Persuasive Technology to Support Chronic Health Conditions: Investigating the Optimal Persuasive Strategies for Persons with COPD

Beatrix Wais-Zechmann[1(✉)], Valentin Gattol[1], Katja Neureiter[1], Rita Orji[2], and Manfred Tscheligi[1,3]

[1] AIT Austrian Institute of Technology, Vienna, Austria
{beatrix.wais-zechmann, valentin.gattol, katja.neureiter, manfred.tscheligi}@ait.ac.at
[2] Faculty of Computer Science, Dalhousie University, Halifax, NS, Canada
rita.orji@dal.ca
[3] University of Salzburg, Salzburg, Austria
manfred.tscheligi@sbg.ac.at

Abstract. Persuasive technology can support persons with chronic conditions to comply with their treatment plan. For persons with chronic obstructive pulmonary disease (COPD), staying physically active is crucial to prevent deteriorations of their health status. However, most persons with COPD do not reach and maintain recommended levels of physical activity goals. Although COPD is expected to become the third most common cause of death worldwide, research on how to design persuasive systems for motivating specifically persons with COPD to engage in regular physical activity is still scarce. To bridge this gap, we conducted a study involving persons with COPD (n = 115) to investigate the *perceived persuasiveness* of 17 strategies (i.e., ratings of their concrete implementation) and *individual susceptibility to persuasion* (i.e., an underlying disposition to be more receptive to certain persuasive strategies). Based on our analysis, the following strategies were perceived as most persuasive: *personalization*, *reminder*, *commitment, self-monitoring, rewards*, *customization*, *authority*, and *scarcity*. Interestingly, the data revealed differences between *perceived persuasiveness* and *individual susceptibility to persuasion*, indicating that both constructs measure distinct aspects of persuasiveness. Our results are relevant to designers and developers of persuasive systems by providing valuable insights about the most promising persuasive strategies and their practical implementation when designing for persons with COPD.

Keywords: Chronic obstructive pulmonary disease (COPD)
Persuasive strategies · Perceived persuasiveness
Individual susceptibility to persuasion

1 Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic progressive lung disease with symptoms like breathlessness, muscle weakness, and chronic cough that leads (in severe stages) to the dependence on external oxygen supply. About 10% of adults

J. Ham et al. (Eds.): PERSUASIVE 2018, LNCS 10809, pp. 255–266, 2018.
https://doi.org/10.1007/978-3-319-78978-1_21

above the age of 40 are affected [1] and COPD is expected to become the third most common cause of death worldwide in 2030 [2]. Within the European Union, health care costs of COPD are estimated to be about 23.3 billion Euro [3]. COPD is not curable, thus, patients have to deal with it throughout their lifetime and there is no getting around without a successful self-management process. Mitigating the disease progression significantly is possible through lifestyle changes [4, 5]. In particular, frequent physical activity is considered to be one of the most effective measures to prevent decline [6]. However, many patients lack motivation and do not reach the recommended physical activity level leading to increased hospitalizations, mortality, reduced quality of life and loss of productivity [6, 7]. Thus, a solution is required that motivates persons with COPD (PwCOPD) to engage in frequent physical activity as a preventive measure. While the use of persuasive technology has been broadly investigated in training applications for the general population [8], little work has been done regarding the use of persuasive technology to motivate PwCOPD to exercise more [9].

The aim of our research is to investigate how persuasive systems should be designed for PwCOPD. In this paper, we contribute to the existing research by answering the following research question: *Which persuasive strategies (PS) are most effective in motivating PwCOPD to engage in more physical activity?*

Findings of this research allow for a more effective design and adaptation of persuasive systems for PwCOPD. The paper is structured as follows: we start with reviewing the related work, followed by a description of the methods, the analysis of the results, their discussion including implications and conclusions for designers and developers of persuasive systems for PwCOPD.

2 Related Work

Persuasive technologies have been successfully applied in a wide range of contexts to trigger behavior change, such as increased physical activity [10]. However, the applications focus mainly on the general population without considering disease-related circumstances of PwCOPD. In those few applications that focus on motivating PwCOPD for physical activities, only little work has been done to investigate the use of persuasive design strategies and principles for this target group [9]. Thus, the scientific literature in the context of PS in COPD treatment reveals knowledge gaps. Behavioral interventions that aim at increasing physical activity in PwCOPD mainly use conventional approaches such as counselling and education [11]. However, the effectiveness of individual PS has not been evaluated specifically for PwCOPD.

