Using Individual and Collaborative Challenges in Behavior Change Support Systems: Findings from a Two-Month Field Trial of a Trip Planner Application

Johann Schrammel[1(✉)], Sebastian Prost[1], Elke Mattheiss[1], Efthimios Bothos[2], and Manfred Tscheligi[1,3]

[1] AIT – Austrian Institute of Technology, Vienna, Austria
{Johann.Schrammel,Sebastian.Prost,Elke.Mattheiss,
Manfred.Tscheligi}@ait.ac.at
[2] NTUA- National Technical University of Athens, Greece
mpthim@mail.ntua.gr
[3] University of Salzburg, Austria
manfred.tscheligi@sbg.ac.at

Abstract. Besides other popular strategies, such as feedback and (social) comparisons, challenges have been proposed and used to influence people's behavior towards a targeted goal. However, only very limited data on the effectiveness of such approaches and how to best design them is available yet. In this work we report the findings of a two months field study analyzing the effectiveness and perception of challenges in the context of influencing personal mobility. Individual and collaborative approaches towards challenges were studied, and specific focus was laid on what aspect makes users willing to participate in these challenges. Our findings suggest that both individual and collaborative challenges have the potential to sustain the interest of users in using behavior change support systems, that collaborative and individual challenges seem to not attract different types of users, that individual challenges in general are preferred, and that challenges are only a useful means for a subset of users. Also, ICT-competence seems to be an important aspect of being willing to participate in electronically organized challenges.

1 Introduction

Sustainable mobility choices are an important aspect of achieving a greener lifestyle. Within the last couple of years different behavior change support systems (BCSS) have been proposed and introduced addressing this issue, e.g. [1, 2]. A concept utilized in this context has been the introduction of challenges i.e. to provide users with a set of behavior-goals, were they can voluntarily decide whether to accept or decline the challenge. This approach is based on the background of goal-setting theory [3, 4]. Typically such implementations are combined with social comparisons, which allow users to participate and engage in pre-defined challenges posed by some mediating instance (typically the provider of the BCSS) and to compare their success (and compete) with others. Whereas such approaches are common, surprisingly few empirical data on their actual performance and empirically funded guidelines for the design of

T. MacTavish and S. Basapur (Eds.): PERSUASIVE 2015, LNCS 9072, pp. 160–171, 2015.
DOI: 10.1007/978-3-319-20306-5_15

such challenges exist. Questions like how to best frame these challenges, whether to better organize them in an individual or collaborative manner, how to tailor them towards specific user groups still remain largely unanswered from an empirical perspective.

We addressed some of these aspects in our work, and this paper reports the findings of an empirical study which researches the influence of different types of challenges and the user's characteristics on the effectiveness, perception and acceptance of challenges in the context of behavior change support systems in personal mobility.

In the following sections we first provide a review of relevant related work from different perspectives, especially persuasive strategies, goal-setting theory and behavior change in personal mobility. We then picture the PEACOX-System, which was used in the field trial and formed the basis for the conduction of this study. Next we describe the study methodology and report the main findings. The paper closes with the discussion of results and provides conclusions for future applications of and research on challenges in persuasive systems.

2 Related Work

Persuasion using technological support tools has been studied in depth for numerous years now, and a substantial body of knowledge has been generated. Different strategies to persuade people have been proposed and identified (e.g. [5, 6]), and have been applied in different application domains, e.g. health, energy consumption, personal mobility, etc. Torning and Oinas-Kukkonen [6] provide an overview and ranking of the most used design principles, and almost all strategies relevant for the design of challenges (e.g. feedback/self-monitoring, (social) comparisons, suggestions and personalization) are included within the top-ten of this list.

Sharing. Sharing ones progress with regard to set goals and making the commitment to achieving the goal public has been suggested as means for increasing the effectiveness of goal-setting approaches and has been used in numerous persuasive systems. Sharing has been found to have positive effects in several systems (e.g. [7, 8]), but research also showed that sharing with strangers is not always motivating and might sometimes be perceived as awkward [8].

