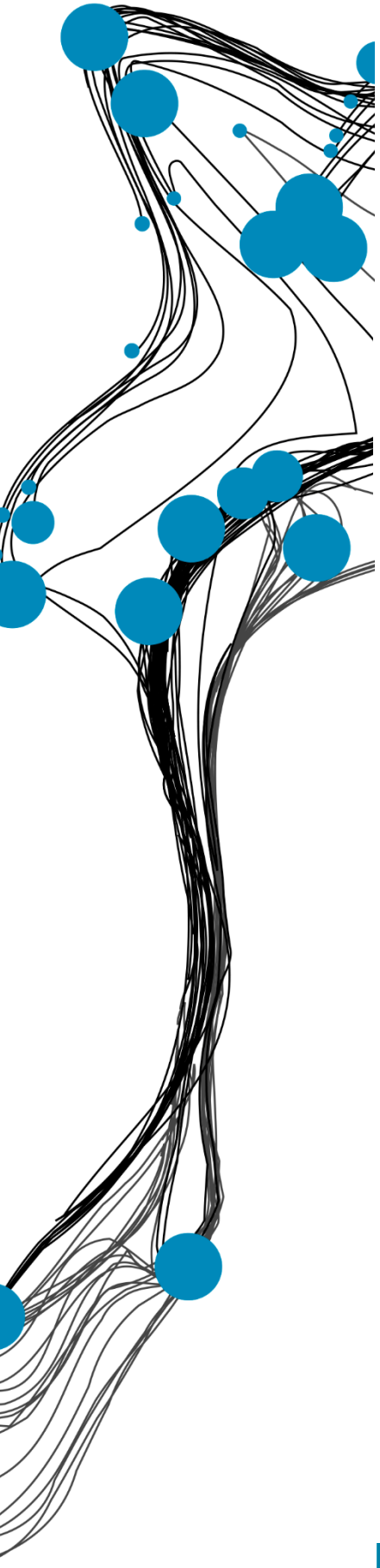

Bachelor Thesis Psychology (HPT)

The relationship between personality traits and acceptability of four different eHealth strategies cooperation, social comparison, competition, and recognition, in the context of Physical Activity

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Abstract

Background. In recent years, physical inactivity and sedentary behaviour increasingly became a global health problem. To counteract the health risks associated with lacking physical activity, research increasingly investigates personalized approaches towards tailoring interventions to individual needs. Social processes, specifically social support, evidently benefit healthcare promotion. However, little research has focused on how individuals would use social support to achieve and maintain a healthy lifestyle. This study focused on personality as an individual user difference. The purpose of this study was to explore the relationship between adults' (18-60 year-olds) personality traits, and their perceived acceptability of the four strategies cooperation, social comparison, competition, and recognition from the social support category of the PSD model in the context of physical activity. The aim is to provide findings that may benefit healthcare application development and help counteract the global problem of physical inactivity and sedentary behaviour.

Methods. An online survey was administered to a total of seventy-nine participants. Perceived acceptability was measured using a six-item scale provided by Halko and Kientz (2010). Personality characteristics were measured using the Ten-Item Personality Inventory (TIPI). Physical Activity levels were measured using the International Physical Activity Questionnaire short form (IPAQ-SF). A Spearman's rank correlation was used to assess the relationship between personality and the perceived acceptance of the social support strategies cooperation, social comparison, competition, and recognition.

Results. The sample was relatively young (*M*age= 25.24, *SD*age= 7.9), and mainly German (66,85%). The sample was found to see themselves as physically active persons, with the majority reporting high physical activity (46%). A Spearman's rank correlation produced a statistically significant positive association between the personality trait conscientiousness and social comparison ($r(77) = .29$, $p = .013$). and between Extraversion and social comparison ($r(77) = .25$, $p = .014$).

Conclusion. This study supports that individuals with increased scores on Extraversion or Conscientiousness prefer to socially compare themselves with others via fitness applications, to exercise. However, the study suggests a differentiated use of findings for the development of healthcare applications, considering the impact of user differences. In this study the sample was already physically active, and findings may not be generalized to physically inactive individuals. Future research is thus recommended to research the persuasive preferences of inactive adults with specific personality dimensions.

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Introduction

Cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases (such as Asthma), account for 70% of all deaths globally (Noncommunicable diseases, n.d.; Noncommunicable diseases, 2018). Sedentary behaviour and physical inactivity are among the leading adjustable risk factors worldwide for these diseases and all-cause mortality (Lavie, Ozemek, Carbone, Katzmarzyk, & Blair, 2019). In detail, physical inactivity is responsible for 21-25% of the breast- as well as colon cancers and 27% of diabetes illnesses (Lavie et al., 2019). Physical inactivity characterizes as an absence of moderate-to-vigorous physical activity performance. The concept distinguishes from sedentary behaviour, which is characterized by remaining seated, reclined, or lying (Lavie et al., 2019). In the recent years, the prevalence of insufficient physical activity has further increased, supposedly as a consequence of worldwide adoption of the "Western lifestyle, characterized by greater sedentary time, lower participation in active transport, and time spent in the leisure of purposeful physical activity" (Lavie et al., 2019, p. 801). The World Health Organization (WHO) responded to the health risks associated with insufficient physical activity and aims for a global 10% physical inactivity reduction by 2025 (Physical Inactivity: A Global Public Health Problem, n.d.). However, this undertaking is challenging, as behaviour change towards physical activity is assumed to be a complex, dynamic process influenced by the diversity of population subgroups (Sherwood and Jeffery, 2000). Concerning this challenge, the question that arises is how to tackle such a global problem which appears across populations, sectors, and cultures. Consistently, research focuses on eHealth technologies to reach and persuade a diverse array of recipients. For the development of these technologies, studies take into account individual character differences (Marzano et al., 2015) and use this personalized information to encourage the recipient to perform healthy behaviours (Neuhauser & Kreps, 2010). This study explores if personality as an individual character difference is associated with how well social support behaviour change techniques implemented into physical activity applications are accepted. The paper aims for useful findings for fitness application development to further counteract physical inactivity and sedentary behavior with user-tailored approaches.