Voncken-Brewster et al. [12] evaluated the usability of an online self-management intervention for COPD patients in a lab setting that included eight behavioural change techniques (based on the I-Change Model [13]). However, they provide few insights on how PwCOPD experience behavioral change strategies. Instead, the paper focuses chiefly on usability aspects of the overall intervention and does not investigate the effectiveness of the strategies. Similarly, other studies include various PS in their interventions but do not evaluate the comparative effectiveness of the individual strategies per se (e.g. [14]).

Bartlett et al. [9] investigated the acceptance of different persuasive design principles for technologies that aim at encouraging physical activity among PwCOPD. They investigated three different prototypes using the three design principles *dialogue support, primary task support, and social support* and investigated acceptance and persuasiveness of the technologies. Although the authors account for design principles, each of them incorporating several PS, their work does not assess the persuasiveness of the individual strategies.

It is essential to evaluate the effectiveness of various PS before implementing them in an intervention. In a review involving 17 randomized controlled trials, four techniques were associated with significantly larger effect sizes related to smoking cessation in COPD patients: *facilitate action planning/develop treatment plan, prompt self-recording, advise on methods of weight control*, and *advise on/facilitate use of social support* [15]. This review also points out that the most frequently used strategy (*boost motivation and self-efficacy*; used in 70.6% of interventions) was associated with very low effectiveness.

To develop suitable persuasive systems for PwCOPD, our paper investigates which of the PS are perceived as most persuasive by PwCOPD to increase their physical activity.

3 Method

To answer the research question, we conducted an online survey involving 118 PwCOPD. The goals of the survey were to assess whether the participants differed in their *perceived persuasiveness* towards the 17 implemented strategies and in their *individual susceptibility to persuasio*n as measured by the STPS scale [16]. The detailed methodology is described in this chapter.

3.1 Persuasive Strategies and Storyboards

We chose to employ ten widely-used strategies by Oinas-Kukkonen and Fogg in our study, which have been used in the health context earlier [17–19]: *comparison, competition, cooperation, customization, personalization, punishment, rewards, self-monitoring, simulation,* and *suggestion*. In addition, we employed the strategy *reminder,* which is an important strategy in fitness applications to increase physical activity [10].

To allow for a comparison with the STPS scale, we employed the six well-established strategies by Cialdini: *reciprocity, scarcity, authority, commitment, consensus, and liking* [20].

To communicate the PS in a visually appealing way, we created storyboards for all 17 PS, each consisting of three individual illustrations that represent the strategy as a scripted interaction between the user and the smartphone application (see Fig. 1 as an example of the storyboard representing the competition strategy). The storyboards were based on those used in the work of Orji et al. [17, 19].

We validated our storyboards prior to the main study to make sure that the visualizations accurately represented each of the PS as intended. We first made two internal rounds of evaluation and adaptation of the storyboards. After that we sent out the storyboards to seven researchers in the field of human–computer interaction familiar with persuasive technology and asked them to allocate the correct storyboard to the 17 strategies. Additionally, we asked the experts to provide further feedback about the storyboards. Following this procedure, the storyboards were further refined and finalized.

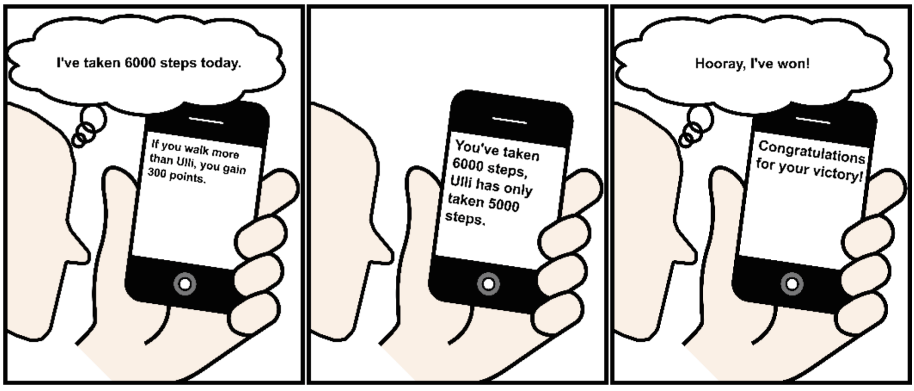

Fig. 1. Example storyboard of the PS *competition* translated to English.

