these aspects, whereas smartphones have multiple other functions. Thus activity trackers have the potential to do a lot better compared to smartphone apps. Since relative advantage applies to everyone, the following hypothesis is set up:

H8: There is no difference in the importance of a tracker being better as an app segmenting on age, and there is no difference segmenting on physical activity.

2.3.9 The ease of use of a tracker

Complexity is the degree to which an innovation is perceived as difficult to understand and use, whereas easily understood innovations are a adopted at a faster rate, according to Rogers (1983). He argues that it is one of the main characteristics which helps to explain the different rate of adoption of innovations. The ease of use of an activity tracker is of great importance. Venkatesh and Davis (2000) found in their research about technology acceptance that 'intention to use' of new technology depends on the customer's attitude towards using the technology and the attitude towards use is based on the perceived usefulness and the perceived ease of use. Perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort." (Davis, 1989; Radner & Rothschild, 1975). Next to that, "perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use the more useful it can be" (Venkatesh and Davis, 2000). They modelled these findings, which resulted in the Technology Acceptance Model [TAM] (see Appendix A). Numerous empirical studies have found that TAM consistently explains a substantial proportion of the variance (typically about 40%) of customers actual usage of the technology. Ease of use, influences both perceived usefulness and attitude towards use, thus plays an important role in the customers propensity to buy (Venkatesh and Davis, 2000).

The ease of use of the trackers is an important factor in deciding, whether or not, you want to buy one. The more complex an innovation is, the lower the rate of adoption (Rogers, 1983) Also, ease of use, is an important factor in the TAM devised by Venkatesh & Davis (2000). Since the trackers being easy to use is helpful for everyone, it is assumed that the amount of physical activity one gets does not interfere with this. However, since age has an important influence on technology adoption (Morris, & Venkatesh, 2000), it is assumed that older people think it is more important to have a tracker that is easy to use, in comparison to younger people. This leads to the following hypothesis:

H9: There is a difference in the importance of the tracker being easy to use segmenting on age, and there is no difference segmenting on physical activity.

2.3.10 The estimates of burned calories of a tracker

The amount of calories burned is estimated based on your basal metabolic rate [BMR] and the recorded activities. BMR is the rate at which you burn calories at rest just to maintain vital body functions such as breathing, heartbeat and brain activity (Schofield, 1985). The BMR estimation is based on your sex, age, height, and weight. People may think it is useful to have this function in an activity tracker, since it maps the amount of calories burned.

A lot of potential customers of activity trackers are people who want to start to live healthier, and maybe lose a few pounds. For those people, knowing the amount of burned calories can be very helpful. Just like people with high physical activity will probably think that the amount of burned calories is going to be helpful, because these people may want to align their diet to their activity. (Rabbi, Pfammatter, Zhang, Spring, & Choudhury, 2015) Thus, it is assumed that all segments will think a burned calories feature is important, however, the reasons behind that may differ. Hence the following hypothesis is derived:

H10: There is no difference in the importance of burned calories measurements segmenting on age, and there is no difference segmenting on physical activity.

2.3.11 Blood pressure & blood oxygen measurements in a tracker

Some activity trackers also have the ability to measure the blood pressure and the blood oxygen. During exercise, heart rate increases significantly (Sharman, Lim, Qasem, Coombes, Burgess, Franco, Garrhy, Wilinson, & Marwick, 2006), the heart pumps blood through your body, resulting in an increased blood pressure and blood oxygen as well. This is especially useful to people who have either a really high or a really low blood pressure.

It is assumed that most people do not feel the need to have this integrated in their activity tracker, because it is most useful for specific cases, where blood pressure is a lot higher or lower than that of the average person. People who specifically would enjoy this feature, could be in any segment. Thus, the average person does not have much use for these features. Hence, the following hypothesis' are formulated:

H11: There is no difference in the importance of blood pressure measurements segmenting on age, and there is no difference segmenting on physical activity.

H12: There is no difference in the importance of blood oxygen measurements segmenting on age, and there is no difference segmenting on physical activity.

2.3.12 The step count in a tracker

Traditional step counters use pedometers to detect daily steps (Corder, Brage & Ekelund, 2007). These are cheap and energy efficient, however they are not as accurate as accelerometers (Henrikson, Haugen Mikalsen, Woldaregay, Muzny, Hartvigsen, Hopstock, & Grimsgaard, 2018), which is the current standard for collecting physical activity data (Corder et. al. 2007). All modern fitness trackers have an accelerometer (Corder et. al. 2007). Most accelerometer-based fitness wearables measure acceleration in three dimensions (Richardson & Mackinnon, 2017). The validity and reliability of these metrics vary. However, in their review, Evenson et. al. (2015) found evidence that accelerometer-based fitness wearables have high validity. Also, just like the GPS tracking,

step counters enhance the activity trackers ability to calculate the amount of burnt calories (Schofield, 1985).

Step counters are somewhat the same as GPS tracking, since it also measures distance. Although, because they only measure the amount of steps, this method is more simplistic. Therefore, step counters have not only a lower perceived usefulness, but also a lower level of complexity. Step counters give clear and easy to use information, and are therefore useful to all consumers, regardless of their segment, and the following hypothesis is set up:

H13: There is no difference in the importance of step counting in a tracker segmenting on age, and there is no difference segmenting on physical activity.

2.3.13 GPS in a tracker

A great deal of the activity trackers nowadays have Global Positioning System [GPS] tracking embedded. GPS is a satellite-based radio navigation system, which was originally developed as a military specific technology, but quickly transformed into a dual use system because of the tremendous potential for civilian use (Akos, 1997). It is used to map distance and speed. It can be used for e.g. running distances, walks or biked distances (Malu & Findlater, 2016). Also, GPS tracking enhances the trackers ability to calculate the amount of burnt calories (Schofield, 1985).

GPS tracking is used to calculate distances, speed & sometimes enhance the calculation of burned calories. These are all useful calculations to potential adopters of activity trackers, and it will enhance the perceived usefulness of those adopters. These calculations can be of value to all customers' regardless of their segment. Therefore, the following hypothesis is created:

H14: There is no difference in the importance of GPS tracking in a tracker segmenting on age, and there is no difference segmenting on physical activity.