The Complexity of Change: Sedentary Behaviour and Physical Inactivity

Tailoring eHealth technologies to individual needs requires understanding the complex and dynamic interactions of individual differences that constitute health behaviour. Sherwood and Jeffery (2000) recognized that physical activity levels are predicted by demographic

differences, suggesting that barriers and preferences for physical activity vary across population subgroups and constitute essential factors in developing interventions to promote physical activity. The researchers made an effort to define 13 determinants of physical activity and separated them into two categories, namely, personal- and environmental characteristics (de Vries, Truong, Zaga, Li, & Evers, 2017). Amongst the personal features, the researchers listed motivation, self-efficacy, stage of change, exercise history, body weight, health risk profiles, diet, and stress. As environmental characteristics, Sherwood and Jeffery (2000) determined social support, time, access, attributes of exercise behaviour, and injury to be associated with physical activity. Moreover, the researchers emphasize the complex interaction of physical activity determinants, which differ at initiation, maintenance, and relapse. As an example, a lack of self-efficacy identifies as a barrier for obese individuals to initiate physical activity (Hills and Byrne, 2006).

On a different account, the COM-B System Design Model by Michie, Van Stralen, and West (2011) conceptualized an interactive system with the components capability (psychological/ physical skills), opportunity (absence of environmental constraints), and motivation. The claim is that behaviour occurs as the result of a collective interaction between these components. Ultimately, this model captures the mechanisms supposed to be involved in behavioural change, including internal-, and external factors. The behavioural explanations emphasize a linkage of behaviour change interventions to an overarching model of behaviour. This way, interventions can consider- and work with the underlying mechanisms that precede specific actions (Michie et al., 2011); Thereby, designs should take into account the individual differences of its users.

mHealth Interventions: Opportunities and Advantages

Consisting growth of health information technologies (eHealth technologies) is promising to account for user differences by providing tailored health care delivery and offering health promotion (Kreps & Neuhauser, 2010). eHealth applications cover a broad range of outreach, such as online social support networks, health information websites (e.g., Medline Plus), or mobile health communication devices (Marzano et al., 2015). There are possible challenges to the use of technologies; for instance, users may be concerned about a lack of personal contact (Rollo et al., 2016). Also, using technologies may be restricted for subgroups, such as disabled people or socially disadvantaged individuals (Dobson and Hall, 2014). Another challenge to eHealth interventions is an individual's lack of eHealth literacy, which is knowledge, comfort, and skills to use an application (Norman and Skinner, 2006).

Despite these challenges, there are considerable advantages and opportunities for the use of technologies to promote physical activity.

Specifically, mobile and wireless devices (mHealth technologies) are quickly accessible and appeal to consumers worldwide as they are "interactive, interoperable, easy to use, engaging, [and] adaptable" (Kreps & Neuhauser, 2010, p. 329). The flexibility of the technologies allows the convergence of user diversity needs, which may sustain user interest over time (Anagnostopoulou et al., 2017; Halko & Kientz, 2010) and thereby gives the applications an advantage towards one-size-fits-all approaches. Intervention designers increasingly use eHealth and mHealth tools to account for the complexity of behaviour and offer a diverse coverage of approaches to change and sustain health behaviours (Dugas, Gao, & Agarwal, 2020). Thereby, the development of technologies that communicate effectively with its consumers' challenges system designers (Marzano et al., 2015) to achieve long-term adoption and behaviour change (Halko & Kientz, 2010). Hereby, research reports that the challenge of successful e-Health interventions requires more design guidance and understanding of how-to tailor technologies to individual user demand (Halko & Kientz, 2010).

Persuasive Technology

Meeting individual user demands and increasing physical activity with personalized interventions has shown to be successful with persuasive technologies (Aldenaini, Alqahtani, Orji, & Sampalli, 2020). Persuasive technology defines as "Interactive information technology designed for changing users' attitudes or behaviour" (Oinas-Kukkonen & Harjumaa, 2009, p. 486). It can be used as a type of intervention associated with the COM-B model's motivational component to reach consumers with a tailored message and guide them toward a successful behaviour change (Mayne, 2018). As consumers vary in personal and environmental characteristics, they require different motivational cues. Research compiled behaviour change technique-taxonomies (Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Michie, Hyder, Walia, & West, 2011; Michie et al., 2013) to provide a comprehensive list of persuasive strategies for reaching consumers with individual differences. For instance, "cooperation" is one strategy for facilitating personalized behaviour change. Oinas-Kukkonen and Harjumaa (2009) made an effort to categorize persuasive principles and provided a comprehensive framework for designing and evaluating compelling systems. For their persuasive system design (PSD) model, they organized strategies in the categories of primary task support, dialogue support, system credibility support, and social support.

Uniquely social support has been identified as a mechanism for social processes that are reportedly influential for achieving and maintaining healthy behaviour, including physical activity (Mollee & Klein, 2016; Stevens, Cruwys, & Murray, 2020). As an example, how healthcare applications could consider social support, a system may facilitate users to share their latest run and compare themselves with friends on challenges (e.g., fastest 5km run of the week). Despite the positive relation between social processes and a healthy lifestyle, there are gaps in the literature on how to apply such processes to persuasive behaviour change interventions (Mollee & Klein, 2016). Additionally, behaviour change interventions in the health domain lack consistent findings of the effectiveness (Free et al., 2013; Marcolino et al., 2018), which emerge due to a lack of replicability and accumulation of evidence across empirical studies (Michie et al., 2011). Also, disregarded individual differences in response to persuasive strategies are made responsible for conflicting results (Kaptein, Lacroix, & Saini, 2010). The unexhausted potential of using social support for physical activity promotion, resulting from limited and inconsistent knowledge about effective personalized intervention content, suggests improving the understanding when, for whom, which message works (Kaptein, Markopoulos, de Ruyter, & Aarts, 2015). This study aims for findings that benefit the development of efficient healthcare applications. In this paper, four design principles were chosen from the PSD model's social support category to explore their acceptability in the physical activity context. The chosen strategies were social comparison, cooperation, competition, and recognition. Personality was chosen as an individual factor to determine whether the acceptability of those strategies differs for people with different personality traits.