3.2 Questionnaire Measures

Perceived Persuasiveness. To measure the *perceived persuasiveness* of the 17 strategies, each storyboard was followed by four questions of the perceived persuasiveness scale by Drozd et al. [21], as also used in the work of Orji et al. [19]. The participants were asked to indicate on a 7-point Likert scale to which degree the strategy (a) would influence them, (b) would be convincing, (c) would be personally relevant for them, and (d) would make them reconsider their physical activity habits.

Individual Susceptibility to Persuasion. In addition to *perceived persuasiveness*, which represents the participants' ratings of external stimuli (i.e., the storyboards), we assessed also their *individual susceptibility to persuasion*. The key distinction between the two constructs is that the former is a person's evaluation of external stimuli, whereas the latter can be understood as a trait that resides within the person. In other words, *individual susceptibility to persuasion* describes a person's underlying disposition to be more or less receptive to certain PS. To measure the individual susceptibility of participants, we included the *Susceptibility to Persuasion Scale* (STPS) [16]. The scale measures the participant's susceptibility towards Cialdini's six strategies [20]: *reciprocity*, *scarcity*, *authority*, *commitment*, *consensus* and *liking*.

3.3 Procedure of the Online Survey

Recruitment of potential participants in Austria and Germany was first done through asking COPD self-support groups to distribute the survey in their network of PwCOPD. As an incentive, participants who finalized the survey could win an Amazon voucher. The survey was additionally distributed via a recruiting panel based in Austria. Participants who completed the survey received credit points via the panel that could be exchanged for money or vouchers. After the potential participants opened the survey link that they received either via mail or the recruiting panel, they first read a short introduction about the aims of the study. Two screening questions assessed the presence or absence of COPD and the age of the person. Each of the subsequent pages showed in randomized order one of the 17 PS, presented as storyboards, followed by four questions assessing the participant's *perceived persuasiveness* of the respective strategies [21]. The next part of the survey contained the STPS items in randomized order followed by sociodemographic questions such as gender, education, height, weight, the presence of other diseases, their physical activity level as well as their stage of change towards doing more physical activity. The entire survey was conducted in German.

3.4 Participants

Given that PwCOPD are typically older, the majority of participants recruited for the study were above the age of 40 (97%). The survey was completed by a total of 118 participants. Three participants were excluded from the analysis because they completed the survey in a time that we deemed unrealistic (i.e., below 5 min); for comparison, participants took 18.77 min on average (SD = 12.99). The remaining 115 participants included 30 women and 85 men. More details on sociodemographic data is shown in Table 1.

Table 1. Sociodemographic data of participants

Sample size	115
Gender	30 women/85 men (26%/74%)
Age	<40 (3%), 40–49 (11%), 55–59 (28%), 60–69 (36%), >69 (23%)
Education	Compulsory school (3%), Professional school (16%), Vocational training (24%), High school (36%), University (or similar) (21%)
Other diseases	no other (35%), 1 other (37%), 2 other (18%), 3–5 other diseases (10%)

3.5 Data Analysis

The data analysis was conducted with SPSS version 22. Boxplot figures were created with the statistics software Wessa.net (Wessa, 2017). To assess which of the 17 PS are most effective for PwCOPD, we first calculated an average score per participant across the four items measuring the *perceived persuasiveness* for each strategy. Similarly, we calculated an average score per participant for the items measuring *individual susceptibility to persuasion*, separately for Cialidini's six strategies: five items were averaged for the strategy of *reciprocity*, another five for *scarcity*, four items for *authority*, another

five for *commitment*, another four for *consensus*, and three items for *liking*. We conducted altogether two repeated-measures ANOVAs (analysis of variance), separately for the two within-subject factors *perceived persuasiveness* (i.e., the 17 strategies implemented as storyboards) and *individual susceptibility to persuasion* (i.e., an underlying disposition to be more receptive to certain PS). Comparing the average values of the study sample per strategy allows gaining insights specifically for the target group of PwCOPD in terms of their underlying dispositions (*individual susceptibility to persuasion*) and their perceptions of implemented strategies (*perceived persuasiveness*). Moreover, we generated notched boxplots that depict the data descriptively and provide a visual gauge of potentially significant differences for each of the 17 strategies with the neutral mid-point of the perceived persuasiveness scale [18].