Comparisons. Sharing ones results e.g. of participation in challenges also implies the possibility for social comparison. Persuasive systems frequently explicitly design for this aspect, e.g. by displaying the individual achievements contrasted with other users [11]. Comparisons have been especially popular in the field of energy consumption, and research studying the consequences of this approach comes to conflicting results [12]. There is indication that comparative approaches might increase the effectiveness in some cases, but also evidence has been presented that indicates direct comparison to other users actually might have detrimental consequences in unfavorable conditions. One possibility to avoid such negative effects is to tailor the interventions towards the user.

Personalization/Tailoring. Personalization and tailoring refers to the adaptation of the persuasive measures and approaches towards the individual person, situation and

usage context. This strategy has been frequently suggested as means to increase both the impact and acceptance of persuasive systems [13]. Also research on identifying persuadability factors has been introduced in order to provide a solid framework for designing and applying tailoring and personalization in practice [14].

Challenges and goal-setting. Challenges are closely related to the concept of goal-setting, and can be understood as a special case thereof. Goal-setting theory was originally developed within an organizational context and showed that specific and hard goals lead to better performance results than easy and unspecific goals [3, 4]. Especially the question of how to define the goal is of major importance. Building on goal-setting theory Consolvo et al. [15] explored the preference of users on different goal sources (self-set, assigned, participatory, guided or group-set) and goal timeframes (fixed weekly scheme versus rolling time-window). Unfortunately no actual behavior data is available in this study, but an analysis of self-reported preferences indicates that self-set goals are preferred, but also that interesting design opportunities for guided and group-set approaches exist. Besides source and timeframe also the role of different defaults in the goal setting process has been researched recently [16]. In the context of energy saving in the household the study found that default goals can lead to significant savings, and that it is important to choose the right defaults as both too low and too high goals have detrimental effects on the behavior.

If the goal-setting is not done directly by the user, but the system presents the user with goals to achieve this is typically labeled challenges. Similar to classical goal-setting for challenges it seems to be important to achieve the correct level of difficulty as well as a close match to the user's intrinsic goals [22].

Using teams rather than individuals has also been suggested to improve persuasiveness [19]. Consequently, team-based challenges are used in several systems, however only very limited data on their performance or guidelines for their design exist.

Personal mobility and behavior change. In our work we research challenges in the context of influencing mobility behavior. Early systems in this domain typically tried to motivate behavioral changes by means of tracking the effects of existing mobility behavior and providing feedback on the ecological footprint of a given route, expressed in different ways, e.g. as gasoline consumption, CO_2 values, or associated emissions of other environmental pollutants, see e.g., [1] and [21]. Such approaches are now very common, and many commercial routing services and web sites already provide this information for everyday use. A common approach is to use these numbers to compute an overall score, which then can be expressed in a more appealing and persuasive way (e.g. a plant growing or the size of an ice floe [1], or a virtual fish [9], etc.). Reitberger et al. [20] use implicit and peripheral cues in the user's environment that provide indicators about the environmental pollution to influence mobility decisions. Also, elements of gamification have been used in the context of personal mobility. For example, Jylhä et al. [22] designed a system that implements personalized challenges which are constructed through automated sensing of travel behaviors whereas Broll et al. [23] describe a system that provides visualizations which illustrate users' performance with regard to saved money, CO2, health, and collected points derived from mobility data.

3 The PEACOX System

PEACOX [26] is a mobile travel planning application, which builds upon the described approaches. Its main design goal is to support the user in engaging in more sustainable travel mode decisions. The PEACOX app allows the user to perform a multi-modal search for a route, which is tailored to the user's individual preferences and behavior patterns. In general, it works like a common journey planner. An origin and a destination are specified and then possible routes are suggested. When routes are requested in PEACOX the available alternatives are enriched with emission information. The enriched results are then ranked and personalized by a recommender engine [10]. Recommendations are partially based on the users' individual trip history that is detected from recorded GPS and accelerometer data. Selected eco-friendly route options are promoted by adding an encouraging message. When clicking on a route all details are displayed, that is walking-, driving- and waiting times, public transport line and schedule. After that the routes can also be viewed on the map. Individual statistics regarding the used trip modes and produced CO_2 can be accessed, and the user's relative performance compared to their own previous behavior is measured and represented by a growing or shrinking tree.