Personality as an individual User Difference

Personality qualifies as a relatively stable personal characteristic in adults (Rhodes, Courneya, & Jones, 2004). Additionally, it is an underlying key factor in behaviour formation regarding physical activity (Boersma, Benthem, van Beek, van Dijk, & Scheurink, 2011). Personality describes individual differences in tendencies to show preferences (Youyou, Kosinski, & Stillwell, 2015), and expression of consistent feeling patterns, thoughts, and actions (McCrae & Costa, 1990; Rhodes & Smith, 2006). The five-factor model (FFM) refers to five dimensions as a description for these tendencies. These dimensions are labeled as Extraversion (tendency to be outgoing, activity, assertiveness), Openness to experience (openness to new ideas, values), Neuroticism (vulnerability, anxiety, and depression), Agreeableness (altruism, compliance, linked with generosity), and Conscientiousness (achievement striving, dutifulness, order, and self-discipline) (McCrae & Costa, 1990; Costa

& McCrae, 1992; De Bruijn, de Groot, van den Putte, & Rhodes, 2009). Regarding the use of FFM in health behaviour determinant research, considerable studies found support for significant involvement of personality characteristics in the acceptance of persuasive strategies in the context of physical activity (Arteaga, Kudeki, & Woodworth, 2009; Anagnostopoulou et al., 2017; Eysenck, 1954; Gerber, Huber, Doherty, Dowling, & Panagopoulos, 2013; Hovland, Janis, & Kelley, 1953; Halko & Kientz, 2010; Rodes & Smith, 2006; Wilson & Dishman, 2015). Consistent with this finding, Courneya and Hellsten (1998) found that exercise behaviour, motives, barriers, and preferences associate with the FFM personality dimensions. For example, conscientious people reportedly have a general preference to exercise (Friedman et al., 1995).

Regarding the acceptability of social support strategies for the five personality dimensions, Halko and Kientz (2010) found that a higher Conscientiousness score increases the likelihood of use, for competitive and cooperative strategies. For Agreeableness, the researchers found positive opinions toward the competitive strategy. Finally, an increased score in Openness is associated with a preference for the competitive strategy. The discussed findings let assume that people with divergent personalities accept different motivational cues to get active. In this case, personality-tailored interventions for physical activity may work to fit better the users' need for persuasive technologies (Rhodes & Smith, 2006; Halko & Kientz, 2010; de Vries et al., 2017). Although personality identifies as a significant behavioural determinant for physical activity, the domain's interventions do not commonly utilize this factor (de Vries et al., 2017). Additionally, research lacks focus on social support and social comparison (Mollee & Klein, 2016). Specifically, extraverted and conscientious adults may prefer social comparison, or even recognition as persuasive strategies, as they characterize by assertiveness (Costa & McCrae, 1992; John, Naumann, & Soto, 2008).

This study investigates the association between adults' personality traits and their perceived acceptability towards persuasive strategies from the social support category employed by a mobile fitness application. In line with the given explanations and the findings by Halko and Kientz (2010), the following research question and hypotheses were derived.

Research Question

To explore the relationship between adults' (18-60-year-olds) *personality characteristics* and the *perceived acceptability* towards the behaviour change techniques, *social comparison, cooperation,* and *competition, and recognition.*from the PSD model in the context of physical activity.

H1: The behaviour change technique of *social comparison* is perceived as most acceptable by individuals with an increased score in Conscientiousness and Extraversion

H2: The behaviour change technique of *cooperation* is perceived as most acceptable by individuals with an increased score in Conscientiousness

H3: The behaviour change technique of *competition* is perceived as most acceptable by individuals with an increased score in Conscientiousness, Extraversion, Agreeableness, and Competitiveness

H4: The behaviour change technique of *recognition* is perceived as most acceptable by individuals with an increased score in Conscientiousness, and Extraversion

Methods

Design

A cross-sectional survey design was employed to study the association between personality traits and perceived acceptability of persuasive eHealth strategies. The persuasive strategies were represented in four storyboards designed by Halko and Kientz (2010) and Beerlage, Wrede, van Gemert-Pijnen, and Sieverink (2017). This paper chose storyboards as they provide an understandable and readable visual language for individuals from diverse backgrounds (Van der Lelie, 2006). All of the used storyboards illustrated different mobile-based persuasive technologies promoting physical activity.

Participants

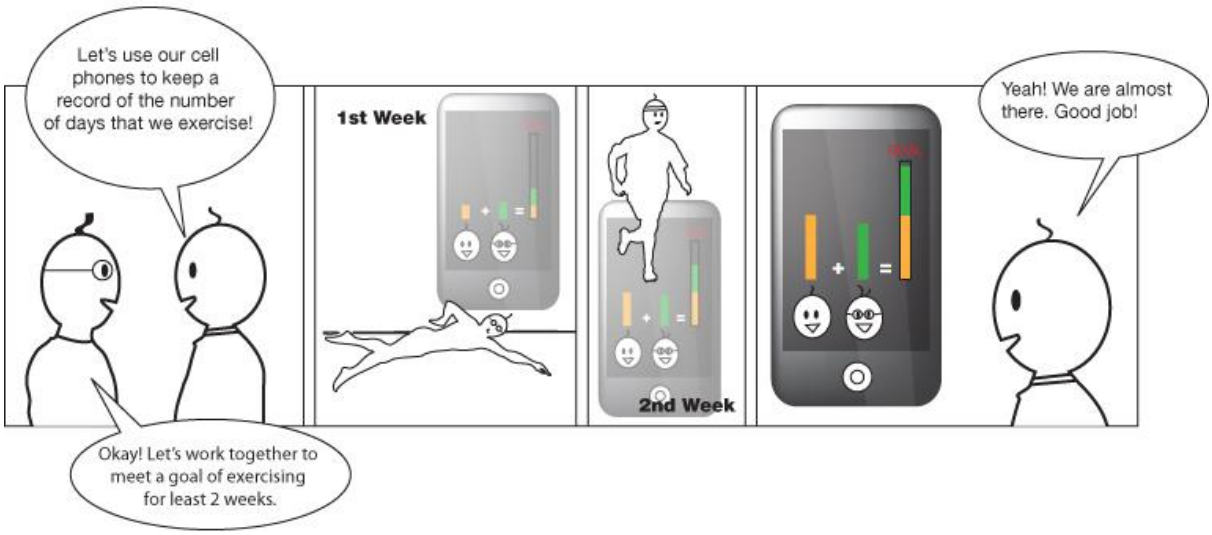
The study included participants from age 18 to 60 years, who were able to provide written, informed consent in English and completed the survey. Participants were excluded from the study if they exceeded the age span or had too many missing values. The ideal sample size was expected to be 385, based on the large, but unknown population size, a set confidence interval to 95%, and a standard deviation of 0.5. To reach the expected number of participants, the researchers spread the survey on several platforms. In total, 116 participants signed up, and thereof 34 had to be removed. This left 79 valid participants (M_{age}=25.24, SD_{age}= 7.9). All of the participants were recruited through non-probability sampling. 34 participants were recruited with convenience sampling from the Sona-Systems platform, a tool to expand the survey's reach within the faculty of behavioural science of the University of Twente. The researchers approached additional participants with convenience sampling by direct messaging via WhatsApp, Facebook, and Instagram. The remainder of the respondents were reached with snowball sampling by allowing participants to share the survey and thereby recruit others for the study.