2.3.14 A tracker being water resistant

Most activity trackers are resistant against splash water, but not all activity trackers are completely waterproof (Kaewkannate & Kim, 2016). Those who are completely waterproof have the advantage to be used in water sports, and thus attract a larger target group. Water-resistance increases the perceived usefulness, since the water-resistance makes the activity tracker useful in different situations (e.g. during rain or water sports).

Most potential customers of activity trackers will probably think that this is a very useful feature of a tracker, since it means that they can use it during rainy days as well. The tracker being water-resistant also gives it the possibility to be used in water sports, and therefore this feature will have the possibility to increase the customer base of a tracker, since it adds a new target group to it, namely: people who participate in water sports. Just like, step counters and GPS, this feature is useful to all consumers regardless of their segment. Hence, the following hypothesis is set up:

H15: There is no difference in importance of a tracker being water resistant segmenting on age, and there is no difference segmenting on physical activity.

2.3.15 Measurements of the energy level in a tracker

Some trackers even have the ability to measure someone's energy level. Garmin's Vivosmart 4, for instance, measures the energy level of your body by using the data about your stress level, heart rate, quality of sleep, and overall physical activity (Liszewski, 2018). It is good to know your energy levels throughout the day, it allows you to see what the optimal time is to exercise, because a higher level means more energy, and thus, the ability to have a better workout, than when your level is lower.

So, it is helpful to know your energy level, so that you can adjust the timing of your workout to it. Therefore, it is logical to assume that the energy level is rated as fairly important. However, in this research, it is assumed that people will be very sceptical about this feature, because they might think that such a device cannot really estimate this value, and they might also think that they can 'feel' their own energy level. Thus, it is assumed that people of all segments will be sceptical, leading to no differences, when segmenting. The following hypothesis is based hereon:

H16: There is no difference in the importance of energy level measurements of a tracker segmenting on age, and there is no difference segmenting on physical activity.

3. METHODOLOGY

3.1 Research design

The sample of this research is segmented based on the level of physical activity and based on age. Therefore, a large sample was needed. Qualtrics, an online survey construction website, was used as data-collection method, since it has the advantage of being capable of collecting data from a large number of respondents, regardless of geographical barriers. Qualtrics also has the advantage that the data derived from Qualtrics can be easily transferred to IBM SPSS statistics 25 [SPSS], which was used to analyse the data. Another advantage of Qualtrics is, is that it records all data, even if the participant is not finished with the survey, this may increase the amount of responses. The survey can be found in appendix B.

3.2 Sample and participants

The study differentiated the sample on three different levels of physical activity, therefore, a minimum sample size of 90 was set ($np >= 10$, & $p = 0{,}33$). However, since the physical activity level of the respondents is unknown prior to the survey, it was necessary to account for the probability that there were uneven segments. Hence, the minimum sample size was set to 120. The actual sample size was 216 respondents, but only 127 respondents completed the survey completely. The 89 respondents who did not completely fill in the survey, were excluded from it, since the data showed, that they all had the same completion rate of 19%, which indicated that they only filled out the first page, which was insufficient to be of use. Out of the 127 other respondents 57 (44,9%) were male, and 70 (55,1%) were female.

Table 1. Gender distribution.

Gender	N	Percentage
Male	57	44,9%
Female	70	55,1%
Total	127	100%

It is commonly believed that older people hold more negative attitudes toward computer technology than younger people (Czaja & Sharit, 1998). The average starting age of higher education in the Netherlands is at the age of 18, and the biggest part (67%) of the students who acquired a bachelor degree, are in the age group of 20-24 years old (Vereniging van hogescholen, 2009). Based hereon, the 'students' age segment is developed, ranging from age 18 to 24, with 69 (54,3%)

Table 2. Age segmentation.

Age segment	N	Percentage
(0) Teenagers	9	7,1%
(1) Students	69	54,3%
(2) Adults	49	38,6%
Total	127	100%

respondents, this is the largest segment. The respondents that were younger than 18, will be referred to as 'teenagers', and have only 9 (7,1%) respondents. Finally, the last segment, consisting of the respondents older than 24 had 49 (38,6%) respondents, and will be referred to as the 'adults' segment.

The subject sample was also segmented into three different levels of physical activity. The first segment, which is classified as low physical activity covered 33 (26%) respondents, the second segment, the moderate physical activity segment, covered 47 (37%) respondents and the high physical activity segment covered 47 (37%) respondents as well. The average person should get 150 minutes of moderate aerobic activity or 75 minutes of vigorous aerobic activity a week (Wen, Wai, Tsai, Yang, Cheng, Lee, Chan, Tsao, Tsai, & Wu, 2011; Laskowski, 2019). Hence, the physical activity categories are based hereon. The borders of the moderate physical activity category are 1,5 hour from the average of 2,5 hours. Participants with less than one hour of physical activity a week were put in the low physical activity segment, participants who exercise between 1 and 4 hours a week were put in the moderate physical activity segment, and participants who exercise more than 4 hours a week were put in the high physical activity segment.

Table 3. Physical activity segmentation

Physical activity segment	N	Percentage
(1) Low	33	26%
(2) Moderate	47	37%
(3) High	47	37%
Total	127	100%

3.3 Measures

The survey consisted of two parts; the first part consisted of the independent variables: age, sex, amount of physical activity. Whereas the second part consisted of the dependent variables, which are the different characteristics of activity trackers one might prefer, such as: GPS, step count, water-resistance, design & sleep measurements. Those characteristics where measured on a 5-point Likert-scale. Also, there were some qualitative questions about each of the characteristics; asking why the respondents scored the characteristics the way they did.

3.4 Data collection procedure

When the survey was completed and pretested, respondents were gathered through Qualtrics, from where an anonymous link was sent out to participate in the survey. Together with the link a short explanation was sent about the survey, the participants could read that the survey would be about fitness trackers and that it would be used in a Bachelor Thesis of a student of the University of Twente.

The survey was distributed through social media channels (WhatsApp & Facebook), and by means of word-to-mouth communication. The survey started on the 6th of April and was finalized a little over two months later on the 13th of June. In order to increase the amount of responses, reminders where sent every two weeks. Prior to the first reminder, the responses were assessed, it turned out that a lot of the responses were incomplete, because almost half of the respondents did only fill in the first page of the survey. Hence, when sending out the reminders, together with the information every respondent gets about the purpose of the survey, they were also informed that the survey consisted of two pages.