The journey planner is implemented as a smartphone application for the Android platform version 4.0 and higher. Challenges were implemented as part of this overall system and were integrated with the rest of the functions. A specified screen within the application provided all necessary information (cf. Figure 1 below). Messages informing the users about new challenges or the outcome of prior ones could be pushed to the users. Messages were also shown in the Android notification bar and supported links, which could be easily followed by a tap.

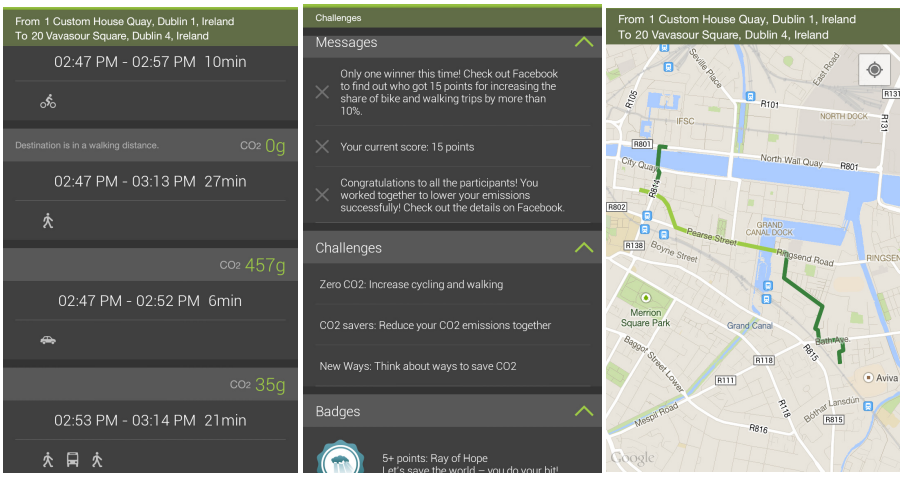

Fig. 1. Screenshots showing key elements of the PEACOX system. Route search results screen (left), overview-screen related to challenges (middle), and route in map view (right).

4 Research Questions and Method

As described above the PEACOX-System provided the basis for the study in order to address our research goals. In detail we wanted to answer the following main research questions with our work:

a) Are challenges a successful means to sustain interest and motivation of users for engaging with behavior change support systems?

b) Is there a main difference in whether challenges are framed on an individual or a collaborative level?

c) How do different types of individuals react to different types of challenges, and what are the design implications of such differences?

In order to answer these questions und to test the overall acceptance and impact of the system we conducted a two month field trial (August & September 2014) with 37 participants in two European cities (Vienna and Dublin). Collaborative and individual challenges were organized, and data regarding usage, success and subjective experience was collected. In the following paragraphs we provide the details on this study.

Participants. Participants were recruited from a database of people interested in taking part in usability and user experience studies and by open calls for participation promoted in university lectures and university mailing lists. Prospective participants had to fill in a screening questionnaire, and only were recruited in case they fulfilled the following predefined criteria: age 18 or older, living and working/studying in the test area (Vienna respectively Dublin metropolitan area), users of an Android smart phone (running Android OS 4.0 or newer) for at least three months, must have an associated data plan with a minimum of 500 MB per month, and during the eight weeks of trial plan to be absent (e.g. holiday outside of the study regions) for no more than one week.

Altogether 37 participants (14 female, 23 male; 20 from Vienna, 17 from Dublin) between 19 and 69 years (mean=32.92, SD=12.48) took part in the study. 16 participants were employed, 12 were students, 4 were unemployed or retired, 3 were self-employed and 2 were on parental leave. Regarding their main transportation means 6 users reported to mainly use car or motorbike, 6 to use bicycles, 11 stated public transport, 5 walking and 9 didn't provide data on this question. A majority of users (29) already used a journey planning app prior to the study.