Materials

The materials consisted of a survey, including four components. The first component entailed the acquisition of demographic information. Respectively the age, native country, and gender was asked from the respondents. The measured variables were perceived acceptability, personality, and physical activity. The dependent measures taken were the perceived acceptability of different persuasive design features, the Ten-Item Personality Inventory (TIPI) by Gosling, Rentfrow, and Swann (2003), and the Physical Activity Questionnaire short form (IPAQ-SF) by Craig et al. (2003).

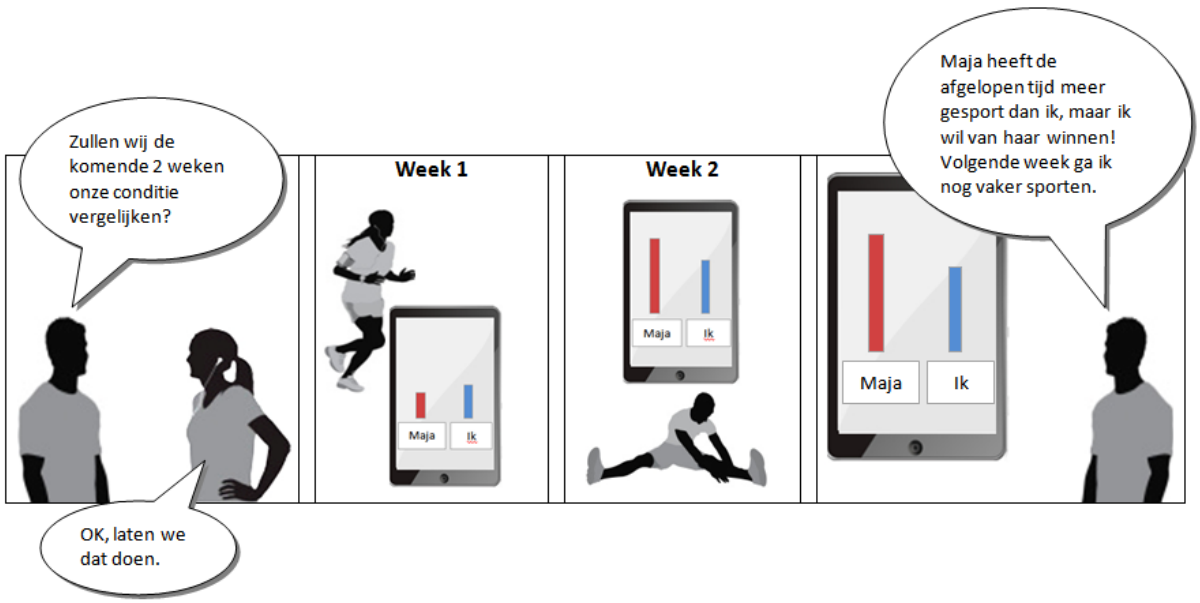
Storyboards. Four storyboards were taken, representing the social support context of the persuasive design model (PSD). The persuasive features, explained by Oinas-Kukkonen and Harjumaa (2009), were measured with the storyboards including social comparison, recognition (Beerlage, Wrede, van Gemert-Pijnen, & Sieverink, 2017), as well as cooperation and competition (Halko & Kientz, 2010). Figures 1,2,3, and 4 show the storyboards used.

Figure 1. *Cooperation*



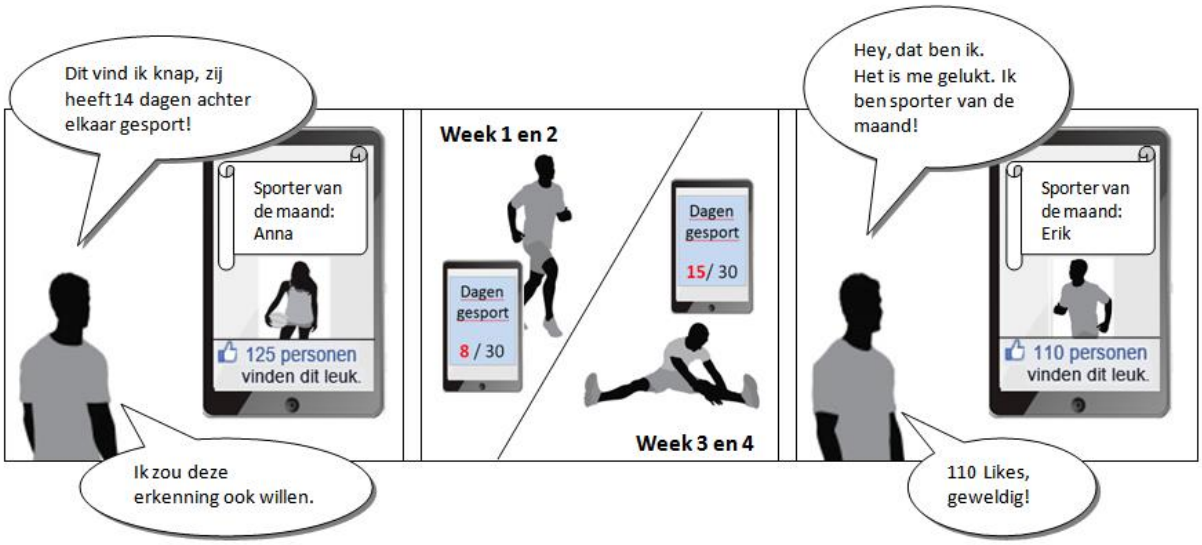
Note. Storyboard illustrating cooperative social feedback

