Motivations to use health-related self-tracking apps

Exploration of underlying motivations to use health-related self-tracking apps

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Abstract

Recently, health-related self-tracking apps have become increasingly popular. Users of these apps track behaviors such as physical activities, eating behavior or their mood. Existing research about how users are motivated to use health-related self-tracking apps lacks depth. Therefore, the current study aims to reveal the underlying motivations for the usage of health-related self-tracking apps.

A qualitative exploratory research design was implemented. Semi-structured interviews were conducted with eight participants. The interviews dealt with the participants' motivation to engage in self-tracking and their usage behavior. Afterwards, a relational content analysis was conducted. Thus, the interviews were analyzed deductively based on the interview scheme and existing literature to find out which factors are the most prevalent and how the factors relate to each other.

The results reveal a great impact of the factor attitude towards self-tracking on the participants' motivation to use health-related self-tracking apps. The participants had a positive attitude towards self-tracking, especially when they were convinced that self-tracking was entertaining or a suitable means in order to improve their self-discipline or health. Furthermore, the effort users needed to exert when using an app was highly impactful and in many cases reported to be the most important factor.

In further research, the results can be tested for significance. Supposed the results persist when tested with larger sample sizes, they suggest that app-developers should keep the apps as effortless to use as possible, provide convincing arguments that the app will improve the potential users' health and self-discipline and implement entertaining features.

Introduction

Nowadays, health-related self-tracking apps have become increasingly popular. These apps offer a simple way to obtain data about everyday activities like progress and engagement in sportive activities, eating behavior or symptoms of chronic illnesses (Halko & Kientz, 2010). Currently, physical exercise and diet are the most frequently tracked parameters (Lomborg & Frandsen, 2016). Depending on the type of tracked behavior, different facets such as frequency and duration of the activity can be tracked (Anderson, Burford, & Emmerton, 2016). In the current study, it will be assessed what underlying factors influence the motivation to use health-related self-tracking apps.

The quantified self

The emerging self-tracking trend is often called "the quantified self (QS)". This term encompasses any individual which engages in some sort of self-tracking, in order to obtain quantitative data about themselves (Swan, 2013). In her paper "The quantified self: Fundamental disruption in big data science and biological discovery", Swan (2013) points out individual and collective chances and opportunities which come along with the rise of the self-tracking-movement.

Individuals benefit from self-tracking as they often successfully use it as a means to solve personal problems. Swan (2013) emphasizes that most self-trackers have a pragmatic and solution-oriented attitude towards tracking their own behavior. For example, they identify a problem in their life like overweight, which is related to problematic behaviors, such as overeating. Self-tracking helps them with obtaining a quantified overview of their own behavior and creating a framework in which they can establish a healthier behavior. Furthermore, the quantitative overview enables them to also set clear quantitative criteria for success in solving the problem. For example, they could set a maximum calorie intake per day for themselves. Subsequently, they can analyze the problem, set goals for themselves and keep track of their own progress. This approach has proven to be motivating and effective for many users (Shull, Jirattigalachote, Hunt, Cutkosky & Delp, 2014). Consistent with this, a study by Stawarz, Cox,

and Blandford (2015), confirmed that self-tracking can be an effective means to implement interventions that support habit-formation.

Concerning the collective chances that come with the rise of the quantified self-movement, Swan (2013) addresses the impact of self-tracking apps on big data science. She explains that the big data sets, driven from self-tracking apps constitute both a great challenge and a powerful opportunity for the field of data science, as the amount of collected data grows continuously. Once researchers will manage to process these data, it will serve to acquire a large variety of health-related knowledge.

Self-tracking-motivations

In contrast to the extensive research about the relevance and benefits of self-tracking apps, there is only little existing research about the underlying causes and motivations which explain the growing trend of using health-related self-tracking apps. Extending this field of research will also serve producers of self-tracking apps to improve the apps in ways which motivate more people to engage in self-tracking. In order to find out more about why people use health-related self-tracking-apps, it is useful to first get an overall overview of the already existing research in the field of motivation to engage in self-tracking.