Average environmental concern [18] of the participants was moderately high (Mean 4.15, STD 0.68 on a scale from 1 low to 5 high). Scores on importance of social comparison [17] are in the medium range (Mean 3.19, STD 0.84, again scale from 1 to 5). On average the user group also had a rather high ICT-competence [25]: Mean 1.99, STD 0.50, scale poled inverse to prior ones with 1 indicating high and 5 low competence.

Procedure. After agreeing to take part in the trial, participants were invited to an introductory workshop which focused on instructing the users on the trial procedure, explaining the functionality and handling of the app and how participants were expected to use it. Participants were instructed to enable GPS-positioning and logging on their smartphones and to regularly charge the device.

During the field trial, after about three and six weeks of usage qualitative in-depth interviews concerning the usage of the app and the experiences made were conducted with most users (some were not reachable for the first interview). At the end of the trial participants were invited to focus groups to reflect on the experiences made.

Additionally online questionnaires were sent three times during the trial: at the beginning, in the middle and at the end. The questionnaires focused on demographic data, mobility behavior, application usage and and attitudes towards different transportation means and environmental issues.

Challenges. There were two different types of challenges used in the study. In the individual challenges participants had to achieve a defined goal on their own. In collaborative challenges participants could join a group, which had to achieve the defined goal together, with each participant contributing to the overall goal. Altogether there were three pairs of challenges; these pairs differed from each other only in the individual or collaborative aspect. All six challenges were presented to the participants.

Challenges were designed so they can be achieved by all mobility types. The following three challenges either framed in an individual or collaborative way have been used in the trial:

Challenge #1: Identify 2 (for individual) respectively 10 (for collaborative) specific possibilities to save CO_2 in personal transport. Please post your findings to the Facebook group.

Challenge #2: Try to lower your (individual or collaborative) CO_2 emissions by 10 percent compared to last week or try to reach a value below 20g/km.

Challenge #3: Try to increase your (individual or collaborative) kilometers for cycling and walking by 10% or try to walk or cycle 50% or more of your kilometers.

Participants were instructed that taking part in the challenges is voluntary. To announce the challenges to the participants, we set up Facebook groups and events and asked the participants to join them. To counterbalance the sequence of individual and collaborative challenges we created four Facebook groups (two for each study site), one starting with an individual challenge and one starting with a collaborative challenge. The challenges were posted as Facebook events in the groups. Additionally participants got a notification through the app with a link to the Facebook event.

During the field trial, every week (except in week one and five) a challenge was proposed to the participants. Each challenge lasted for five to seven days. The travel behavior of the participating users was analyzed in the middle and end of the challenge period. In the middle of the challenge period, we presented an intermediate result to the participants by posting in the respective Facebook event site. For each challenge we measured how many participants took part in them and how many succeeded.

All participants who wanted to take part in a challenge had to accept the event invitation. As a reward for succeeding in a challenge participants could earn points, which defined the reputation level of each participant. By winning challenges the participants could rise from “wannabe” to “eco guru”. In order to support motivation of participating in the challenges information regarding their status was made visible on the Facebook group page.

5 Results

5.1 General Usage and Perception of the Application

Before we analyze the data regarding our main research questions we want to report some general information on the overall usage and perception of the application in order to provide a sound background for the detailed understanding of the specific findings.

Usability and Satisfaction. The overall usability of the application was rated average to well in the middle of the trial (3.57±1.09 on a scale from 1 – totally disagree to 5 – totally agree on the statement "The system is easy to use"), and improved until the end of the field trial (3.97±0.84). Similarly the experienced usefulness ("The system is useful") improved from 3.73±0.96 to 4.06±0.68. This increase in perceived usability and usefulness is probably related to the increased familiarity of the users with the application.

Application Usage. After the trials participants were asked how often they accessed two important system parts: the summary feedback provided by the tree, and the general statistics page. Answer categories were the following: 1 - never, 2 - once, so far, 3 - once a month, 4 - once every other week, 5 - once a week, 6 - several times a week, 7 - every day. Reported usage frequency for both system parts was in the order of once per week (tree 5.35±1.64, statistics 4.58±1.50).