Figure 2. *Social Comparison*



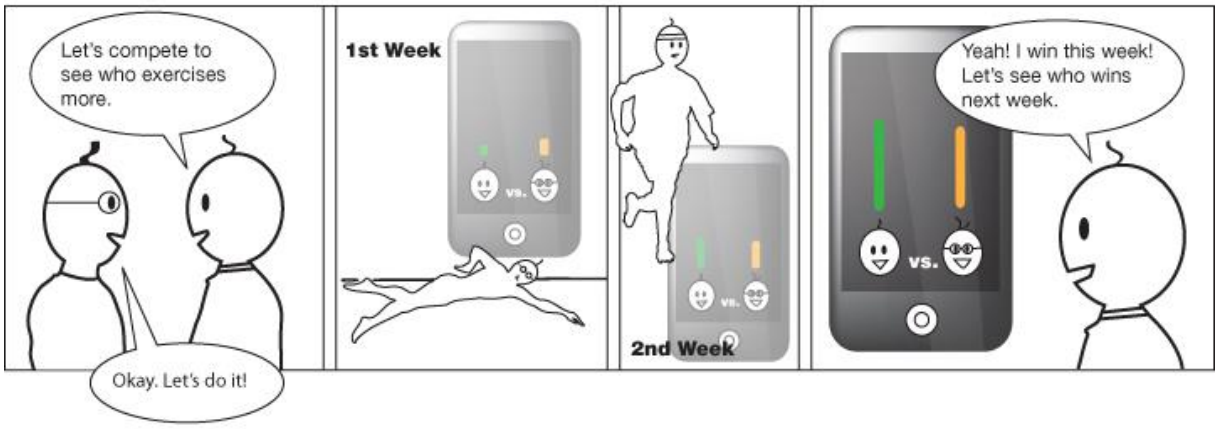
Note. Storyboard illustrating social comparison

Figure 3. *Recognition*



Note. Storyboard illustrating recognition

Figure 4. *Competition*



Note. Storyboard illustrating competitive social feedback

Perceived Acceptability. Each storyboard depiction was followed by a measurement, indicating the level of agreement with the persuasive strategy shown. With this, the respondents were assigned the acceptance of technology questionnaire used by Halko and Kientz (2010), consisting of seven items. The first six items were 5-point Likert-scale questions probing the users' opinions on the persuasive strategies in terms of 1) enjoyment; 2) the likelihood of use, 3) helpfulness; 4) quality of life; 5) ease of use and 6) time savings. The seventh item was an open-ended question leaving space for the respondent to write down

additional remarks. An example item of the questionnaire was Enjoyment: *"This technology is something that I would: (5-Really enjoy using, 1-Really dislike using)".* For each storyboard, the sum of perceived acceptability items was computed for a new variable representing an average perceived acceptability score for each persuasive strategy. The scale was found to be excellently reliable for each persuasive strategy, respectively social comparison (α = .90), cooperation (α = .92), competition (α = .92), and recognition (α = .90).

Personality. The Ten-Item Personality Inventory (TIPI) by Gosling et al., (2003) was presented to briefly assess the Big five dimensions of personality (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness). The TIPI scale consists of 10 items (α = .53) on a 7-point Likert scale ranging from 1 (*Disagree strongly*) to 7 (*Agree strongly*). An example item to measure personality dimensions with the TIPI was*: "I see myself as extraverted, enthusiastic*." (See Appendix A for the complete set of items). The reversed items two, four, six, eight, and ten were recoded, and used to compute the subscales for each trait. According to Gosling et al. (2003), the convergent validity between the TIPI and Big-Five Inventory (mean *r* = .77) exceeds the discriminant correlations (absolute mean *r* = .20). Further, strong convergent correlates, ranging from .68 for Conscientiousness to .56 for Openness, exist between the TIPI and the NEO-PI-R scale. The test-retest reliability for the TIPI is acceptable (mean *r* = .72).

Physical Activity. The International Physical Activity Questionnaire – Short Form (IPAQ-SF) by Craig et al. (2003) was utilized as an internationally suited estimation for total physical activity in MET-min/ week. The 7-item short-form includes closed and open-ended questions surrounding individuals' last 7-day recall of physical activity (Craig et al., 2003), and groups the activity in four intensity levels: 1) vigorous-intensity activity such as aerobics, 2) moderate-intensity activity such as leisure cycling, 3) walking, and 4) sitting. An example item from the measurement of vigorous-intensity activity was: "*During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?"* (See Appendix B for the complete set of items). For the scoring of the IPAQ, any responses to duration (time) provided in the hours and minutes response option were converted from hours and minutes into minutes. This value of minutes per week being active or sedative was calculated into the MET-value, which presents the amount of energy consumed by carrying out different activities. Subsequently, continuous analyses were conducted due to the non-normal distribution of energy expenditure. With the converted duration responses and predetermined MET values (weight score) provided by Ainsworth et al. (2000), new variables were computed, measuring the MET minutes per week for the three

