

An ideal physical activity app for adults – what should it be like? Requirements of adult users

Kerli Mooses
Institute of Computer Sciences
University of Tartu
Tartu, Estonia
Kerli.Mooses@ut.ee

Abstract—Despite the numerous health benefits provided by physical activity, people struggle to meet healthy activity levels. There are numerous apps aiming to support the physical activity of adults. However, it is unclear whether and at what extent is the end user been involved in the development process. In addition, there is a lack of research which examines which functional, quality and emotional goals are preferred and expected by the user of physical activity app. To address this issue, *do-be-feel* workshops were carried out with 38 adults and the results were combined into goal model. These results offer a good overview of the expectations of end user which can be used in further development.

Keywords—requirements elicitation, physical activity, goal modelling, adults

I. INTRODUCTION

The positive impact of physical activity on mental, social and physical health are widely recognized [1], [2]. Countries make efforts to support and promote healthy physical activity levels among their citizens. It has been shown that if all inactive people became active, more than 5 million deaths per year could be avoided [2]. Recent research indicates that every move counts as health benefits occur even when physical activity is below the international recommended levels [1], [3]. At the same time, higher physical activity levels and reduced sedentary time substantially reduces the risk for premature mortality [4]. Despite the facts and research reassuring the positive influence of physical activity on health, a lot of people struggle to achieve healthy physically active levels as third of adult population do not meet the physical activity recommendations by World Health Organisation [5]. According to the literature reviews, the most common barriers for physical activity reported by adults are lack of time, motivation and self-discipline [6], [7]. This indicates that a tool supporting the motivation and self-discipline could have beneficial effects on physical activity levels of adults.

The rapid advantages in information and communication technologies (ICTs) and their extensive use worldwide make ICTs valuable tools in health promotion, including supporting physical activity. There are numerous apps available in app stores for physical activity. However, it has been shown, that their effect on physical activity behaviour is modest [8]–[10]. It could be partly explained by the fact that the involvement of end user during the development process seems to be modest or even non-existing as no physical activity app has reported users involvement during the development process [11]. In addition, to the best of our knowledge there is no study describing the involvement of the end user during the requirements elicitation phase of physical activity app. At the same time end user is a crucial stakeholder who should be involved in the development

process. Early identification of the needs, preferences and problems of end users helps to address them during early development phase and thereby ensure the acceptance and usability of the end product. The findings about the features that adults would like to have in a physical activity app are sparse. According to a qualitative study [12] young adults prefer physical activity apps that coach and motivate them, provide tailored feedback, enable to set personal goals and allow competition with friends. User-friendliness and flexibility has also been reported [8]. Most published data focus on describing existing apps, trying to identify most effective and/or most frequently used features [9], [11], [13]–[15]. For example, it has been found that giving feedback, setting goals, receiving rewards, social sharing and competition can positively influence the physical activity of adults [13]. These studies mostly focus on functional requirements, but in addition to functional requirements it is important to consider the quality and emotional requirements which also influence the acceptance and usability of end product [16]. Therefore, knowledge of quality and emotional requirements needed by the end user can increase the effectiveness and attractiveness of the app.

The aim of current study is to find out the needs and expectations of adults for an app that would support their physical activity. In addition, we combine the elicited requirements into hierarchical goal model to give a good visual overview of gathered requirements.

II. METHODS

To identify the functional, quality and emotional goals of an app that would support the physical activity of adults, nine online workshops with a total of 38 adults (22 female, 16 male, aged 35-45) were conducted. The participants were recruited through the requirements elicitation course of the university. The workshops were carried out online due to the COVID-19 situation and to reduce the personal contact. The *do-be-feel* method was used in the workshop. At first the participants were given a following description: “It is advised by World Health Organisation that adults should accumulate 10 000 steps per day or 150 minutes of moderate activity per week in order to stay healthy. If there would be an app that helps you to fill these activity goals, what would it be like?” The participants were asked to think on four aspects: 1) what should such app *do*? (functional goals), 2) what should such app *be* like? (quality goals), 3) how should such app make you *feel*? (emotional goals). In addition, the participants were asked to think which roles are associated with the app. The answers were all gathered in one table where participant could add additional ideas. The results from nine workshops were divided into subthemes and combined into one summary table presented in Results section. The frequency of goals

mentioned by different workshop groups was also added to the table to identify the most popular needs.