Additionally, access to different parts of the system was automatically logged. Figure 2 below shows the evolution of usage for the whole trial period. The data show only a slight decline of usage over time. This decline is much less pronounced than with prior versions of the system (which did not including challenges and statistics) tested in the field in similar conditions a year earlier. Also, logged access data is not 100% conform to the reports of the users. This is probably related to the fact that what might be perceived as one action actually results in several screen accesses.

The graph also shows comparatively small amount of screen accesses to the challenges overview screen. This should not be misinterpreted as lack of interest as all information presented there was also accessible either on the Facebook group page or as Android system messages. Access to these elements unfortunately could not be logged due to technical restrictions.

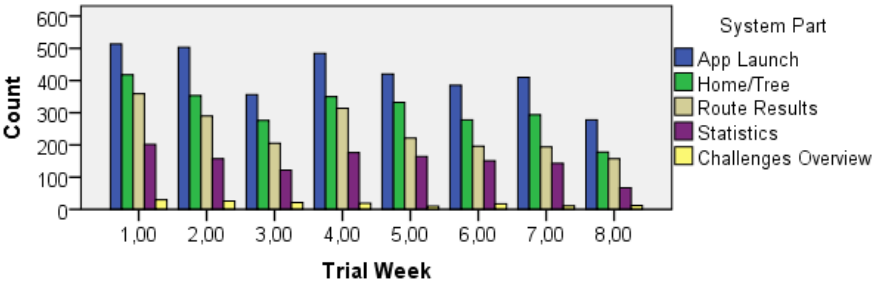

Fig. 2. Logged access numbers to different system parts during the trial period

5.2 Challenges

Overall Perception and Participation. Overall the challenges were perceived well by the participants, and a substantial amount of users participated in the challenges, although participation was voluntary. However, there seems to be a subgroup of users which did not like the challenges. Of our 37 participants 14 did not take part in a single challenge. Possible reasons for this behavior are analyzed in the section discussing factors influencing willingness to participate on the next page. Table 1 below provides an overview on the number of users that participated in the challenges over the duration of the field trial split according to individual versus collaborative challenge, and also provides information on how many of the accepted challenge were actually won.

Table 1. Participation and achievements in challenges

	Individual				Collaborative			
	Participated	%	Won	%	Participated	%	Won	%
Challenge #1	13	35.1	11	84.6	10	27.0	7	70.0
Challenge #2	15	40.5	8	53.4	12	32.4	9	75.0
Challenge #3	10	27.0	5	50.0	16	43.2	4	25.0
Total	38	34.3	24	63.2	38	34.3	20	52.6

Interest in participation in the challenges fluctuates somewhat (as has to be expected considering the limited number of users), but generally seems to continue over time and does not decline as might be expected. This is especially remarkable, as the app usage however slightly drops. This seems to indicate that challenges have the potential to better stimulate the long-term interest of users.

This interpretation is also supported by qualitative feedback collected in the interviews. Several users stated that the announcement of challenges worked as a reminder for them to keep using the app. As one user puts it: „It is motivating when you get 5 or 15 points as a reward. This is a motivational boost to keep using the app".

Moreover, the challenges helped some users to spur goals for greener mobility: "I'm trying to fit it in, to exercise, to see how much more exercise I can do compared to using the car. The challenges were enabling me to use the bike. It's good to do exercise and take part in a challenge".

Overall most participants liked the idea of the challenges, as they were seen as a way to raise awareness and rethink existing behavior patterns. The challenges were seen as an aid to make new experiences by pushing you to try out alternative modes of transport or routes: "[I participated] because it was fun […], because one is motivated to do things different, stop doing things by the book. […] You are encouraged to try something new. [Normally,] you just do these things out of habit".

Also, several users liked that the challenges posed also personal goals: "It was something to aim for. It's always nice to have targets, […] because you can't achieve anything without goals. So I tried to set myself little objectives, […] to be proud of achievements".

Individual versus Collaborative Challenges. Another question of our study was whether individual versus collaborative framing of challenges influences the willingness to participate in them. Table 1 above shows the average number of challenges the partic-

ipants took part in. As is already obvious from the identical means paired samples t-test does not show any difference at all (t_{36}=0, p=1.00). Participation in collaborative challenges was highly correlated with participation in the individual challenges (r=0.833).