categories, walking, moderate-intensity, and vigorous physical activity. The equations for MET-minutes per week appeared as Walking MET-minutes/week = 3.3 * walking minutes * walking days; Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days, and Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days. Based on the active time of participants, they were grouped in the categories low, moderate, and high (Forde, 2018). Participants were categorised in high activity level if they were vigorously active on at least three days with a minimum of 1500 MET minutes a week or if they had seven days of any combination of walking, moderate-intensity or vigorous-intensity with a minimum of 3000 MET minutes a week. Participants were categorised in the moderate level of physical activity if either the participant fulfilled three or more days of vigorous-intensity and/or walking at least 30 minutes per day, or having five or more days of moderate-intensity and/or walking at least 30 minutes per day, or fulfilling on a minimum five days of any combination of physical activity achieving a minimum of total physical activity of at least 600 MET minutes a week (Forde, 2018). Craig et al. (2017) found the International Physical Activity Questionnaire to be of good stability and having a high internal consistency (α <.80), making it reliable measurement. In terms of validity, a systematic review by Lee, Macfarlane, Lam, and Stewart (2011) reported a negligible to small correlation in total physical activity with objective measuring devices (*Mdn* = 0.29).

Procedure

The BMS Ethical Committee of the University of Twente approved the application for conducting this study. After the ethical approval, the data collection took place between the 31st of March, and the 19th of May, through an Online Survey using Qualtrics software (Qualtrics, Provo, UT, 2019). Linked to this was Sona Systems, a cloud-based participant management software (Copyright © 1997 – 2020 Sona Systems Ltd.) to enlarge the reach of the study. Respondents to the Sona systems were credited 0.25 Sona points as compensation. The respondents answered the survey from the surrounding of their preference. To begin with the study, the participants were required to fill out an informed consent (see Appendix C) to ensure confidentiality. Hereby, the respondents were informed about the research purpose, their privacy rights, and data handling during the research. The contact information of the researchers was also on the consent form. Before being able to continue with the survey, the participants had to declare their understanding and agreement with the above-stated terms and that they are aware of the possibility of withdrawing from the study at any time without

providing a reason. The survey consisted of four components. The participants were expected to take 15 minutes to get through the survey, though no time limit was imposed.

In the first component, the respondents were asked for demographic information, such as age, gender, and heritage. Subsequently, the participants were presented the IPAQ to measure their self-reported physical activity during the week prior to the study partake. The third component consisted of the TIPI, measuring the big five personality dimensions. The final component made use of four different storyboards illustrating user/ app interactions with a mobile app aimed to facilitate physical activity, linked to the perceived acceptability questionnaire. Following each storyboard, the respondents were asked to rate the extent to which they agree with six statements indicating the perceived acceptability of the persuasive strategy shown in the corresponding storyboard. After the participants completed their indication for every storyboard, they reached the survey's end and were thanked for their time and honesty.

Data Analysis

The statistical program SPSS version 25 (IBM Corp., 2017) was used to analyze the dataset. In total, 116 responses were recorded by Qualtrics software. Data was cleaned, removing participants with any missing values on the measurement from the dataset. 79 complete responses remained for analyses. In the following, descriptive statistics were carried out to depict the socio-demographic characteristics of the participants. Mean, and standard deviation for the age, personality traits, and perceived acceptability were computed. The personality scores and perceived acceptability were tested for normal distribution via histograms and a Shapiro-Wilk test. A Spearman's rank Correlation Coefficient was computed to test the association between personality traits and perceived acceptability of the persuasive strategy's social comparison, cooperation, competition, and recognition from the social support category of the PSD model. A common significance level of $\alpha = .05$ was used.

Results

Socio-demographic Characteristics

In table 1, the sociodemographic characteristics of the sample are shown. The sample was relatively young (M_{age}= 25.24, SD_{age}= 7.9). 57 (72%) of the participants were female and 22 (28%) were male. The main nationality of the participants was German (66, 85%). The evaluation of physical activity levels from the IPAQ-SF showed that the sample sees themselves as physically active. The majority of the sample estimated themselves as highly physically active (46%), whereas 40% reported moderate physical activity. In contrast, the least people engaged in low physical activity during the last seven days prior participation in the study (14%). Moreover, the sample indicated a greater tendency to being open (*M*= 5.5, *SD*= 1.08), and the least preference for Extraversion (*M* = 4.86, *SD* = 1.44) compared to the other personality traits (see Table 1).

Table 1

Overview of the socio-demographic characteristics of the total sample (n=79)

Characteristic	n	Frequency (%)	*M (SD)*	Range
Age (in years)	79		25.24 (7.9)	18-58
Gender				
Male	22	28		
Female	57	72		
Country of origin				
Netherlands	5	6		
Germany	66	84		
Other	8	10		
Level of Physical Activity*				
Low	11	14		
Moderate	32	40		
High	36	46		
Personality				
Openness			5.55 (1.08)	
Conscientiousness			5.38 (1.16)	
Extraversion			4.86 (1.44)	
Agreeableness			5.06 (1.05)	
Emotional Stability			4.88 (1.23)	

*retrieved from the IPAQ-SF

Perceived Acceptability

The perceived acceptability scores for each persuasive strategy, namely social comparison, cooperation, competition, and recognition were calculated. The scores on each persuasive strategy were found to be non-normally distributed ($p < .05$). In table 2, the median scores for the persuasive strategies are shown. The sample liked the cooperation strategy best with a median of 3.2 *(IQR* = 2.4 – 4.0*).* However, considering the 5-point Likert scale, a score

of 3.2 is not high. The least accepted strategy was recognition, with a median of 2.3 *(IQR* = 1.5 – 3.1).