In order to give a good visual and systematic overview of gathered requirements agent-oriented goal model [17]–[21] was created. In this hierarchical goal tree, the functional goals are presented in tilted rectangles. Roles, quality and emotional goals are attached to the functional goal that they are associated with. The roles are presented as stick man, quality goals with clouds and emotional goals with heart symbols. Goal modelling was used as it presents early functional, quality and emotional requirements in a holistic and coherent way, which can be further developed into user stories [22]. User stories in turn are often used in agile software engineering [23], [24]. In addition, it has been shown that goal models are also helpful when there is a need to involve or communicate with nontechnical stakeholders or experts [25].

III. RESULTS

Measuring activity and making reports were two functional goals that were mentioned by all groups (Table 1). A variety of indicators for measuring physical activity by the app was mentioned – for example, the number of steps, heart

rate, time, velocity, distance and activity minutes. In addition to the possibility that the app itself tracked the activity, it was important that activity data could be imported from watches and activity trackers. As for the reports, different input variables, such as activity minutes, steps, activity types, and time periods, such as day, week, month, was mentioned. The goal setting was considered an important feature. All groups wanted to set personal goals and some groups preferred the app to make suggestions for next goals based on previous goals and activity. Together with goal setting, the participants wanted to get notification and praise for meeting the goal. Reminders, motivating tips and messages were considered as encouraging and motivating which help them to meet goals and overcome barriers. The participants also considered notifications that would remind activity in case of prolonged passive periods useful. Another popular features were possibility to participate in challenges and share and compare your progress with others within app or in social media. Participants were interested the app to suggest nearby tracks for different activities, such as hiking, orienteering, running etc.

TABLE I. FUNCTIONAL, QUALITY AND EMOTIONAL REQUIREMENTS IDENTIFIED WITH *DO-BE-FEEL* WORKSHOPS

To-do	To-be	To-feel	Roles
Measure activity	Safe (7)	Healthy (9)	User (9)
Track activity (9)	Intuitive (6)	Satisfied (7)	Friend (9)
Use GPS (6)	Modern (6)	Motivated (6)	Sponsor (5)
Import data from other apps/ watches/ activity trackers (5)	Simple (5)	Happy (6)	Doctor (3)
Insert activity manually	User friendly (5)	Inspired (4)	Scientist, Health expert (2)
Make adjustments to activity data	Precise, accurate (5)	Self-confident (4)	Athlete (2)
Goals	Reliable (5)	Aware (4)	Sport psychologist
Set personal goals (5)	Compatible (4)	Proud (3)	Sport club
Suggests new goals based on previous activity (3)	Motivating (3)	Victorious (3)	Coach
Feedback	Free (3)	Proud (3)	
Make reports (9)	Reasonably priced (3)	Informed (2)	
Get points for activity / virtual medals / awards (5)	Energy-saving (3)	Addicted (2)	
Visualise the distance from goal (4)	Inspiring (2)	Supported (2)	
Present distance virtually (e.g. home to Rome/ move around a globe)	Playful (2)	Recognised (2)	
Get personal advice from coach	Adaptive (2)	Cared for (2)	
Reminders and notifications	Comfortable (2)	Positive (2)	
Get notification when filling a goal (7)	Fast (2)	In control	
Get notifications when passive (6)	Spectacular	Hopeful	
Get reminders, motivating messages and tips (4)	Innovative	Success	
Turn off notifications and reminders	Unnoticed	Amused	
Challenges	Practical	Special	
Participate in challenges (5)	Interesting	Belong to	
Win awards from sponsors (2)	Realistic	Active	
Create challenges (2)	Adds-free	Excited	
Invite friends to join a challenge		Energetic	
Create leader boards based on activity type		Guided	
Socialize			
Share and compare results with others (5)			
Invite friend(s) to training session (3)			
Invite friend to join the app (2)			
Find activity			
Save and rate track (with GPS) (4)			
Show/suggest tracks nearby (4)			
Add training sessions to calendar (2)			
Other			
Insert personal data (5)			
Call help			
Keep a creature alive with your activity			
Read motivating info about the benefits of physical activity			

() – number of groups who mentioned this requirement. Presented if N > 1.