We also explicitly asked which type of challenges the users preferred. 14 stated that they did not look at the challenges closely and therefore cannot answer the question. About half of the remaining users did not have a preference (8) or didn't notice the difference (4). 8 participants clearly preferred individual challenges, and only 3 users favored collective ones.

A very similar trend is present in the qualitative data. While during the interviews users were not explicitly asked about the two different types of challenges, none made an explicit statement differentiating between the two. All statements mentioned above refer to the challenges in general, not a particular type. When referring to challenges, many participants did, however, implicitly express a preference to individual challenges. Users were complaining that in group challenges other participants did not show enough engagement to complete the challenge: "[Regarding] the challenges with ideas […]: Most of the suggestions in the group work are mine. I would have wished more collaboration from the others." Also, the overall participation in the challenges was perceived as low by some: "I'm surprised so few participate. For me, if I say yes to something I say yes to the whole of it." This behavior can be explained by the fact that the participants mostly did not know each other before the trial and therefore social pressure to work together as a group was low. As has been suggested before [24], collaborative and competitive mechanisms work better if participants know each other: "There is another guy that I know who is participating in the study. So, I'm only just checking to make sure I'm ahead of him. […] There's lot of people […] I wouldn't know, so I'm not that interested in them".

We also analyzed the success rates of the two types of challenges. On average the individual challenges were successful in 60% of cases, whereas the collective ones only were successful in 49.21%. This difference however is not statistically significant (paired-samples t-test with 18 users that participated in individual and collective Challenges, t_{17}=0.772, p=0.451).

Due to the fact that most users did not distinguish between the two types of challenges, and no clear differentiation is visible in the data, in the following analysis steps we do not distinguish between the two types of challenges anymore.

Factors Influencing Willingness to Participate. In order to further explore which factors actually underlie the users willingness to participate in challenges we analyzed the data using a multiple linear regression approach with the number of challenges participated as independent variable. As dependent variables we used basic demographics (sex, age), ICT-competence, Environmental concern (measured using the scale provided in [18]) and a score of importance of the dimension of social comparison (based on [17]). This resulted in an overall marginally significant model ($F_{5,31}$=2.326, p=0.066, adjusted r^2=0.156). As shown in Table 2 below only ICT-competence had a significant influence on the willingness to participate in challenges. The more competent users were the more likely they are to participate in challenges.

Motivations for Participation. Some users remarked that the reward scheme through points and achievement levels was motivation for them: "There were no real rewards waiting, but you could get virtual points, a form of reward. […] I thought

Table 1. Summary of multiple linear regression model

	B	Std. Error	t	p
Constant	1.539	3.296	0.467	0.644
Age	0.015	0.027	0.563	0.578
Sex	-0.686	0.740	-0.927	0.361
ICT Competence	-1.790	0.630	-2.839	**0.008****
Environmental Concern	0.565	0.527	1.071	0.292
Social Comparison	0.548	0.402	1.364	0.182

that was fun". Also, not gaining points can be motivational factor: „I didn't take part in the first [challenge]. I didn't get any points in the second group challenge. Then I thought, that can't be it, can it? And so I tried in the third and fourth if it is possible to achieve a little something using [different] modes of transport".

Others did not share this excitement about virtual rewards. Just collecting points was not motivation enough. They would have wanted "real" value in order to change their transport behavior: "Which grown-up person changes his behavior because of four points?". A number of users also explicitly expressed their disinterest in the game-like aspects: "I'm not the player type. This has never interested me". Also, the competitive character of challenges was sometimes rejected: "I'm not the competitive type. When I do something then I do it. Not because I want to trump someone".

Reasons for not Participating. Participation in challenges does require users to commit additional effort. A number of users stated that they did not find the time to participate in challenges. Some of them stated they rarely use Facebook and therefore missed the challenge, despite the app notification that was sent out. For most users, the reason why they wouldn't find the time for the challenges, was that they were simply too busy in their lives. Others, however, blamed their own laziness: "To be honest, I was too lazy. It was not immediately obvious how this works. There was too much to look at for joining. […] I thought I can't change my modes of transport anyway, because I will not cycle to work".