The five-factor-framework of self-tracking-motivations (Gimpel et. al, 2013) offers a clearly structured overview of the factors that motivate users to engage in self-tracking. Gimpel et. al (2013) found out that five main factors predict the motivation to use self-tracking applications. The factors are self-healing, self-discipline, self-design, self-association, and self-entertainment. People use self-tracking apps for the sake of self-healing when the usage is aimed at improving the users' health (Gimpel et. al, 2013). For example, symptom-tracking is applied to help users and their physicians to keep track of the symptoms and subsequently manage their chronic health conditions (Schroeder et. al, 2018). Furthermore, users find self-tracking apps in general appealing because they feel it increases their self-discipline. For example, food-tracking-apps might motivate users to stick to a consistent and healthy diet. Moreover, the usage of apps such as sport-tracking apps is often deemed to fulfill the purpose of optimizing oneself or one's lifestyle. Gimpel et al, 2013 called this motivational factor

self-design. The motivation self-association plays a major role when people are using self-tracking apps in order to inspire or connect with others. Sharon and Zandbergen (2017) state that sharing their self-tracking experience is fundamental for users. Lastly, self-entertainment plays another important role in the usage of self-tracking apps as it is often perceived as entertaining engagement. For example, it has been proven that gamification functions which make the self-tracking experience more entertaining serve the users' motivation. One example of gamification is a "streak-function" which counts the days the user uses the app in a row (Renfree, 2016).

In order to test the five-factor-framework of self-tracking-motivation, the usage activity of the participants was used to determine the users' motivation to use self-tracking apps. The usage activity of the participants was broken down in the number of tracked parameters and the time they spend with self-tracking (Gimpel et. al, 2013). An illustration of the five-factor-framework of self-tracking-motivations can be found in Figure 1.

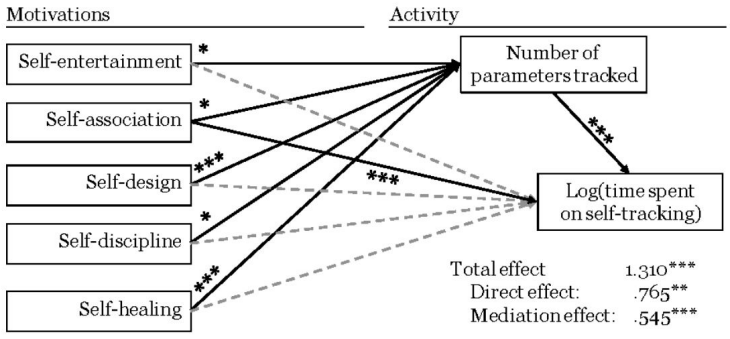

Figure 1. Five-factor-framework of self-tracking-motivations (Gimpel et. al, 2013)

Additional motivational factors can be drawn from the theory of planned behavior which assumes that the three factors attitude towards the behavior, subjective norm and perceived behavioral control to be formative for the behavioral intentions (Ajzen, 1991). Here, the term "intention" is used as a synonym for "motivation". According to the theory of planned behavior, the factors behavioral intentions (motivations) and actual behavioral control determine the actually performed behavior. The factor behavioral intentions (motivation) is determined by the factors attitude, subjective norm and perceived behavioral control (Ajzan, 1991).

Firstly, the factor attitude towards the behavior includes the feelings and opinions of the individuals towards a particular behavior. For example, when a user of a self-tracking app perceives the app as entertaining, it will lead to a positive attitude towards the self-tracking-behavior. Subsequently, the user will be more likely to engage in self-tracking via smartphone.

Secondly, the factor subjective norm describes that the individual perceives social norms about a certain behavior which influences his decision whether or not to perform it. For example, in a family with certain very traditional values, the usage of smartphone applications might be unaccepted. Thus, family members will be less likely to engage in self-tracking via smartphone.

Thirdly, the factor perceived behavioral control describes to what extent the individual perceives to have control over his or her own behavior. This encompasses beliefs about self-efficacy which are determined by beliefs about how much effort the behavior will take and beliefs about how capable one is to perform the behavior. For example, the self-efficacy beliefs about self-tracking via smartphone might be low for somebody who has not learned to use a smartphone yet. Furthermore, when self-tracking takes too much effort, potential users might assume that they will not be able to perform self-tracking consistently what may also result in negative self-efficacy beliefs, and therefore decrease the motivation to engage in it. An illustration of the theory of planned behavior can be found in Figure 2.

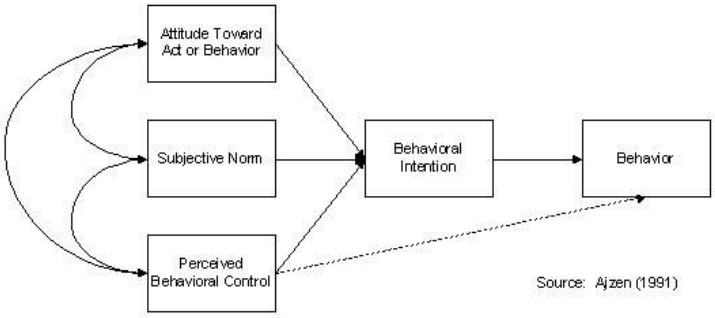

Figure 2. Theory of planned behaviour (Ajzen, 1991)