3.5 Analysis procedure

Qualtrics was used to record all the data from the participants. Afterwards, the data was transferred to SPSS. SPSS is software used for predictive analytics. After the data was transferred to SPSS, the data first needed to get cleaned up. Since SPSS also records a lot of unnecessary data (e.g. start date, end date, distribution channel). Furthermore, since the responses had either 19% or 100% completion, all the responses with 19% were excluded, since it indicated that the respondents only answered the first page of the survey, which is insufficient information to be of any use. First, an overview of the sample size, means, & standard deviation is given. After this the respondents were segmented based on their age and physical activity. These segments were then subjected to ANOVA to see if there were any significant results. Furthermore, the different means of the characteristics opposed to the different segments (physical activity level & age) are compared. Finally, the qualitative data was researched in order to find patterns, and explanations for the means.

4. RESULTS

In the next section, the results of the ANOVA analysis', mean comparison and the qualitative research will be discussed briefly for every activity trackers' characteristic. Afterwards, the hypothesis' will be accepted or rejected, depending on the data. The two ANOVA analysis' and the mean comparison can be found on the next pages (Table 4 to 6).

4.1 Embedded motivational tools in a tracker

The results of the two ANOVA analyses both showed no significance. Hence, there is no difference in the importance of motivational tools based on age or physical activity. However, when comparing the means, it came to notice that the means of the different physical activity levels decreased with each level of physical activity, with means (M = 3,09; 2,87; & 2,62) respectively, suggesting a negative relationship between physical activity and motivational tools. Furthermore, when looking into the qualitative data about the motivational tools, it stood out, that a lot of responses from the low physical activity segment said that "it would help me get motivated" and "I can't motivate myself", whereas respondents from the high physical activity segment answered "I have enough intrinsic motivation" and "I can motivate myself".

Thus, the hypothesis: "*There is a difference in the importance of motivational tools in an activity tracker segmenting on physical activity, and there is no difference when segmenting on age"* is partly rejected: there is no difference in the importance of motivational tools when segmenting on age, and there is also no difference in the importance of motivational tools when segmenting on physical activity, since the possible negative relation between physical activity and motivational tools were not supported by the ANOVA analysis.

Table 4. ANOVA analysis segmenting on age.

Dependent variable	(I) age category	(J) age category	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower bound	Upper bound
Motivational tools	0	1	-,17	,348	1,000	-1,02	,67
	0	2	-,19	,356	1,000	-1,05	,67
	1	2	-,02	,183	1,000	-,46	,43
Price	0	1	-,84*	,292	,015	-1,54	-,13
	0	2	-,38	,299	,631	-1,10	,35
	1	2	,46*	,154	,010	,09	,83
Precision	0	1	,16	,321	1,000	-,61	,94
	0	2	,67	,328	,129	-,12	1,47
	1	2	,51*	,169	,010	,10	,92
Sleep measurements	0	1	-,49	,382	,598	-1,42	,43
	0	2	,05	,391	1,000	-,90	1,00
	1	2	,54*	,201	,025	,05	1,03
Design	0	1	-,89*	,356	,040	-1,76	-,03
	0	2	-,45	,356	,655	-1,34	,43
	1	2	,44	,188	,060	-,01	,90
Security	0	1	-,40	,445	1,000	-1,48	,68
	0	2	-,76	,455	,293	-1,86	,35
	1	2	-,36	,235	,371	-,93	,21
Compatibility	0	1	,05	,356	1,000	-,83	,91
	0	2	,64	,364	,239	-,24	1,53
	1	2	,60*	,188	,006	,14	1,05
Better as an app	0	1	-,78	,360	,095	-1,66	,09
	0	2	-,31	,369	1,000	-1,20	,59
	1	2	,48*	,190	,040	,02	,94
Ease of use	0	1	,38	,307	,647	-,36	1,13
	0	2	,37	,314	,740	-,40	1,13
	1	2	-,02	,162	1,000	-,41	,38
Calorie usage	0	1	,37	,348	,863	-,47	1,22
	0	2	,85	,356	,057	-,02	1,71
	1	2	,47*	,184	,033	,03	,92
Blood pressure	0	1	-,27	,387	1,000	-1,21	,67
	0	2	,07	,396	1,000	-,89	1,03
	1	2	,34	,204	,284	-,15	,84
Blood oxygen	0	1	,00	,375	1,000	-,91	,91
	0	2	,03	,384	1,000	-,90	,96
	1	2	,03	,198	1,000	-,45	,51
Step count	0	1	,04	,366	1,000	-,85	,93
	0	2	,59	,374	,345	-,31	1,50
	1	2	,56*	,193	,014	,09	1,02
GPS	0	1	-,13	,432	1,000	-1,18	,92
	0	2	,06	,443	1,000	-1,01	1,14
	1	2	,19	,228	1,000	-,36	,74
Water resistance	0	1	-,21	,333	1,000	-1,02	,60
	0	2	,43	,341	,626	-,40	1,26
	1	2	,64*	,176	,001	,21	1,06
Energy level	0	1	-,18	,391	1,000	-1,13	,77
	0	2	,08	,400	1,000	-,89	1,05
	1	2	,26	,206	,614	-,24	,76

Based on observed means.
The error term is Mean Square(Error) = 1,216.
*. The mean difference is significant at the ,05 level.

Table 5. ANOVA analysis segmenting on physical activity.