6 Discussion and Conclusion

In our research we were interested in exploring the role and possibilities of challenges in persuasive technology. Our findings suggest that challenges have the possibility to sustain the interest in using persuasive systems for a longer time compared to approaches that rely merely on feedback strategies. In order to maximize this effect known design principles especially the correct match of challenge difficulty and users' needs should be applied. Also, timing is important, and measurements of a users' activity level should be considered to decide when to prompt challenges to users. Alternatively, the possibility to postpone challenges in a simply manner could be a good design solution to allow the users to better fit challenges into their busy lives.

Our data suggest that individual challenges are the more appropriate means for organizing challenges, if there is no intrinsic collaborative aspect present. This is mainly

linked to the users' possibility to feel in charge of the outcome (Self-efficacy). However, this finding does not mean that one should approach challenges in an isolated manner. Sharing of results of individual challenges was perceived as supportive, and has been shown to can have positive effects when designed well [8].

Participation in challenges was correlated with ICT competence. This is surprising, as a selection criterion for participating in the study was regular use of an up-to-date Android phone, which excluded technology-avoiding users. Even though the system was easy to use according to the feedback from our participants, users confident in dealing with new technologies seem to be more willing to engage in digital challenges. Consequently, it is even more important to design the challenges as user friendly as possible. Also providing different access means for users might be a good design solution, as this allows users' to rely on known technologies.

Another unexpected find was that environmental concern was not related to the number of challenges the user participated in. Concerned users might focus their energy on changing their lifestyle, and playful means such as challenges are not needed to support this as they already are willing to do so. However, more data and research is needed to confirm (or disprove) this conjecture.

Some users explicitly rejected challenges as they dislike games and competitions. Therefore designers need to carefully consider their use. Gamification elements should be voluntary, so that users can simply ignore them. Regarding the persuasiveness of a system, elements like social comparison, competition and virtual rewards should not be the only strategy to be included, as some users will not respond to them.

Conclusions. In conclusion we can say that challenges seem to present an important possibility to sustain interest in interacting with persuasive technology, even though this is only true for a subset of users. Further research is needed regarding the question of how challenges can be made more attractive to these users, or to identify other approaches that better address the needs of them.

Our results also suggest that individual challenges seem to be preferable over collaborative ones, especially in application contexts were the users are not personally known to each other, and where there is no intrinsic collaborative aspect of the task.

References

1. Froehlich, J., Dillahunt, T., Klasnja, P., Mankoff, J., Consolvo, S., Harrison, B., James, A., Landay, J.A.: UbiGreen: investigating a mobile tool for tracking and supporting green transportation habits. In: Proc. CHI 2009. ACM (2009)
2. Carreras, I., Gabrielli, S., Miorandi, D., Tamilin, A., Cartolano, F., Jakob, M., Marzorati, S.: SUPERHUB: a user-centric perspective on sustainable urban mobility. In: Workshop Proc. Sense Transport 2012. ACM (2012)
3. Locke, E.A., Latham, G.P.: A theory of goal setting and task performance. Prentice-Hall, Englewood Cliffs (1990)
4. Locke, E.A., Latham, G.P.: Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. American Psychologist 57 (2002)
5. Fogg, B.J.: Persuasive Technology: Using Computers to Change What We Think and Do (Interactive Technologies). Morgan Kaufmann Publishers Inc. (2003)
6. Torning, K.: Oinas-Kukkonen. H.: Persuasive system design: state of the art and future directions. In: Proc. Persuasive 2009. ACM (2009)