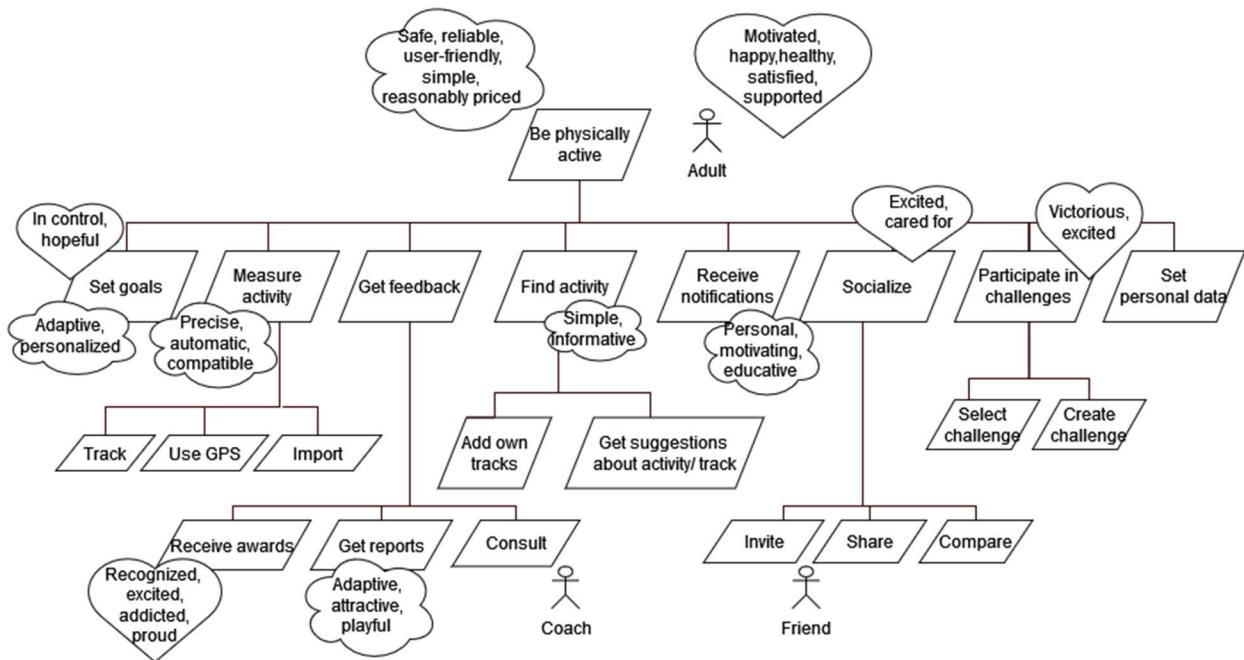


Fig. 1. Goal model for app supporting the physical activity levels of adults based on most frequently mentioned requirements

Safety, simplicity, user-friendliness, accurate measurements and reliability were most frequently mentioned quality goals. As for emotional goal, the participants wanted to feel healthy, satisfied, motivated and happy when using the app.

The gathered requirements were transformed into goal models which give a good visual of the most popular needs of adults who want to be physically active with the help of an app (Fig. 1).

IV. DISCUSSION

There is a limited evidence in scientific literature about the needs and expectations of adults who use physical activity app. In current study we addressed this knowledge gap and identified functional, quality and emotional requirements for such app with the help of do-be-feel workshops.

Most common behaviour change techniques such as measuring activity, setting goals and getting feedback [11], [14], [15] were mentioned by most of our workshop groups. Being aware of one's activity levels can be considered a prerequisite for evaluating the sufficiency of physical activity. In addition, it helps to increase the awareness of actual activity levels and review the changes over time [26]. According to studies, these three features have a potential to increase the effectiveness of the app [27]. For our participants it was equally important to use the app for performing activity measurements as well as importing the data from watch or activity tracker. As different sporting disciplines can make restrictions on the measurement device, it would be useful to ensure compatibility and connectivity with a variety of devices. As for feedback, only one group mentioned the possibility to consult a coach although personalised feedback has been identified one factor that encourages PA change [9]. Our participants preferred to get feedback and view progress over time with graphical and numeric reports.