Dependent variable	(I) physical activity category	(J) physical activity category	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower bound	Upper bound
Motivational tools	1	2	,22	,219	,959	-,31	,75
	1	3	,47	,219	,097	-,06	1,00
	2	3	,26	,199	,604	-,23	,74
Price	1	2	-,15	,197	1,000	-,62	,33
	1	3	-,19	,197	1,000	-,67	,29
	2	3	-,04	,179	1,000	-,48	,39
Precision	1	2	,10	,212	1,000	-,41	,62
	1	3	-,17	,212	1,000	-,69	,34
	2	3	-,28	,193	,461	-,74	,19
Sleep measurements	1	2	,38	,250	,381	-,22	,99
	1	3	,17	,250	1,000	-,44	,78
	2	3	-,21	,227	1,000	-,76	,34
Design	1	2	,04	,237	1,000	-,54	,61
	1	3	,04	,237	1,000	-,54	,61
	2	3	,00	,215	1,000	-,52	,52
Security	1	2	-,03	,288	1,000	-,73	,67
	1	3	,24	,288	1,000	-,46	,94
	2	3	,28	,262	,878	-,36	,91
Compatibility	1	2	,40	,231	,259	-,16	,96
	1	3	-,18	,231	1,000	-,74	,38
	2	3	-,57*	,210	,021	-1,08	-,07
Better as an app	1	2	,07	,239	1,000	-,51	,65
	1	3	,10	,239	1,000	-,48	,68
	2	3	,02	,217	1,000	-,51	,55
Ease of use	1	2	,39	,195	,144	-,08	,86
	1	3	,20	,195	,938	-,27	,67
	2	3	-,19	,177	,842	-,62	,24
Calorie usage	1	2	,15	,226	1,000	-,40	,70
	1	3	-,34	,226	,420	-,88	,21
	2	3	-,49	,205	,056	-,99	,01
Blood pressure	1	2	,13	,250	1,000	-,47	,74
	1	3	,09	,250	1,000	-,52	,70
	2	3	-,04	,227	1,000	-,59	,51
Blood oxygen	1	2	,08	,239	1,000	-,50	,66
	1	3	-,13	,239	1,000	-,71	,45
	2	3	-,21	,217	,989	-,74	,31
Step count	1	2	-,09	,242	1,000	-,67	,50
	1	3	-,19	,242	1,000	-,78	,39
	2	3	-,11	,220	1,000	-,64	,43
GPS	1	2	,39	,274	,458	-,27	1,06
	1	3	-,03	,274	1,000	-,70	,63
	2	3	-,43	,249	,270	-1,03	,18
Water resistance	1	2	,32	,222	,470	-,22	,86
	1	3	,02	,222	1,000	-,52	,56
	2	3	-,30	,202	,427	-,79	,19
Energy level	1	2	-,14	,250	1,000	-,75	,47
	1	3	-,33	,250	,556	-,94	,27
	2	3	-,19	,227	1,000	-,74	,36

Based on observed means.
The error term is Mean Square(Error) = 1,215.
*. The mean difference is significant at the ,05 level.

Table 6. Mean comparison.

	Age segments			Physical activity segments			
Dependent variable	0	1	2	1	2	3	Total
Motivational tools	2,67	2,84	2,86	3,09	2,87	2,62	2,83
Price	2,89	3,72	3,27	3,36	3,51	3,55	3,49
Precision	4,22	4,06	3,55	3,85	3,74	4,02	3,87
Sleep measurements	2,33	2,83	2,29	2,79	2,40	2,62	2,58
Design	2,22	3,12	2,67	2,91	2,87	2,87	2,88
Security	2,44	2,84	3,20	3,03	3,06	2,79	2,95
Compatibility	3,89	3,84	3,24	3,70	3,30	3,87	3,61
Better as an app	3,00	3,78	3,31	3,61	3,53	3,51	3,54
Ease of use	4,22	3,84	3,86	4,09	3,70	3,89	3,87
Calorie usage	4,11	3,74	3,27	3,52	3,36	3,85	3,58
Blood pressure	2,89	3,16	2,82	3,09	2,96	3,00	3,01
Blood oxygen	2,67	2,67	2,63	2,64	2,55	2,77	2,65
Step count	3,78	3,74	3,18	3,42	3,51	3,62	3,53
GPS	3,00	3,13	2,94	3,18	2,79	3,21	3,05
Water resistance	3,78	3,99	3,35	3,85	3,53	3,83	3,72
Energy level	2,78	2,96	2,69	2,67	2,81	3,00	2,84

4.2 The price of a tracker

The age ANOVA analysis showed significance between the teenagers and students segment (p = 0,015), and between the students and adults segment (p = 0,01). However, the ANOVA results of physical activity showed no significance. On the other hand, when comparing the means, the only pattern that could be found is the slight increase of means when the physical activity level increases, with means (M = 3,36; 3,51; & 3,55) respectively. Next to that, when looking at the qualitative data, the answers are more or less the same for all segments. Most respondents are looking for a "good price-quality proportion", and a "not too expensive" product.

Hence the hypothesis: *there is a difference in the importance of the price of a tracker segmenting on age, and there is a difference segmenting on physical activity* is partly rejected, because there were only significant results found in the ANOVA of age. Thus, there is a difference in the importance of the price of a tracker when segmenting on age, but there is no difference in the importance of the price of a tracker when segmenting on physical activity.

4.3 The accuracy of the measurements of a tracker

The ANOVA analysis' showed significance between the students and adults segment (p = 0,01), but showed no results for physical activity. The mean comparison did not find a pattern between the means of the physical activity segments, but it does suggest that there is a negative relation between age and precision, the respective means (M = 4,22; 4,06; & 3,55) decrease, when the age increases. The reason for this can be found in the qualitative data: answers from the adults segment like "I just want to have an indication" and "I want to know my progress" suggest that older people tend to care more about progress, whereas teenagers and students responses were mostly in the trend of "if it is not precise, it is not useful to me" and "the more precise, the better", which indicate that the younger age segments value the importance of precision more.

Thus, the hypothesis: *There is a difference in the importance of the accuracy of the measurements segmenting on physical activity and there is no difference segmenting on age*, will be rejected completely. The ANOVA showed significance for age, but not for physical activity. Meaning that there is a difference in the importance of the accuracy of the measurements when segmenting on age, but there is no difference in the importance of the accuracy of the measurements when segmenting on physical activity.

4.4 The measurements of sleep in a tracker

The ANOVA analysis' showed significance between the students and adults segment (p = 0,025), and it showed no significance for physical activity. Next to that, when comparing the means, no pattern was found. However, the overall mean of sleep measurements was the lowest of all (M = 2,58). When looking into the qualitative, no notable differences were found between the different segments. The main reasons for the low scores of the respondents were in the trend of "I sleep well, and do not need to know" or "I would not wear it during sleep".

Hence, the hypothesis: *There is a difference in the importance of sleep measurements segmenting on physical activity, and there is no difference segmenting on age*, is rejected. The ANOVA made it clear that there is no significant difference when segmenting on physical activity. However, there is a difference in the importance of sleep measurements when segmenting on age.