7. Consolvo, S., Everitt, K., Smith, I., Landay, J.A.: Design requirements for technologies that encourage physical activity. In: Proc. CHI 2006. ACM (2006)
8. Richardson, C.R., Buis, L.R., Janney, A.W., Goodrich, D.E., Sen, A., Hess, M.L., Piette, J.D.: An online community improves adherence in an internet-mediated walking program. Journal of Medical Internet Research 12(4) (2010)
9. Lin, J.J., Mamykina, L., Lindtner, S., Delajoux, G., Strub, H.B.: Fish'n'Steps: encouraging physical activity with an interactive computer game. In: Dourish, P., Friday, A. (eds.) UbiComp 2006. LNCS, vol. 4206, pp. 261–278. Springer, Heidelberg (2006)
10. Bothos, E., Prost, S., Schrammel, J., Röderer, K., Mentzas, G.: Watch your Emissions: Persuasive Strategies and Choice Architecture for Sustainable Decisions in Urban Mobility. PsychNology Journal 12(3) (2014)
11. Toscos, T., Faber, A., An, S., Praful Gandhi, M.: Chick clique: persuasive technology to motivate teenage girls to exercise. In: CHI 2006 Extended Abstracts. ACM (2006)
12. Petkov, P., Foth, M., Road, V.P.: Motivating domestic energy conservation through comparative, community-based feedback in mobile and social media. In: C&T 2011 (2011)
13. Berkovsky, S., Freyne, J., Oinas-Kukkonen, H.: Influencing individually: Fusing personalization and persuasion. ACM Transactions on Interactive Intelligent Systems 2(2) (2012)
14. Kaptein, M., Lacroix, J., Saini, P.: Individual differences in persuadability in the health promotion domain. In: Ploug, T., Hasle, P., Oinas-Kukkonen, H. (eds.) PERSUASIVE 2010. LNCS, vol. 6137, pp. 94–105. Springer, Heidelberg (2010)
15. Consolvo, S., Klasnja, P., McDonald, D.W., Landay, J.A.: Goal-setting considerations for persuasive technologies that encourage physical activity. In: Persuasive 2009. ACM (2009)
16. Loock, C., Staake, T., Thiesse, F.: Motivating energy-efficient behavior with green IS: an investigation of goal setting and the role of defaults. Mis Quarterly 37(4) (2013)
17. Busch, M., Schrammel, J., Tscheligi, M.: Personalized Persuasive Technology – Development and Validation of Scales for Measuring Persuadability. In: Berkovsky, S., Freyne, J. (eds.) PERSUASIVE 2013. LNCS, vol. 7822, pp. 33–38. Springer, Heidelberg (2013)
18. Worsley, A., Skrzypiec, G.: Environmental attitudes of senior secondary school students in South Australia. Global Environmental Change 8(3) (1998)
19. Staats, H., Harland, P., Wilke, H.A.: Effecting durable change a team approach to improve environmental behavior in the household. Environment and Behavior 36(3) (2004)
20. Reitberger, W., Ploderer, B., Obermair, C., Tscheligi, M.: The percues framework and its application for sustainable mobility. In: de Kort, Y.A.W., IJsselsteijn, W.A., Midden, C., Eggen, B., Fogg, B.J. (eds.) PERSUASIVE 2007. LNCS, vol. 4744, pp. 92–95. Springer, Heidelberg (2007)
21. MIT SENSEable City Lab, `http://senseable.mit.edu/co2go` (last retrieved January 12, 2014)
22. Jylhä, A., Nurmi, P., Sirén, M., Hemminki, S., Jacucci, G.: Matkahupi: a persuasive mobile application for sustainable mobility. In: UbiComp 2013 (2013)
23. Broll, G., Cao, H., Ebben, P., Holleis, P., Jacobs, K., Koolwaaij, S.B.: Tripzoom: an app to improve your mobility behavior. In: Proc. Conference MUM. ACM (2012)
24. Gabrielli, S., Forbes, P., Jylhä, A., Wells, S., Sirén, M., Hemminki, S., Jacucci, G.: Design challenges in motivating change for sustainable urban mobility. Computers in Human Behavior 41 (2014)
25. Weiss, B., Wechsung, I., Marquardt, S.: Assessing ICT user groups. In: NordCHI 2012. ACM (2012)
26. Schrammel, J., Busch, M., Tscheligi, M.: Peacox – Persuasive Advisor for CO2-Reducing Cross-modal Trip Planning. In: 1st International Workshop on Behavior Change Support Systems, BCSS (2013)