Another quite popular behaviour change techniques that are used in existing physical activity apps and which were mentioned several times by our participants, were providing

rewards and enabling social comparison [9], [13], [14]. Although rewards have a potential to support engagement in physical activity, they have to be aimed at intrinsic motivation, which supports long term changes [28]. Caution should be taken when incorporating social comparison feature to the app as the scientific findings are contradictory – some people find motivating comparing with more active people, whereas the others demotivating [12].

Our participants also pointed out the need to invite a friend to training session and share your results with friends or in social media. Social support and enjoyment have been reported as one of the main motives for physical activity [6] and being able to train with a friend will certainly support these motives. Being active with friends helps to fulfil abundance of emotional goals which emerged from our workshops. For example, supported, cared for and recognised are only few of them.

Possibility to create challenges and participate in them was favoured by half of our workshop groups. Similarly, participating in challenges has been previously reported by young adults [12]. However, not all people are competitive and interested in challenges [13], thus this feature should be kept optional.

Interestingly a possibility to find activity has not been mentioned in previous studies with adults or in existing apps, whereas this feature was reported by almost half of the workshop groups. Previously a shortage of facilities has been reported as one of the barriers for physical activity [6]. In some cases, there could be a lack of information about different opportunities for in- and outdoor physical activity. In such cases, including a possibility to search or get suggestions about nearby tracks and facilities can help to overcome this barrier. This feature would also be beneficial in a case of a holiday or a trip to a new and foreign surrounding.

Safety was the most highly valued quality goal by our participants. Participants wanted to share their personal data as it enhances user experience and improves personalisation.

As the privacy and security of existing physical activity apps has been rated as low [11], [29], developers should pay extra attention to meet this requirement.

Motives for being physically active are health benefits, social support [6], [7] and enjoyment [6]. These are in line with emotional goals reported by our participants.

A. Limitations

One limitation of our requirements elicitation method is that the workshops were online which could have hindered some co-creation that would have emerged during face-to-face meetings. However, we believe this effect was minimal as all participants participated actively during the workshops and due to the prolongation of COVID-19 restrictions people have become more familiar, experienced and comfortable with online meetings.

Another limitation of our model is, that it presents the viewpoint of one stakeholder group – the end user. Inclusion of health and behaviour experts could also be beneficial to ensure the correctness and safety of the content, and long-term usage of the app which in turn supports healthy and lifelong physical activity. Despite the benefits of experts involvement, experts are rarely involved during the development process [11], [14], [29], [30]. We have previously created goal models for supporting the physical activity of adolescents [25]. These goal models were based on the literature review and inclusion of health experts and overall resulted in similar themes as in current study with adults. Therefore, we could argue that in an early requirements elicitation phase the involvement of experts might not be that urgent. At the same time, we agree that behavioural and physical activity experts should be involved in later development phases and during validation of the early requirements in order to create an evidence-informed mobile app [30]. Such expert help to ensure that suggestions and information provided to the users is healthy and evidence-based and presented in a way that they support intrinsic motivation. This in turn supports the long-term behavior change [28].

When interpreting the results, it should be kept in mind that participants aged 35-45 were involved in the workshop and their present physical activity levels are unknown. Whether and to what extent created goal model apply to younger or older end users warrants further investigation.

V. CONCLUSION

Do-be-feel workshops conducted with adults helped to discover the needs and preferences that adults have for physical activity app. These findings are valuable input for developers who want to improve their existing app or develop a new one.

ACKNOWLEDGMENT

We thank all the participants of workshops for their valuable input and time.

REFERENCES

[1] F. C. Bull *et al.*, “World Health Organization 2020 guidelines on physical activity and sedentary behaviour,” *Br. J. Sports Med.*, vol. 54, no. 24, pp. 1451–1462, Dec. 2020, doi: 10.1136/bjsports-2020-102955.

[2] I. M. Lee, E. J. Shiroma, F. Lobelo, P. Puska, S. N. Blair, and P. T. Katzmarzyk, “Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy,” *Lancet*, vol. 380, 2012, doi: 10.1016/S0140-6736(12)61031-9.