4.5 The design of a tracker

The ANOVA analysis of design showed significance between the teenagers and students segment (p = 0,04). When the means of these two segments were compared, it was notable, that there is a big increase from teenagers (M = 2,22) to students (M = 3,12). Reasons for the low score of the teenagers were "It needs to be practical, not beautiful" and "Does not matter to me". Whereas respondents of the students segment answered "It needs to look okay, otherwise I would not wear it".

Thus, looking at the hypothesis: *There is a difference in the importance of the design of a tracker segmenting on physical activity, and there is no difference segmenting on age,* it is safe to say, that this hypothesis is partly rejected. The ANOVA's showed only significance between the teenagers and students segment, but since the teenagers segment only has a sample of 9, this is not reliable, so there is no difference in the importance of the design of a tracker when segmenting on age, and there is also no difference when segmenting on physical activity.

4.6 The security of the data in a tracker

There was no significance found for security in both of the ANOVA analysis'. However, the means of the different age segments do increase with every age segment, suggesting a positive relation between age and security. In the teenagers segment most respondents answered "It does not matter to me that others can see my results", but as the age increases more and more respondents answered "it's personal information", "it's private", and "I do not want others to know this information". Hence, older people are more concerned about the security of their data.

The ANOVA showed no significance, so the hypothesis: *There is no difference in importance of the security of trackers segmenting on age, and there is no difference segmenting on physical activity,* is accepted.

4.7 The compatibility of a tracker with a smartphone

The ANOVA analysis' found significant results for both physical activity as well as age. The moderate and high physical activity segments showed significance (p = 0,021), with means (M = 3,30; 3,87), respectively. This suggests a positive relation between physical activity and the importance of a tracker being compatible with a phone. However, the mean of the low physical activity segment is contradictory to this (M = 3,70). The ANOVA showed for age significance between the students and adults segment (p = 0,006). The means of the different age segments (M =3,89; 3,84; & 3,24) respectively, decrease as the age segment increases, suggesting a negative relation between age and the importance of a tracker being compatible with a smartphone. In the teenagers, and students segment most respondents found this feature "nifty" and "it makes it easier to read". Whereas respondents of the adults segment had responses like: "I don't use my phone" and "I don't want that".

Hence, the hypothesis: *There is a difference in the importance of the compatibility of a tracker segmenting on age, and there is no difference segmenting on physical activity,* is partly rejected. The ANOVA showed significant results for age and physical activity. So there is a difference in the importance of the compatibility of a tracker when segmenting on age, and there is also a difference when segmenting on physical activity.

4.8 The relative advantage of a tracker over an app

The ANOVA showed no significance for the physical activity levels, but it did show significance between the students and adults segment (p = 0,04). When comparing the means of these two (M = 3,78; & 3,31) respectively, it suggests a negative relation between the importance of a tracker being better as an app and age. However, the mean of the teenagers segment (M = 3,00) contradicts this suggestion. No pattern was found when comparing the means of physical activity. The overall mean (M = 3,54), was quite high, most respondents found a tracker being better as an app quite important, and a lot of respondents said: "if it's not better, why bother buying an expensive tracker".

Thus, the hypothesis: *There is no difference in the importance of a tracker being better as an app segmenting on age, and there is no difference segmenting on physical activity,* is partly rejected. Since the ANOVA showed significance for age, there is a difference in the importance of a tracker being better as an app when segmenting on age, and there is no difference in the importance of a tracker being better as an app when segmenting on physical activity.

4.9 The ease of use of a tracker

There were no significant results for ease of use in the ANOVA. Also, no pattern was found when comparing the means. What was notable, is that the overall mean (M = 3,87) was quite high. According to the qualitative data the reasons respondents gave were "I would not use it, if it is too complicated" and "I want to navigate through it quickly, so that I don't waste my time during exercise".

This means the hypothesis: There is a difference in the importance of the tracker being easy to use segmenting on age, and there is no difference segmenting on physical activity., is partly accepted. Since there were no significant results found in the ANOVA when segmenting on age or physical activity. This means that there is no difference in importance of ease of use when segmenting on age, and there is also no difference in importance when segmenting on physical activity.

4.10 The estimates of burned calories of a tracker

There was also significance found between the students and adults segment for calorie usage (p = 0,033). The means of calorie usage decrease with every increase in age segment (M = 4,11; 3,74; 3,27) respectively, suggesting a negative relation between age and the importance of calorie usage. In the qualitative data it showed that most respondents who rated high on calorie usage, because "it is one of the main purposes to get a tracker", and "I want to lose weight". The most important reason for a lower score was "I am not fat, ergo I don't need to know this".

Hence, the hypothesis: *There is no difference in the importance of burned calories measurements segmenting on age, and there is no difference segmenting on physical activity,* is also partly rejected, because the ANOVA showed significance between the students and adults segment. This means that there is a difference in the importance of burned calorie measurements when segmenting on age, but there is no difference when segmenting on physical activity.

4.11 Blood pressure & blood oxygen measurements in a tracker

When looking into the ANOVA analysis', no significant results were found for blood pressure nor for blood oxygen. In the mean comparison, there were also no patterns found. The means of the segments fluctuate a little around the overall means of blood pressure (M = 3,01) and blood oxygen (M = 2,65). The reason for these low scores the respondents gave is that they "do not know what it does" and "I do not need this".

Since there were no significant results in the ANOVA of blood pressure and blood oxygen, the hypothesis: *There is no difference in the importance of blood pressure measurements segmenting on age, and there is no difference segmenting on physical activity,* is accepted, and the other hypothesis: *There is no difference in the importance of blood oxygen measurements segmenting on age, and there is no difference segmenting on physical activity,* is accepted as well.

4.12 The step count in a tracker

The ANOVA analysis showed significance between the students and adults segment (p = 0,014). There was not any significance found in the ANOVA of physical activity. The mean comparison showed that with every increase in age segment the mean decreases (M = 3,78; 3,74; 3,18) respectively, suggesting a negative relation between the importance of a step counter and age. This is because younger respondents find a step count to be "cool" and "a nice milestone". Whereas, older respondents have "no interest in this" and think "I don't need it, cause I exercise enough".