In order to integrate the theory of planned behavior with the five-factor-framework of self-tracking-motivation, they are compared first. It becomes clear that the five-factor-framework

of self-tracking-motivation is a detailed framework of factors that determine the attitude towards specifically self-tracking-behavior and therefore shows how the motivations to engage in self-tracking are composed. For example, the factor self-design describes that users of self-tracking apps are convinced that the app will help them to improve themselves is certain aspects. Subsequently, this conviction leads to a positive attitude towards self-tracking. However, the theory of planned behavior describes next to attitude towards the behavior, two further factors which have an impact on the motivation. The two additional factors are the perceived behavioral control and subjective norm.

Aim of the current study

As described above, a lot of research has been done in the field of health-related self-tracking apps. However, the underlying motivating factors which constitute the decision of whether or not people use health-related self-tracking apps are not yet explored to a sufficient extent. While the five-factor framework of self-tracking-motivation provides five determinants of users' motivations to engage in self-tracking in the following study it will be explored more in depth which of these factors are the most prevalent. Furthermore, it will be explored to what extent it adds exploratory value to integrate the five-factor-framework of self-tracking-motivations with the theory of planned behavior. Answering the question of what are the main motivating factors for users to track their own behavior could help developers of future health-related self-tracking apps to develop them in ways which allow potential users to be motivated to consistently engage in the usage of health-related self-tracking apps.

The research question of the current study is: What are the main motivating factors for users to use health-related self-tracking apps? In order to answer the research question, a qualitative and exploratory research design will be applied. Therefore, the five-factor framework of self-tracking-motivations will be integrated with the theory of planned behavior. The integrated version will be used to explore the prevalence of the different factors which determine the users' motivation to engage in self-tracking.

Methods

Participants

The participants were eight adults from the age of 21 to 29 (Mage = 23,5; SDage = 2,72). All the participants were drawn from a convenience sample which was assembled from the close social environment of the researcher (Etikan, Musa, & Alkassim, 2016). Three of the participants were female and five were male. The only inclusion criterion was that the participants must have previous experience with the usage of health-related self-tracking apps.

Materials

The materials were an audio recorder and the interview scheme. The interview scheme consisted of three parts. Firstly, the participants were asked to introduce themselves and to give a short overview of their history with health-related self-tracking apps. Here, the participants were asked what apps they used, and in which frequency did they use them. Furthermore, they were asked to give a detailed description of the apps. In the second part, the participants were asked about their experience with health-related self-tracking apps in general. Here, they were asked to describe their usage behavior, their motivation, their results, etc. with health-related self-tracking apps in general. In the third part, the participants were asked about their experience with their favorite health-related self-tracking app. Here, the questions were similar to those of the second part, but they were asked in the context of the participants' favorite app. The interview scheme can be found in Appendix B.

Design and Procedure

For the current study, an exploratory qualitative research design was chosen. Thus, qualitative data in the form of interviews were collected and exploratively analyzed. The data analysis will be described in the next section. The procedure of the study looked as follows. The study took place partly in the library of the University of Twente and partly in private facilities of the participants between the 8th of April and the 22nd of April in 2019. Each participant was seated opposite the researcher. The participant data were anonymized for privacy reasons. The research was registered and approved by the University of Twente Research Ethics Committee

with the registration number 190351. All participants have read and signed the informed consent that can be found in Appendix A. Next, they were face-to-face interviewed with the help of the interview scheme which provided a structure for the interviews (Appendix B). Every participant was interviewed individually in either english or german. Next, to applying the interview scheme, the interviewer used non-suggestive probes. This means, when participants mentioned a certain relevant topic, the interviewer probed the participants into going more in detail. However, in order to avoid being too suggestive and therefore distorting the results, the participants were not asked about specific motivations which they did not name in the first place. The semi-structured interviews took between 10 and 20 minutes with a mean duration of 16.89 minutes. The interviews were recorded with a smartphone and afterwards temporarily stored on a computer.

Data analysis

The interviews were saved as audio files and afterwards transcribed to text documents. The interviews were transcribed to a clean transcript. In a clean transcript, the interviews were transcribed sentence by sentence, while filling-words such as “hm” and other verbal errors were left out (“Verbatim Transcription vs. Non-verbatim Transcription,” 2015). Nextly, the interview transcripts were coded with the coding scheme which is shown in Table 1.