Table 2

Acceptability of the four BCT's (Comparison, Cooperation, Competition, and Recognition)

Acceptability Scores[1]	Strategy	Mdn (IQR)
	Comparison	3.0 (2.4 – 4.0)
	Cooperation	3.2 (2.4 – 4.0)
	Competition	3.0 (1.8 – 4.0)
	Recognition	2.3 (1.5 – 3.1)

[1] *Values were based on the acceptance of technology questionnaire*

[2] *IQR = interquartile range = 25th -75th percentile*

Associating Personality Traits with Persuasive Strategies

Correlational analyses were conducted to test the association between personality characteristics and perceived acceptability. It can be read from Table 3, that for three out of four persuasive strategies, no association was found between personality and acceptability of that strategy. Only for the persuasive strategy social comparison, significant (though weak) correlations were found with two personality tracks: People high in Conscientiousness, and people high in Extraversion felt more attracted to the storyboard depicting social comparison. Thereof, the highest association among the calculated values was found to be between Conscientiousness and social comparison ($r(77) = .29$, $p = .013$). This finding indicates that organized and self-disciplined respondents like to compare themselves with others. Besides that, the significant correlation between Extraversion and social comparison ($r(77) = .25$, $p = .014$) indicates that outgoing, social persons tend to prefer comparing themselves with others regarding their physical activity.

Table 3

Comparing the correlation between the five personality traits and the perceived acceptability of the four persuasive strategies

	Social Comparison	Cooperation	Competition	Recognition
Openness	-.18	-.06	-.21	.09
Conscientiousness	.29*	-.19	-.15	.01
Extraversion	.25*	-.06	-.14	.05
Agreeableness	.14	.01	-.04	-.01
Emotional Stability	-.13	-.11	-.06	-.00

*p < .05

In summary, the findings show, that an association between the variables Extraversion and social comparison, and Conscientiousness and social comparison was established, indicating that people scoring high on these traits prefer social comparison as an acceptable strategy to engage in physical activities. Further, an association between personality and perceived acceptability of social support could not be confirmed for the behaviour change techniques cooperation, competition, and recognition.

Comparison with Norms

To classify the scores on the significant personality dimensions associated with the perceived acceptability of social comparison, mean scores were calculated for the personality characteristics Extraversion and Conscientiousness (see Table 4). Compared to the norm scores provided by Gosling, Rentfrow, and Potter (2014), this study's collected responses were on average higher for both dimensions. This indicates that the sample scored above the average on the personality dimensions Extraversion and Conscientiousness.

Table 4

Comparing the average scores on the personality dimensions Extraversion and Conscientiousness with the Norm scores by Gosling, Rentfrow, and Potter (2014)

		Study Scores		Norm scores	
Age Group		Extraversion	Conscientiousness	Extraversion	Conscientiousness
> 20	*n*	18	18	134621	134621
	M	5.42	5.56	3.93	4.47
	SD	1.34	1.22	1.57	1.41
21 to 30	*N*	51	51	87267	87267
	M	4.66	5.24	3.90	4.68
	SD	1.41	1.16	1.58	1.40
>31	*N*	8	8	54322	54322
	M	4.80	5.17	4.02	5.07
	SD	1.62	0.75	1.58	1.35

Note. Adapted from "Norms for the Ten Item Personality Inventory" by Gosling, S. D., Rentfrow, P. J., & Potter, J., 2014. Unpublished Data.

Discussion

The present study aimed to explore the relationship between personality traits from the five-factor model and perceived acceptability of four persuasive strategies from the social support category of the PSD model in the context of physical activity. No significant associations were found between the behaviour change techniques cooperation, competition, recognition, and the five personality factors. Therefore H2, H3, and H4 are rejected. In contrast, the study found a significant association between Conscientiousness and social comparison, as well as Extraversion and social comparison. Therefore, H1 is supported. It is notable that the respondents scored above the average on Extraversion and Conscientiousness and were a physically active sample.

The negligible correlation found between Openness, Agreeableness, Emotional Stability, and the persuasive strategies cooperation, competition, and recognition were surprising. Especially the findings on cooperation and competition were unexpected, as they contradict Halko and Kientz (2010), who found significant correlations for both traits in the context of physical activity. The contradictory findings may be due to demographic sample differences that influence user preferences (Sherwood & Jeffery, 2000). The significant

associations between Extraversion and social comparison, as well as Conscientiousness and social comparison, was expected as conscientious people characterize with assertiveness, and an aim for achievement against expectations (Costa & McCrae, 1992). Both characterizations are applicable for comparing oneself with others, for instance, for boosting one's self-view or by motivating improvement (Mollee & Klein, 2016). Also, Conscientiousness predicts the performance of health behaviour (Lodi-Smith et al., 2010), and a general tendency to exercise (Friedman et al., 1995) across a lifetime (Reiss, Eccles, & Nielsen, 2014). Second, people scoring high on Extraversion are generally highly sociable (McCrae & Costa, 2003), assertive (John et al., 2008), and due to an increased social media consumption (Blackwell, Leaman, Tramposch, Osborno, & Liss, 2017; Kuss & Griffiths, 2011) likely to compare themselves with others across domains (Nortje, 2020). In the context of physical activity, a low score on Extraversion indicates a disinterest in social gatherings, and the avoidance of engagement in physical activities (Rhodes & Smith, 2006). However, the findings contradict Halko and Kientz (2010). The researchers did not find any positive correlations between Extraversion and persuasive strategies, which led them to conclude that the availability of large social networks replaces the need for extraverts to use technology for goal achievement. The findings of this study disagree with this conclusion, as the social comparison strategy positively correlated with Extraversion. Apart from the context of physical activity, Anagnostopoulou et al. (2017) explored the links between persuasion, personality, and mobility types and neither found Extraversion, nor Conscientiousness to be significantly associated with the preference for persuasive strategies to use certain mobility types. This finding may indicate that the success of persuasive strategies for personality traits varies across contexts.

Limitations and Strengths

Concerning the study limitations, the recruitment of participants considers as a drawback of this research. Participants were free to join the study regardless of their physical activity level. At the outset of this paper, physical inactivity and sedentary behaviour were thematized as factors for global health problems that require healthcare interventions. As the sample identified as a very physically active, the study's findings might not be applicable for inactive people. Thus, intervention designs focused on reducing physical inactivity in people lacking physical activity might not necessarily benefit from this study's findings. To prevent this limitation from being a threat to future research, studies should consider the impact of physical activity levels on perceived acceptability. Also, physically inactive adults should be

targeted.