Hence, the hypothesis: *There is no difference in the importance of step counting in a tracker segmenting on age, and there is no difference segmenting on physical activity,* is partly rejected, because the ANOVA showed significance for age. Meaning, that there is a difference in the importance of step counting in a tracker when segmenting on age, but there is no difference when segmenting on physical activity

4.13 GPS in a tracker

The ANOVA analysis' for GPS showed no significance at all, and the mean comparison showed, that the means of the different segments fluctuate a bit around the overall mean (M = 3,05). However, looking at the qualitative data there were a lot of differences: some respondents find it "nifty" and "nice to know what route I jogged", whereas other respondents say "I don't need this" and "redundant".

The analysis' showed no significance, so the hypothesis: *There is no difference in the importance of GPS tracking in a tracker segmenting on age, and there is no difference segmenting on physical activity,* is accepted.

4.14 A tracker being water resistant

The ANOVA analysis' for water resistance showed only significance between the students and adults segment (p = 0,001). However, when looking at the mean comparison, no patterns were found. The relative high overall mean (M = 3,72), is explained by the respondents. The main reasons they give are that "it helps against the rain", "I can swim with it too then", and "I sweat a lot".

Hence, the hypothesis: *There is no difference in importance of a tracker being water resistant segmenting on age, and there is no difference segmenting on physical activity,* is partly rejected. Since the ANOVA showed significance age, there is a difference in importance of a tracker being water resistant when segmenting on age, but there is no difference when segmenting on physical activity.

4.15 Measurements of the energy level in a tracker

There were no significant results found in the ANOVA's of energy level. The mean comparison shows a little increase with every physical activity level (M = 2,67; 2,81; & 3,00) respectively, suggesting a positive relation between physical activity and the importance of energy level measurements in a tracker. The qualitative data pointed out that the respondents were a little sceptical about this feature. Reasons for this were: "I can feel that myself" and "How can a tracker do that?". However, in the more active segments more and more responses indicate interest, like: "You can adjust your exercises hereon" and "I am interested in this".

Thus, the hypothesis: *There is no difference in the importance of energy level measurements of a tracker segmenting on age, and there is no difference segmenting on physical activity,* is accepted. There were no significant results, hence there are no differences in the importance of energy level measurements of a tracker when segmenting on age, and there are also no differences when segmenting on physical activity.

5. DISCUSSION

This section aims to discuss the findings from the previous section. First, the main findings of this paper will be discussed. Second, a reflection of the research methodology will be provided. Limitations are explained and suggestions for future research will be addressed in this paragraph. Next, the relevance of this research is covered by discussing the implications for producers of activity trackers. Finally, the most important findings will be summarized in the conclusion.

5.1 Main findings

When looking into the results, it was noticeable that there was only one significant result found when segmenting on physical activity. The moderate physical activity and the high physical activity segment showed significant results for compatibility. That was quite contradictory to what was expected, since it was expected to find more significant results, and therefore more differences, when segmenting on physical activity. On the other hand, when segmenting on age, there were several significant results (price, accuracy, sleep measurements, design, compatibility, relative advantage, burned calories, step count, & water resistance) found. More than half of the activity trackers' characteristics had significant results. Thus, if manufacturers of activity trackers want to differentiate, they should focus on segmenting on age, since this is the most effective.

Furthermore, when having a closer look at the survey results, it is noticeable that some characteristics of activity trackers are more important than others. According to the survey an activity tracker should be precise, compatible with a smartphone, easy to use, & water resistant. Next to that, the activity tracker should measure step count, calorie usage and it should be better as an app.

This research also supports Rogers' (1983) diffusion of innovations model. Rogers' argues that there are five main factors which influence the adoption of innovations. Three out of these five characteristics were implemented in this study, namely: compatibility, complexity (ease of use), & relative advantage (being better as an app). Since these factors belong to

the highest scoring characteristics of activity trackers, it is safe to say that this study supports Rogers' diffusion of innovations model.

5.2 Limitations

During the research, there were also some limitations that came across. The ANOVA analysis' showed significant results twice between the teenagers and students segment. However, given the fact that the teenagers segment only consists out of 9 respondents, this data is not reliable. Moreover, a lot of respondents were removed from the sample due to incomplete answering. This led to a far smaller sample than the original sample, only 58,8% of the 216 respondents answered the entire survey. The information notice prior to the survey should have included clearer information about the length of the survey, that way, the completion rate could have been increased.

The average overall mean was 3,25, and there were 7 means of the characteristics who ended up having more than 0,5 points above the average of 3. Whereas there were no means which ended up having more than 0,5 point below the average of 3. This, together with the fact that there is only one Likert scale question for every construct, leads to the following problem: the ceiling effect. The ceiling effect is used to describe how subjects in study have scores that are at or near the possible upper limit (Everitt, 2002), so that variance is not measured or estimated above a certain level (Cramer & Howitt, 2005). If there were two questions about every construct, where one was negatively asked and the other one was positively asked, this could have been prevented.

Also, since this research is spread around Dutch citizens and the survey was held in Dutch language, it does not necessarily mean the results are the same in other countries. It is more than likely that in other countries people will find other characteristics of an activity tracker important. Hence, it may be wise to do the same research within other countries, so that it can be researched if there are any differences when looking at other countries.

5.3 Future research

As stated above, the teenagers segment (n = 9, p = 0,33, np = 3) was not large enough to be reliable, but it did show significant results. Hence, for future research it is recommended to test this with a larger sample, to investigate if this is still the case with a larger sample, and if it leads to more significant results, when using a larger sample. Furthermore, if this research is done with a larger sample, it may lead to different results regarding the physical activity aspect of this research. Since, the sample just barely meets the required sample size, it is possible that a larger sample gives different results.

Another limitation of this study is that it investigates just two ways of segmentation. There are a lot of other ways to do this, causing new target segments to arise (Kaewkannate & Kim, 2016). It may be interesting to investigate different ways to do the segmentation, in order to increase knowledge about the different characteristics and their value to the different customers.

5.4 Contributions

There is already a lot of existing literature on activity trackers. A lot of these papers investigate different activity trackers to find out which ones are better (Evenson, Goto, & Furberg, 2015; Gandhi & Wang, n.d.; Kaewkannate & Kim, 2016). Next to that, there are also quite some papers which focus on one characteristic when researching activity trackers (Liszewski, 2018; Mansukhani & Kolla, 2017; Zhou & Piramuthu, 2014).. This paper contributes to the existing literature, because it uses segmentation as a basis for researching activity trackers. Next to that, it also includes multiple characteristics of activity trackers, which were researched.