A relational content analysis was applied to the data. This means the concept of motivation to engage in self-tracking was chosen and subsequently the relationship between different motivational factors was explored with the help of a coding scheme. The overall structure of the coding scheme was established in a deductive manner based on the interview guide (Soiferman, 2010). Thus, the coding scheme was structured in “participant data”, “app content”, “usage behavior” and “factors that influence motivation”. Moreover, the codes and subcodes in all code groups apart from the code group “motivation” were inductively established, without the help of theory.

The integrated version of the five-factor framework of self-tracking-motivation and the theory of planned behavior will serve as a theoretical framework to structure the motivations of the participants in a deductive manner. An illustration of the integrated version can be found in

Figure 3. Subsequently, it can be assessed to what extent these theories explain the users' motivations to engage in self-tracking and how the motivating factors relate to each other.

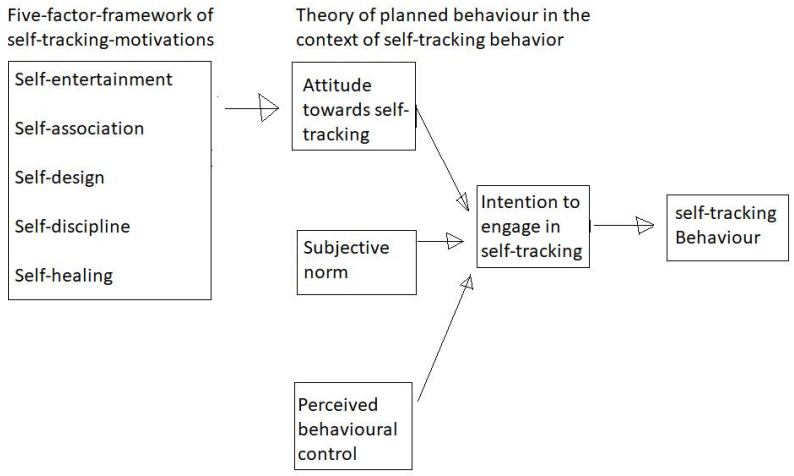

Figure 3. Integrated version of the theory of planned behaviour and the five-factor-framework of self-tracking-motivations

Thus, the code group "factors that influence motivation" was divided into the codes "attitude", "perceived behavioral control" and "subjective norm" from the theory of planned behavior. Afterwards, the code "attitude" was divided into the subcodes "Self-healing", "Self-discipline", "Self-design", "Self-association" and "Self-entertainment" from the five-factor-framework of self-tracking-motivations.

Subsequently, the program atlas.ti was used to code the interview transcripts with the help of the interview scheme. It was possible that two or more codes applied for one quote in the transcripts as for instance, the code "subjective norm" and the code "self-association" were closely related. Furthermore, the number of participants to which each code applied was ascertained in order to attain an overview of how important the code was.

Table 1

coding scheme

Code Group	Code	Subcode	Code description
Participant data	Favourite App		Favourite app of each participant
	Age		Age of the participant
Content of app	App name		Brand name of the app
	App design		Design of the app
	App Category	Physical activity tracking	
		Tracking of undesired behaviour	
		Food tracking	
		Others	
Usage behaviour	Frequency of use		How often is the app used?
	Duration of use		For how long is the app in use?
Factors that influence motivation	Attitude (related to attitude towards the behaviour)	Self-healing	The healing of symptoms or general health as motivating factor
		self-discipline	Increase in self-discipline as motivation factor
		self-design	Design of body, psyche or lifestyle
		self-association	Connections to others
		self-entertainment	Entertainment and fun
	Perceived behavioural control		Self-efficacy beliefs as factor that impacts motivation
	Subjective norm		Normative beliefs as factor that impacts motivation

Results

About the apps

All eight participants mentioned their favorite health-related self-tracking app. Among the favorite apps of the participants, five apps were concerned with physical health and three apps were concerned with mental health. Among the apps concerned with physical health, three were tracking physical activities, one was tracking food and one was tracking menstruation. Among the apps concerned with mental health, one was tracking mood, one was tracking meditation sessions and one was tracking the screen time.

Next to the favorite apps, the participants had the opportunity to mention several further apps they used before. All apps that were mentioned by the participants can be categorized in physical activity tracking which was reported six times , tracking of undesired behavior which was reported three times, food tracking which was reported four times and others which was reported four times. An overview of the frequencies in

Factors that influence motivation

Perceived behavioral control. In the code-group motivation, the code "Perceived behavioral control" was used for seven out of eight participants. Subsequently, it seemed to be significant for the participants how capable they felt using a self-tracking application. This did not mean whether or not they were capable of handling the self-tracking application but rather whether or not they felt capable of consistently putting the necessary effort into the usage of a self-tracking app.