Another drawback of this study was the restricted use of storyboards being the only format. Depicted formats can influence the conveying of persuasive strategies, such as videos (Sellen, Massimi, Lottridge, Truong, & Bittle, 2009), or in-person interactions. Some people might have disliked the format or content shown in the storyboards, such as people who do not associate themselves with running. The potential rejection could have negatively affected scores on the perceived acceptability scale. An improved approach could consider several formats and measure the participants' interest in the subject. Another possible issue is that some participants might have had problems understanding the four storyboards. The storyboards have not been validated, so the design or content could have led to misunderstandings. That means that it is not clear if participants answered the concept that was intended for them to be answered. Based on this assumption, invalid results could have been drawn, due to underestimating an underlying effect. A manipulation check for the materials could help to detect misunderstandings.

Regarding positive aspects of this research, the study established positive associations between social comparison and the personality traits Conscientiousness and Extraversion. In detail, the findings indicate that young, physically active adults who score above the average on Conscientiousness and Extraversion are more likely to prefer social comparison as a persuasive strategy integrated into mobile fitness applications to guide their physical activity performance. Vice versa, as people are increasingly introverted or adaptable (opposite of Conscientiousness), social comparison as a compelling strategy is less likely to be accepted. Based on this study's results, system designers can improve developing personalized mHealth technologies for people who have a conscientious or extraverted personality trait to keep track of their exercise schedules and maintain a healthier lifestyle.

Implications for Future Research and Practice

Based on the previously discussed findings, it is recommended to intensify the research about personality as a factor for personalized fitness applications. First, the study dealt with an active sample. Future research should also target physically inactive groups for the development of persuasive mHealth technologies. Cohort studies could compare the persuasive preferences between groups of people with similar personality traits, but differences in physical activity level. This study focus might be essential to detect behaviour change techniques that work for people with a common personality type but lack physical activity. The findings may then be utilized to counteract physical inactivity and sedentary

behaviour, thereby lowering the health risks associated with it (Neuhauser & Kreps, 2010).

Using the findings for Conscientiousness and Extraversion can also help develop personalized healthcare applications to tackle the global problem of an increasingly sedentary lifestyle. Specifically, Conscientiousness predicts cardiovascular health behaviours, such as exercise (Bogg & Roberts, 2004). On the other hand, people who are not conscientious tend to have poor health outcomes, for instance, being at higher risk of suffering cardiovascular diseases (Lodi-Smith et al., 2010). Concerning that, researchers can look for an appropriate strategy to persuade people that score low on Conscientiousness, to specifically improve their health behaviour, which could prevent negative health consequences. Another implication for future research is an extended approach towards researching the field. Instead of sticking to storyboards, researchers should utilize different formats. As storyboards usage is just one way of conveying persuasive strategies, other formats such as videos (Sellen et al., 2009) could be deployed to compare the user feedback for both formats. This approach would require interactive exchanges with users, as consistent feedback from users can help persuasive system design developers in a joint effort to create user-friendly technologies (van Gemert-Pijnen et al., 2011). Finally, personalization efforts should not just be focused on means – ways in which a specific group of people (e.g., people high in Extraversion) can be influenced. Instead, the means can be complementary for other efforts of tailoring persuasion. For example, computer-tailored health education (Brug, Oenema, & Campbell, 2003) also focuses on setting realistic health goals for the current individual (Kaptein et al., 2015).

Conclusion

Overall, the study demonstrates that the preference for specific behaviour change techniques depends on individual user differences. Personality characteristics are significantly involved in adults' user demand for social support to use fitness applications. Young, physically active adults with an increased score on extraversion and/or conscientiousness seem to prefer social comparison to maintain a physically active lifestyle. Vice versa, a lower score on both traits indicates a rejection to use social comparison in fitness applications. Future research should further examine the interplay of individual user differences to offer individual programs for individual circumstances. To create a better fit between technological, human, and contextual factors, the study recommends an approach that emphasizes the interdependence between behavioural determinants. In the end, the rationale remains, "What works, how well, for whom, in what settings, for what behaviors, and why?" (Michie, Yardley, West, Patrick, & Greaves, 2017, p. 9).

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Appendices

Appendix A

Ten-Item Personality Inventory

Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
1	2	3	4	5	6	7

I see myself as:

1. _____ Extraverted, enthusiastic.
2. _____ Critical, quarrelsome.
3. _____ Dependable, self-disciplined.
4. _____ Anxious, easily upset.
5. _____ Open to new experiences, complex.
6. _____ Reserved, quiet.
7. _____ Sympathetic, warm.
8. _____ Disorganized, careless.
9. _____ Calm, emotionally stable.
10. _____ Conventional, uncreative.

TIPI scale scoring ("R" denotes reverse-scored items): Extraversion: 1, 6R; Agreeableness: 2R, 7; Conscientiousness; 3, 8R; Emotional Stability: 4R, 9; Openness to Experiences: 5, 10R.

Appendix B

International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

No vigorous physical activities Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day _____ minutes per day

Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

No moderate physical activities Skip to question 5

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

4. How much time did you usually spend doing moderate physical activities on one of those days?

_____ hours per day _____ minutes per day

Don’t know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____ days per week No walking Skip to question 7

6. How much time did you usually spend walking on one of those days?

_____ hours per day _____ minutes per day

Don’t know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?

_____ hours per day _____ minutes per day

Don’t know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix C

Informed Consent

Dear participant,

Thank you for participating in our online survey!

Your participation will take about 15 minutes. Participation is restricted to those who are 18 years or older (max. 60).

This research aims at finding out more about the relation between the perceived acceptability of different strategies that are commonly employed in mHealth/ m-mental health interventions, and individual user characteristics such as personality, socio-demographic factors or stages of change.

There are no risks to you from this research. Your participation is entirely voluntary. Should you at any time choose to withdraw from this study, you will be allowed to do so.

Your answers will be handled confidentially. Responses are saved anonymously and may eventually be presented in a research publication.

Please answer the questions as honestly as possible. There is no right or wrong answer.

If you have any questions, feel free to send an email to s.wehrmeyer@student.uwente.nl. to write the question text

I read and understood all the above mentioned and agreed to participate in the study. Further, I partake out of my own free will and I am informed that I can withdraw from the study at any time without providing a reason.