Next to that, this paper is helpful for producers of activity trackers; the market survey can give guidance to producers, so that they can position themselves better, because the paper shows were the consumers interests are, what they think is important in an activity tracker, and which characteristics are less important. This, together with the segmentation on age and physical activity can contribute to better positioning and targeting.

5.5 Conclusion

In this study, the segmentation of activity trackers was investigated, in order to find out if manufacturers of activity trackers benefit more from segmentation on age or segmentation on physical activity. In order to finalize this research, the following research question will be answered:

What are the differences in importance of characteristics in activity trackers between age-based segments and physical activity based segments?

In this research, fifteen different characteristics / features of activity trackers where investigated, to see what people think is important when they are looking for an activity tracker. When segmenting on physical activity, there were only differences found when looking at compatibility. However, when segmenting on age, almost half of the activity tracker's characteristics showed differences. Hence, manufacturers of activity trackers will not benefit from segmentation on physical activity, but manufacturers will benefit from segmentation on age.

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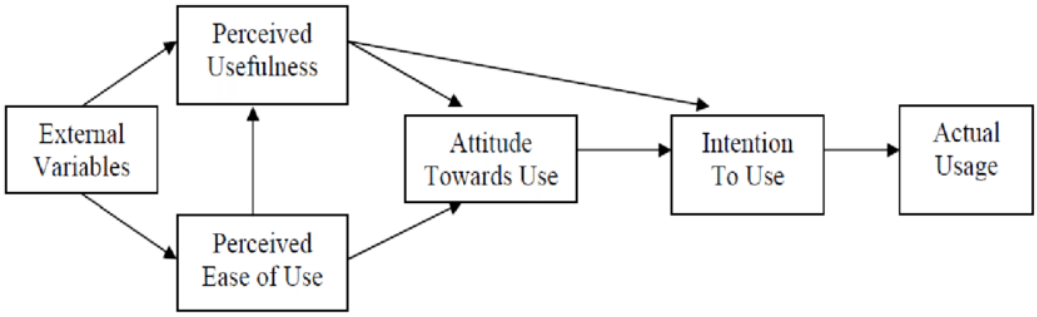
7. APPENDIX

Appendix A: Technology Acceptance Model, Venkatesh & Davis (2000).



Appendix B: Online survey.

1. Ben je een man of vrouw?
   1. Man 2. Vrouw
2. Hoe oud ben je?
3. Hoe vaak sport je gemiddeld per week?
4. Hoeveel uur sport je gemiddeld per week?
5. Hoe vaak sport je gemiddeld per maand
6. Hoeveel uur sport je gemiddeld per maand?
7. Een fitness tracker is een draagbaar apparaat, die de dagelijkse fysieke activiteiten van iemand registreert en andere data met betrekking tot iemand zijn gezondheid, zoals verbrandde calorieën, hartslag, kilometers gelopen etc.**
8. Ben je in het bezit van een fitness tracker?
   1. Ja 2. Nee (Ga verder naar vraag 10)
9. Wat zou dan voor jou een goede reden zijn om een nieuwe te kopen?
10. Stel je voor, je wil graag een fitness tracker kopen, welke eigenschappen vind jij het belangrijkst? Geef alsjeblieft de volgende eigenschappen een cijfer op basis van belangrijkheid.**
11. De fitness tracker dient als een motivator met behulp van textuele feedback.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

12. Waarom vind je dat?*
13. De prijs van een fitness tracker.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

14. Waarom vind je dat?*
15. De precisie van de metingen die de fitness tracker geeft.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

16. Waarom vind je dat?*
17. De fitness tracker kan je slaappatroon meten.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

18. Waarom vind je dat?*
19. Het design van de fitness tracker.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

20. Waarom vind je dat?*
21. Je bent bang dat de fitness tracker de data van jou niet goed beveiligd.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

22. Waarom vind je dat?*
23. De fitness tracker kan worden gebruikt in combinatie met je telefoon.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

24. Waarom vind je dat?*
25. In vergelijking met een sportapplicatie op je telefoon, is de fitness tracker beter.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

26. Waarom vind je dat?*
27. De fitness tracker is makkelijk in gebruik.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

28. Waarom vind je dat?*

29. De fitness tracker kan je calorieverbruik meten.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

30. Waarom vind je dat?*
31. De fitness tracker kan je bloeddruk meten.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

32. Waarom vind je dat?*
33. De fitness tracker kan je bloedzuurstof meten.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

34. Waarom vind je dat?*
35. De fitness tracker kan je stappen tellen.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

36. Waarom vind je dat?*
37. De fitness tracker beschikt over een GPS tracker.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

38. Waarom vind je dat?*
39. De fitness tracker is waterafstotend.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

40. Waarom vind je dat?*
41. De fitness tracker kan je energielevel meten.

Helemaal niet belangrijk 1 2 3 4 5 uitermate belangrijk

42. Waarom vind je dat?*

*= Niet verplicht

**= Informatieve tekst

Appendix C: ANOVA: segmentation on age

Dependent variable	(I) age category	(J) age category	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower bound	Upper bound
Motivational tools	0	1	-,17	,348	1,000	-1,02	,67
	0	2	-,19	,356	1,000	-1,05	,67
	1	2	-,02	,183	1,000	-,46	,43
Price	0	1	-,84*	,292	,015	-1,54	-,13
	0	2	-,38	,299	,631	-1,10	,35
	1	2	,46*	,154	,010	,09	,83
Precision	0	1	,16	,321	1,000	-,61	,94
	0	2	,67	,328	,129	-,12	1,47
	1	2	,51*	,169	,010	,10	,92
Sleep measurements	0	1	-,49	,382	,598	-1,42	,43
	0	2	,05	,391	1,000	-,90	1,00
	1	2	,54*	,201	,025	,05	1,03
Design	0	1	-,89*	,356	,040	-1,76	-,03
	0	2	-,45	,356	,655	-1,34	,43
	1	2	,44	,188	,060	-,01	,90
Security	0	1	-,40	,445	1,000	-1,48	,68
	0	2	-,76	,455	,293	-1,86	,35
	1	2	-,36	,235	,371	-,93	,21
Compatibility	0	1	,05	,356	1,000	-,83	,91
	0	2	,64	,364	,239	-,24	1,53
	1	2	,60*	,188	,006	,14	1,05
Better as an app	0	1	-,78	,360	,095	-1,66	,09
	0	2	-,31	,369	1,000	-1,20	,59
	1	2	,48*	,190	,040	,02	,94
Ease of use	0	1	,38	,307	,647	-,36	1,13
	0	2	,37	,314	,740	-,40	1,13
	1	2	-,02	,162	1,000	-,41	,38
Calorie usage	0	1	,37	,348	,863	-,47	1,22
	0	2	,85	,356	,057	-,02	1,71
	1	2	,47*	,184	,033	,03	,92
Blood pressure	0	1	-,27	,387	1,000	-1,21	,67
	0	2	,07	,396	1,000	-,89	1,03
	1	2	,34	,204	,284	-,15	,84
Blood oxygen	0	1	,00	,375	1,000	-,91	,91
	0	2	,03	,384	1,000	-,90	,96
	1	2	,03	,198	1,000	-,45	,51