[3] J. M. Jakicic *et al.*, “Association between Bout Duration of Physical Activity and Health: Systematic Review,” *Med. Sci. Sports Exerc.*, vol. 51, no. 6, pp. 1213–1219, Jun. 2019, doi: 10.1249/MSS.0000000000001933.

[4] U. Ekelund *et al.*, “Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis,” *BMJ*, vol. 366, pp. 14570–14570, Aug. 2019, doi: 10.1136/bmj.14570.

[5] R. Guthold, G. A. Stevens, L. M. Riley, and F. C. Bull, “Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants,” *Lancet Glob. Health*, vol. 6, no. 10, pp. e1077–e1086, Oct. 2018, doi: 10.1016/S2214-109X(18)30357-7.

[6] M. R. L. Pedersen, A. F. Hansen, and K. Elmoose-Østerlund, “Motives and Barriers Related to Physical Activity and Sport across Social Backgrounds: Implications for Health Promotion,” *Int. J. Environ. Res. Public Health*, vol. 18, no. 11, p. 5810, May 2021, doi: 10.3390/ijerph18115810.

[7] A. Baillot *et al.*, “Physical activity motives, barriers, and preferences in people with obesity: A systematic review,” *PloS One*, vol. 16, no. 6, pp. e0253114–e0253114, Jun. 2021, doi: 10.1371/journal.pone.0253114.

[8] S. S. Coughlin, M. Whitehead, J. Q. Sheats, J. Mastrotonico, and S. Smith, “A review of smartphone applications for promoting physical activity,” *Jacobs J. Community Med.*, vol. 2, p. 021, 2016.

[9] J. Bort-Roig, N. D. Gilson, A. Puig-Ribera, R. S. Contreras, and S. G. Trost, “Measuring and Influencing Physical Activity with Smartphone Technology: A Systematic Review,” *Sports Med.*, vol. 44, no. 5, pp. 671–686, May 2014, doi: 10.1007/s40279-014-0142-5.

[10] R. Gal, A. M. May, E. J. van Overmeeren, M. Simons, and E. M. Monnikhof, “The effect of physical activity interventions comprising wearables and smartphone applications on physical activity: a systematic review and meta-analysis,” *Sports Med. Open*, vol. 4, p. 42, 2018, doi: 10.1186/s40798-018-0157-9.

[11] S. Paganini *et al.*, “Quality of Physical Activity Apps: Systematic Search in App Stores and Content Analysis,” *JMIR MHealth UHealth*, vol. 9, no. 6, pp. e22587–e22587, Jun. 2021, doi: 10.2196/22587.

[12] A. Middelweerd *et al.*, “What features do Dutch university students prefer in a smartphone application for promotion of physical activity? A qualitative approach,” *Int. J. Behav. Nutr. Phys. Act.*, vol. 12, p. 31, 2015, doi: 10.1186/s12966-015-0189-1.

[13] M. Hosseinpour and R. Terlutter, “Your personal motivator is with you: A systematic review of mobile phone applications aiming at increasing physical activity,” *Sports Med.*, vol. 49, no. 9, pp. 1425–1447, 2019, doi: 10.1007/s40279-019-01128-3.

[14] P. Simões, A. G. Silva, J. Amaral, A. Queirós, N. P. Rocha, and M. Rodrigues, “Features, Behavioral Change Techniques, and Quality of the Most Popular Mobile Apps to Measure Physical Activity: Systematic Search in App Stores,” *JMIR MHealth UHealth*, vol. 6, no. 10, pp. e11281–e11281, Oct. 2018, doi: 10.2196/11281.

[15] A. Middelweerd, J. S. Mollee, C. N. van der Wal, J. Brug, and S. J. Te Velde, “Apps to promote physical activity among adults: a review and content analysis,” *Int. J. Behav. Nutr. Phys. Act.*, vol. 11, pp. 97–97, Jul. 2014, doi: 10.1186/s12966-014-0097-9.

[16] A. Mendoza, T. Miller, S. Pedell, and L. Sterling, “The role of users’ emotions and associated quality goals on appropriation of systems: two case studies,” *ACIS 2013 Proc.*, p. 57, 2013.