Generally, apps which require much time and effort to use were often dismissed or the usage was abandoned after a short period of time, even when the participants were initially highly motivated to use them. For instance, a participant said about his experience with a food tracking app *"Yea I got tired to put every time I eat, my meal in the food tracking apps. And it felt like it was not the purpose of the app to only do that sometimes so I stopped it completely"*. This example also illustrates that inconsistent usage was often perceived as a failure.

Furthermore, five participants reported being motivated using a self-tracking app because both usage and installation took them not much or barely any time and effort. Three participants

mentioned this as the main reason, and two of them even as the only reason to engage in self-tracking. The following statement of a participant illustrates such a case: *"I think if it wouldn't be pre-installed at my phone I wouldn't use it, but I think it is the availability and ease to use which keeps me motivated doing it."*

Subjective Norm. The code "subjective norm" was used for the coding of the interviews of two participants. In both cases, the participants reported enjoying to share their step-counter results with other people *"But from time to time I compare my results to the results of other people and that's kind of fun."* This example illustrates that it might also be motivating when the participants had entertaining conversations about their self-tracking-apps in their social environment.

Attitude as motivating factor. The code "attitude as motivating factor" which was split into the five factors of the five-factor-framework of self-tracking-motivation was used for the coding of the interviews of all eight participants.

Self entertainment. The sub-code "self-entertainment" was applicable to the interviews of six from the eight participants. Several participants stated that it *"is fun"* to either use the app or look at the results. Other participants stated that the results of self-tracking are interesting. For instance, one participant stated *"It is kind of interesting to keep an overview about useful and productive things you do and then look at it from time to time. It makes me feel good to know that I did good in a day or in a week and that things go according to plans."(Nr. 6).* Furthermore, two participants reported that the app-design motivated them to use an app. As they reported that the style of the design motivated them to use an app, this was also coded as "self-entertainment". For instance, one participant emphasized that he chose one app over another similar app, because of its superior design *"I know some apps which are not really fancy and then I don't like it. I'm very superficial when it comes to it. For example, 'myfitnesspal' is a very popular food tracker but I don't like it because of the style."* This example illustrates that these participants did not prefer the design because it made the app easier to use, but because he found the style more appealing.

Self-discipline. The sub-code "self-discipline" was used for the coding of the interviews of five of the eight participants. This code was applicable when participants reported feeling

motivated to use an app because it helps them to increase their self-discipline. For instance, one participant stated that a meditation app helped him to stick to meditation in a very consistent manner. He stated, *"It feels like it is easier to stick to meditation when you have an overview which is kind of like a nice reward when you see that you did it very consistently."* Another participant reported that it was much easier for him to stick to a healthy and complete vegan diet when he tracked all the food he ate.

Furthermore, four participants reported that the self-tracking made them more aware of their own behavior. One participant stated, *"It definitely makes me more aware of what I am doing (...)."* Participants who mentioned the increased awareness often emphasized that the increased awareness also increased their self-discipline. For instance, one participant stated in the context of a food-tracking app *"It gives me the feeling that I do engage more in what I'm doing. When I track my eating behavior I feel like I care more about my health. So it gives me a better feeling of my eating."*

Self-healing. The sub-code "self-healing" was used for the coding of the interviews of five of the eight participants. One participant reported using a mood tracking app in which she entered diary-like notes and assigned a mood to it. Furthermore, the app had the function to automatically assign a mood to a diary entry, based on the vocabulary which was used. She stated, *"What keeps me motivated is that my psychotherapy lessons are much more effective since I use this app."* Another participant reported that the usage of a food tracking app was essential for him in order to retain his physical health on a vegan diet. He stated, *"I eat a certain amount of rice (...), what is important because I am vegan."* Another participant mentioned that she used a screen time tracker because she considers the time she spent with her smartphone as unhealthy and wanted to reduce it. She stated *"The screen time tracker is my favorite app because today a lot of interaction is happening online. I think we should go back to the roots and the app is a good way to control one's behavior in that regard."*

Self-design. The sub-code "self-design" was used for the coding of the interviews of two of the eight participants. For example, one participant reported that he made crucial improvements in his sports exercises. He used the app to guide his improvement process and keep an overview about it. He stated *"Also, the idea of the app is nice that you can work towards*

different specific exercises which look pretty cool even though you can not do anything remarkable when you start using the app. So far I haven't reached one of the top goals but I progressed pretty well and that feels good."

Self-association. The sub-code "self-association" was used for the coding of the interviews of two of the eight participants. Two participants mentioned enjoying sharing their step counting results with other people. One of them stated *"... from time to time I compare my results to the results of other people and that's fun. "*

The codes from the code-group "factors that influence motivation" and the frequency in which each of them was coded can be found in Table 2.