Step count	0	1	,04	,366	1,000	-,85	,93
	0	2	,59	,374	,345	-,31	1,50
	1	2	,56*	,193	,014	,09	1,02
GPS	0	1	-,13	,432	1,000	-1,18	,92
	0	2	,06	,443	1,000	-1,01	1,14
	1	2	,19	,228	1,000	-,36	,74
Water resistance	0	1	-,21	,333	1,000	-1,02	,60
	0	2	,43	,341	,626	-,40	1,26
	1	2	,64*	,176	,001	,21	1,06
Energy level	0	1	-,18	,391	1,000	-1,13	,77
	0	2	,08	,400	1,000	-,89	1,05
	1	2	,26	,206	,614	-,24	,76

Based on observed means.
The error term is Mean Square(Error) = 1,216.
*. The mean difference is significant at the ,05 level.

Appendix D: ANOVA segmentation on physical activity.

Dependent variable	(I) physical activity category	(J) physical activity category	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower bound	Upper bound
Motivational tools	1	2	,22	,219	,959	-,31	,75
	1	3	,47	,219	,097	-,06	1,00
	2	3	,26	,199	,604	-,23	,74
Price	1	2	-,15	,197	1,000	-,62	,33
	1	3	-,19	,197	1,000	-,67	,29
	2	3	-,04	,179	1,000	-,48	,39
Precision	1	2	,10	,212	1,000	-,41	,62
	1	3	-,17	,212	1,000	-,69	,34
	2	3	-,28	,193	,461	-,74	,19
Sleep measurements	1	2	,38	,250	,381	-,22	,99
	1	3	,17	,250	1,000	-,44	,78
	2	3	-,21	,227	1,000	-,76	,34
Design	1	2	,04	,237	1,000	-,54	,61
	1	3	,04	,237	1,000	-,54	,61
	2	3	,00	,215	1,000	-,52	,52
Security	1	2	-,03	,288	1,000	-,73	,67
	1	3	,24	,288	1,000	-,46	,94
	2	3	,28	,262	,878	-,36	,91
Compatibility	1	2	,40	,231	,259	-,16	,96
	1	3	-,18	,231	1,000	-,74	,38
	2	3	-,57*	,210	,021	-1,08	-,07
Better as an app	1	2	,07	,239	1,000	-,51	,65
	1	3	,10	,239	1,000	-,48	,68
	2	3	,02	,217	1,000	-,51	,55
Ease of use	1	2	,39	,195	,144	-,08	,86
	1	3	,20	,195	,938	-,27	,67
	2	3	-,19	,177	,842	-,62	,24
Calorie usage	1	2	,15	,226	1,000	-,40	,70
	1	3	-,34	,226	,420	-,88	,21
	2	3	-,49	,205	,056	-,99	,01
Blood pressure	1	2	,13	,250	1,000	-,47	,74
	1	3	,09	,250	1,000	-,52	,70
	2	3	-,04	,227	1,000	-,59	,51
Blood oxygen	1	2	,08	,239	1,000	-,50	,66
	1	3	-,13	,239	1,000	-,71	,45
	2	3	-,21	,217	,989	-,74	,31
Step count	1	2	-,09	,242	1,000	-,67	,50
	1	3	-,19	,242	1,000	-,78	,39
	2	3	-,11	,220	1,000	-,64	,43
GPS	1	2	,39	,274	,458	-,27	1,06
	1	3	-,03	,274	1,000	-,70	,63

	2	3	-,43	,249	,270	-1,03	,18
Water resistance	1	2	,32	,222	,470	-,22	,86
	1	3	,02	,222	1,000	-,52	,56
	2	3	-,30	,202	,427	-,79	,19
Energy level	1	2	-,14	,250	1,000	-,75	,47
	1	3	-,33	,250	,556	-,94	,27
	2	3	-,19	,227	1,000	-,74	,36

Based on observed means.
The error term is Mean Square(Error) = 1,215.
*. The mean difference is significant at the ,05 level.

Appendix E: Mean Comparison

	Age segments			Physical activity segments			
Dependent variable	0	1	2	1	2	3	Total
Motivational tools	2,67	2,84	2,86	3,09	2,87	2,62	2,83
Price	2,89	3,72	3,27	3,36	3,51	3,55	3,49
Precision	4,22	4,06	3,55	3,85	3,74	4,02	3,87
Sleep measurements	2,33	2,83	2,29	2,79	2,40	2,62	2,58
Design	2,22	3,12	2,67	2,91	2,87	2,87	2,88
Security	2,44	2,84	3,20	3,03	3,06	2,79	2,95
Compatibility	3,89	3,84	3,24	3,70	3,30	3,87	3,61
Better as an app	3,00	3,78	3,31	3,61	3,53	3,51	3,54
Ease of use	4,22	3,84	3,86	4,09	3,70	3,89	3,87
Calorie usage	4,11	3,74	3,27	3,52	3,36	3,85	3,58
Blood pressure	2,89	3,16	2,82	3,09	2,96	3,00	3,01
Blood oxygen	2,67	2,67	2,63	2,64	2,55	2,77	2,65
Step count	3,78	3,74	3,18	3,42	3,51	3,62	3,53
GPS	3,00	3,13	2,94	3,18	2,79	3,21	3,05
Water resistance	3,78	3,99	3,35	3,85	3,53	3,83	3,72
Energy level	2,78	2,96	2,69	2,67	2,81	3,00	2,84