[17] K. Taveter, L. Sterling, S. Pedell, R. Burrows, and E. M. Taveter, “A method for eliciting and representing emotional requirements: two case studies in e-Healthcare,” in *IEEE 27th International Requirements Engineering Conference Workshops (REW)*, Sep. 2019, pp. 100–105. doi: 10.1109/REW.2019.00021.

[18] L. Sterling and K. Taveter, *The art of agent-oriented modelling*. MIT Press, 2009.

[19] A. L. Lorca, R. Burrows, and L. Sterling, “Teaching motivational models in agile requirements engineering,” in *IEEE 8th International Workshop on Requirements Engineering Education and Training (REET)*, Aug. 2018, pp. 30–39. doi: 10.1109/REET.2018.00010.

- [20] T. Miller, S. Pedell, L. Sterling, F. Vetere, and S. Howard, "Understanding socially oriented roles and goals through motivational modelling," *J. Syst. Softw.*, vol. 85, no. 9, pp. 2160–2170, 2012, doi: 10.1016/j.jss.2012.04.049.
- [21] T. Miller, S. Pedell, A. A. Lopez-Lorca, A. Mendoza, L. Sterling, and A. Keirnan, "Emotion-led modelling for people-oriented requirements engineering: The case study of emergency systems," *J. Syst. Softw.*, vol. 105, pp. 54–71, 2015, doi: 10.1016/j.jss.2015.03.044.
- [22] T. Tenso, A. H. Norta, H. Rootsi, K. Taveter, and I. Vorontsova, "Enhancing requirements engineering in agile methodologies by agent-oriented goal models: two empirical case studies," in *2017 IEEE 25th International Requirements Engineering Conference Workshops (REW)*, Sep. 2017, pp. 268–275. doi: 10.1109/REW.2017.24.
- [23] M. Cohn, *User stories applied: For agile software development*. Addison-Wesley Professional, 2004.
- [24] F. Paetsch, A. Eberlein, and F. Maurer, "Requirements engineering and agile software development," in *WET ICE 2003. Proceedings. Twelfth IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, 2003.*, 2003, pp. 308–313. doi: 10.1109/ENABL.2003.1231428.
- [25] K. Mooses and K. Taveter, "Agent-Oriented Goal Models in Developing Information Systems Supporting Physical Activity Among Adolescents: Literature Review and Expert Interviews," *J. Med. Internet Res.*, vol. 23, no. 5, pp. e24810–e24810, May 2021, doi: 10.2196/24810.
- [26] L. Dennison, L. Morrison, G. Conway, and L. Yardley, "Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study," *J. Med. Internet Res.*, vol. 15, no. 4, p. e86, 2013, doi: 10.2196/jmir.2583.
- [27] J. M. Murray, S. F. Brennan, D. P. French, C. C. Patterson, F. Kee, and R. F. Hunter, "Effectiveness of physical activity interventions in achieving behaviour change maintenance in young and middle aged adults: A systematic review and meta-analysis," *Soc. Sci. Med.*, vol. 192, pp. 125–133, 2017, doi: 10.1016/j.socscimed.2017.09.021.
- [28] S. J. G. Ahn, K. Johnsen, and C. Ball, "Points-based reward systems in gamification impact children's physical activity strategies and psychological needs," *Health Educ Behav.*, vol. 46, no. 3, pp. 417–425, 2019, doi: 10.1177/1090198118818241.
- [29] P. Bondaronek, G. Alkhalidi, A. Slee, F. L. Hamilton, and E. Murray, "Quality of Publicly Available Physical Activity Apps: Review and Content Analysis," *JMIR MHealth UHealth*, vol. 6, no. 3, pp. e53–e53, Mar. 2018, doi: 10.2196/mhealth.9069.
- [30] E. Knight, M. I. Stuckey, H. Prapavessis, and R. J. Petrella, "Public health guidelines for physical activity: is there an app for that? A review of android and apple app stores," *JMIR MHealth UHealth*, vol. 3, no. 2, pp. e43–e43, May 2015, doi: 10.2196/mhealth.4003.