Patterns between different motivating factors

During the coding process, the following patterns among codes became apparent. While the definitions of the codes "self-association" and "subjective norm" are different, the statements to which these codes applied were the same. Furthermore, the factor self-entertainment seemed to be related to the factors self-association, self-design and self-healing, as participants mentioned that using the app was entertaining because they could compare the results to the results of peers, improve themselves and improve their health. Moreover the factors self-healing and self-design showed some overlap as participants stated that the apps help to improve themselves in ways which are also beneficial for their health.

Table 2:

Codegroup factors that influence motivation: codes based on the integrated version of the theory of planned behaviour and the five-factor-framework of tracking-motivation

Code	Subcode	Number of participants for which the code was applicable
Attitude	Self-healing	5
	Self-design	2
	Self-discipline	5
	Self- association	2
	Self- entertainment	6
Perceived behavioural control		7
Subjective norm		2

Discussion

Overview of the findings in the light of existing literature

The research question of the current study was: What are the main motivating factors for users to use health-related self-tracking apps? The results reveal that the attitude towards self-tracking is the factor that arose most frequently in the interviews. Furthermore, the factor perceived behavioral control seemed to be highly influential. Lastly, the factor of subjective norm seemed to have played a small role in the participants' motivation. Thus all three factors of the theory of planned behavior could be supported by the results of the current study (Ajzen, 1991). However, the factor subjective norm has only little support.

The study showed that the attitude towards self-tracking was constituted by the factors “self-entertainment”, “self-healing”, “self-discipline”, “self-design” and “self-association”. Thus all factors from the five-factor-framework of self-tracking-motivation could be supported by the current study to a varying degree (Gimpel et. al, 2013).

The factor self-entertainment was found often to impact on the client's attitude towards self-tracking, as participants often reported to engage in self-tracking because it was fun or interesting. The factors self-healing and self-discipline seemed to also play an important role in the participants' attitude towards self-tracking. The statement by Swan (2013), that most self-trackers have a pragmatic and solution-oriented attitude could also be confirmed as the factor self-healing was often reported to be the primary reason to engage in self-tracking. Participants often used applications because they were convinced that it would help them to modify their behavior in a healthier way.

Furthermore, some participants reported that they engage in self-tracking because it increased their self-discipline. This confirms the statement by Shull et. al (2014), that self-tracking is an effective means to implement specific new habits in a consistent manner. The increase of self-discipline was often stated to be a consequence of increased awareness of the tracked parameter and of having a clear criterion of success.

The factors self-design and self-association could also be supported in the current study, even though to a lower degree. The factor of self-design was supported as some participants reported to use self-tracking apps in order to optimize themselves or certain facets of their lifestyles. Furthermore, the factor of self-association was supported as some participants stated that it was fun to compare the results of self-tracking with peers. Nevertheless, the statement by Sharon and Zandbergen (2017), that connecting with others is fundamental to users of self-tracking apps could not be confirmed by the current study.

The second most influential factor for the participants' motivation to engage in self-tracking seemed to be perceived behavioral control. Many participants reported that they failed using a self-tracking app consistently or did not even start using it because they felt incapable of exerting the necessary effort over a long time. This was the case, even though they had other important motivations to use a health-related self-tracking app. The participants often described inconsistent usage as a failure to use the app properly. More surprising was that some participants reported that very low effort to use a self-tracking app was their main motivation. It seemed like when an app is very easy to use, the participants did not need other important

conscious motivations. Thus, it can be concluded that self-efficacy beliefs played a major role in the participants' motivation to engage in self-tracking.

Lastly, the factor subjective norm was less recognizable in the participants. Even though the subjective norm is very closely related to the factor self-association, the two factors must be distinguished. While self-association describes that one is motivated to engage in self-tracking because of its affiliation-value within a community, subjective norm describes the beliefs one has about how accepted self-tracking is within the community (Gimpel et. al, 2013; Ajzen, 1991). However, in the current study, only a few participants mentioned that it was fun for them to share their results with peers. This indicates that those participants had a positive subjective norm. It is possible that the factor subjective norm did not find great support because of the following reason. Nowadays, one can engage in self-tracking without anybody else noticing it, and therefore the perceived social pressure would be non-existent. Thus, the factor subjective norm would not have a great impact (Ajzen, 1991).

The motivational factors which were found in the interviews were explainable with the integrated version of the theory of planned behavior and the five-factor framework of tracking-motivation. The results of the current study suggest that the five-factor framework of tracking-motivation can be combined with the theory of planned behavior, to create a model which displays the most important factors that influence the motivations to use health-related self-tracking apps. In order to explain all the factors that influenced the participants' motivations, a combination of both theories is necessary.

The added value of integrating the theory of planned behavior and the five-factor-framework of self-tracking-motivation to the theory of planned behavior alone is that it gives more concrete underlying motivations. Instead of the very general factor attitude towards the behavior, it gives the concrete factors of the five-factor-framework of self-tracking-motivation.

The added value of integrating the theory of planned behavior and the five-factor-framework of self-tracking-motivation to the five-factor-framework of self-tracking-motivation alone is that it has a broader explanation value. The five-factor-framework of self-tracking-motivation misses the important factor perceived

behavioral control, which the current study suggests to have great explanation value. Furthermore, it misses the factor subjective norm, even though it seems to only have a slight impact, according to the results of the current study.

Strength and limitations

The most important strength of the current study was the interview design which allowed to explore the participants' motivation in a personal manner. In that way, it was possible to reveal what motivated the participants to engage in self-tracking, what other factors influenced how motivated they were and how these factors are related to each other.

The questions of the study were asked general and allowed for a wide range of different answers. This could be seen as a strength because the questions were asked as non-suggestive as possible, as specific questions were only asked when a participant himself introduced a specific topic. Thus it can be assumed that the participants did not feel pressured to answer in a certain way. However, this could also be seen as a limitation as the participants may have given more specific answers when the questions would have been more specific. Thus, more specific questions could have lead to longer interviews and subsequently more detailed data.

A further limitation was that the data were analyzed in a deductive manner. This means that the results could only confirm or disconfirm factors of existent theories and show how they are related to each other. An inductive approach could have lead to more original results.

Another limitation was that the study was conducted by only one researcher. Commonly, quantitative studies are implemented by at least two researchers to assure that more than one perspective can be considered.

Future studies and practical recommendations

In order to reveal the underlying motivations of self-tracking in general, other methods than one-time interviews could be implemented. For example, daily reports of self-trackers might contain more detailed and deeper explanations of the underlying motivations than interviews. Thus, a study with a longitudinal design which takes measures at different points in time could

be applied in order to reveal more significant and detailed results. Such a design could also be used to confirm the strong impact of the factor perceived behavioral control.

Furthermore, different motivational factors could be isolated in order to reveal their explanatory power. For instance, the same app could be tested with a poor and with a very modern app - design, in order to test what difference the design makes when it comes to motivating people to use the app constantly. In that way, the motivating value of more specific factors of an app could be detected.

Moreover, as the design of the current study did not allow to find out a lot about how subjective norm impacts the motivation to engage in self-tracking, a study which explores this factor more in depth could be conducted. For example, it could be measured how many people use the share button in self-tracking apps and share their self-tracking results, for example on their Facebook page. If many people make use of this function, this may imply that the factor subjective norm plays an important role.

Subsequently, the practical recommendations can be best explained in the context of the Persuasive System Design-Model (PSD-model) (Oinas-Kukkonen, & Harjumaa, 2009). The PSD - model provides a framework of three steps for the design of persuasive systems. Firstly, the model provides some general postulates about persuasion. Secondly, the model provides a framework on how to analyze the persuasion context. Thirdly, the model provides a framework for the design of system features. In the PSD-model, the system features are categorized in primary task support, dialogue support, credibility support and social support (Oinas-Kukkonen, & Harjumaa, 2009). The following practical recommendations are drawn from the results of the current study and supported with the design principles of the PSD-model.

For example, the results of the current study suggest that reducing the effort potential users have to exert when using a self-tracking app would be highly beneficial. This would be possible with the design principle of reduction, from the PSD-model (Oinas-Kukkonen, & Harjumaa, 2009). Reduction is a design principle in the category primary task support as it directly supports the user by performing his task by simplification and reduction of effort. In order to implement reduction, app-developers could develop simpler versions of existing apps by relinquishing all functions which take effort to use, despite their usefulness. For example, one

could produce a food-tracker which only counts the number of meals. The results would not be as useful as those of current food-tracker apps, but it might increase the users' awareness of their eating behavior. The current study indicates that increased awareness could already lead to more desired behavior.

Furthermore, the study results, which are yet to be confirmed by further research, indicate some further “do’s” and “don'ts” for app developers. Firstly, the current study indicates that app-producers could benefit from advertising their apps with a focus on health and self-discipline and implementing entertaining features.

Finally, the results of the current study indicate that for some users it might be helpful to provide a framework in which an inconsistent usage is not perceived as a failure. This could be achieved, for example by providing an overview about how often the user used the app, next to the often implemented “streak-overview” which shows how many days in a row the user used the app. Even though research has proven that the streak-function can be very motivating as long as the streak continues it may also be demotivating once it breaks (Renfree et. al, 2016). The streak function is related to the design principle of rewards from the PSD-model. Rewards is a design principle in the category dialogue support what suggests that users should receive virtual rewards for performing the target behavior (Oinas-Kukkonen, & Harjumaa, 2009).

Conclusion

The current study could find empirical evidence for the integrated version of the theory of planned behavior and the five-factor-framework of self-tracking-motivation which explain the factors that motivate users to use health-related self-tracking-apps. The factors attitude towards self-tracking and perceived behavioral control were found to be particularly influential. Subsequently, the current study gives some thought-provoking impulses to researchers in the field of self-tracking motivations and developers of health-related self-tracking apps.

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Appendix A

University of Twente

Informed consent

Investigators: Milan Meiners

Contact Person: Milan Meiners (m.meiners@student.utwente.nl)

We invite you to participate in a interview and survey study. If you agree, take part in a study of approximately 30 minutes. The study consists of an approximately 15 minutes interview and a personality survey.

We do not believe that there are any risks or discomforts from participating in this research. However, participating in this study is completely voluntary. Even if you decide to participate now, you may change your mind and stop at any time. You do not have to do anything you do not want to do and you can withdraw from the study at any time without naming any reason.

We will not include any information that would identify you. Your privacy will be protected, and your research records will be confidential. If you wish, you will be provided with the results of the study after it is finished.

(If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researchers, please contact the secretary of the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente, Drs. L. Kamphuis-Blikman P.O. Box 217, 7500 AE Enschede (NL), telephone: +31 (0)53 489 3399, email: l.j.m.blikman@utwente.nl)

By signing this document, you are agreeing to be in the study. We will give you a copy of this document for your records. We will keep one copy with the study records. Be sure that we have answered any questions you have about the study and that you understand what you are being asked to do. You may contact the researcher if you think of a question later.

I agree to participate in the study and also that the categories made by me are photographed for later analyses.

_____

Printed Name

_____

Signature Date

Appendix B

Interview Schedule

Hello, my name is Milan Meiners and I am conducting a study about the motivation for using health-related self-tracking apps. I will interview you about your experience with those apps As explained in the informed consent, your data will be processed anonymously and you are free to cancel your participation at any moment. In case you are interested you will get informed about the results when the thesis is finished.
Do you have any further questions?

Demographic questions:
What is your name?
How old are you?

Overview about the participants history with health-related self-tracking applications:
What are the names of the health-related self-tracking apps you are using at the moment?
What are the functions of the apps you just mentioned?
How frequently are you using/ have you used the apps you just mentioned?
How much time do you spend in a day with self-tracking, when you are self tracking?
For how long are you using health-related self-tracking apps in general?

General Motivation
What motivates you to use health-related self-tracking apps in general?
In what way do health-related self-tracking apps in general change your experience of what you are tracking?
In case of activity-related self-tracking apps:
To what extent change the apps how frequently in which you are performing the tracked activity?
To what extent change the apps how willing you are to perform the tracked activity?
In case of food-tracking apps or other apps which track activities the user wants to reduce:
To what extent change the apps your self-awareness when performing the tracked activity?
To what extent change the apps your experience of performing the tracked activity?
To what extent change the apps the frequency of performing the tracked activity?
In case of symptom-tracking apps
To what extent change the apps your self-awareness when reporting a symptom?
To what extent change the apps the experience of having a symptom?
To what extent change the apps your behavior concerning your illness?

What general points have you noticed which discourage you or make you stop using a health-related self-tracking app? (in case the participant does not know how to answer, ask more detailed questions concerning design, usability, utility)
What other positive and negative points about health-related self-tracking apps come into your mind?

Focus on favorite application:
What is your favourite health-related self-tracking application
Can you describe it in more detail?
How often do you use the app?
In case of activity-related self-tracking app:
To what extent changes the app how frequently in which you are performing the tracked activity?
To what extent changes the app how willing you are to perform the tracked activity?
In case of food-tracking app or other apps which track activities the user wants to reduce:
To what extent changes the app your self-awareness when performing the tracked activity?
To what extent changes the app your experience of performing the tracked activity?
To what extent changes the app the frequency of performing the tracked activity?
In case of symptom-tracking apps
To what extent changes the app your self-awareness when reporting a symptom?
To what extent changes the app the experience of having a symptom?
To what extent changes the app your behavior concerning your illness?

How frequently are you using the app?
For how long are you using the app?
What keeps you motivated using the app? (in case the participant does not know how to answer, ask more detailed questions concerning design, usability, utility)
In case you have stopped using the app, why?
What additional positive and negative points about the app comes into your mind?

Conclusion
Thank you for answering my questions!