4 Results

4.1 Perceived Persuasiveness of the 17 Strategies

In order to identify the most suitable PS for PwCOPD, we compared the means of the perceived persuasiveness scores of the 17 strategies. Results from the repeated-measures ANOVA revealed a significant effect for the within-subjects factor PS, ($F(16, 1824) = 16.15$, $p < .001$, partial eta squared = .124). This indicates that there is a significant difference in the *perceived persuasiveness* between the PS. Figure 2 below shows notched boxplots of the *perceived persuasiveness* for all 17 strategies. Notches indicate the 95% confidence interval of the median and allow estimating significant differences between the strategy and the neutral mid-point of the persuasiveness scale [18]. The neutral mid-point for *perceived persuasiveness* (i.e., the value '4' on the 7-point Likert scale) indicates that a strategy is perceived as rather neutral (i.e., neither persuasive nor unpersuasive). Out of the 17 strategies, PwCOPD perceived eight strategies as significantly more persuasive than the neutral mid-point—in the following listed from highest (most persuasive) to lowest (least persuasive): *personalization, reminder, commitment, self-monitoring, rewards, customization, authority,* and *scarcity* (see Fig. 2 and Table 2). Interestingly, two PS were perceived as significantly less persuasive than the neutral mid-point, namely *liking* and *reciprocity*.

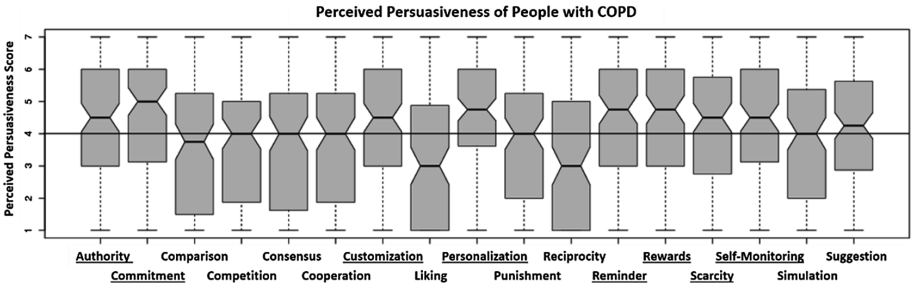

Fig. 2. Perceived persuasiveness (y-axis) of the 17 PS (x-axis) on a Likert-type scale ranging from 1 to 7 (higher scores indicate a higher persuasiveness; the horizontal line at 4 indicates the neutral mid-point, the eight underlined strategies are perceived as significantly more persuasive than the neutral mid-point).

Table 2. Means and standard deviations of perceived persuasiveness towards the 17 strategies

Strategy	*M*(*SD*)	Strategy	*M*(*SD*)	Strategy	*M*(*SD*)
Authority	4.3 (±1.9)	Customization	4.3 (±1.9)	Rewards	4.4 (±2.0)
Commitment	4.4 (±1.9)	Liking	3.2 (±2.0)	Scarcity	4.1 (±1.9)
Comparison	3.6 (±2.1)	Personalization	4.6 (±1.9)	Self-monitoring	4.4 (±1.8)
Competition	3.7 (±2.1)	Punishment	3.7 (±2.1)	Simulation	3.8 (±1.9)
Consensus	3.7 (±2.0)	Reciprocity	3.3 (±2.0)	Suggestion	4.1 (±1.9)
Cooperation	3.7 (±2.0)	Reminder	4.4 (±2.0)		

Note. *M* = mean, *SD* = standard deviation.

4.2 Individual Susceptibility to Persuasion

In order to examine the *individual susceptibility to persuasion* of PwCOPD to different strategies, we compared the mean scores for each of the strategies that we calculated from the *Susceptibility to Persuasion Scale* (STPS).

Results from the repeated-measures ANOVA revealed a significant effect for the within-subjects factor *individual susceptibility to persuasion*, ($F(5, 545) = 89.00$, $p < .001$, partial eta squared = .449), indicating that people's self-assessment of individual susceptibility differed for Cialidini's six PS.

As illustrated in Fig. 3 and Table 3 below, PwCOPD had a significantly higher individual susceptibility towards *reciprocity, commitment* and *liking*, than to *scarcity, authority* and *consensus*.

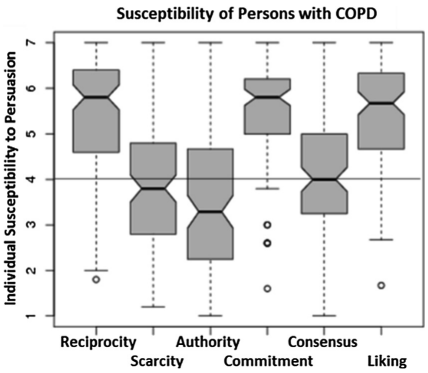

Fig. 3. Individual susceptibility (y-axis) towards Cialdini's six strategies (x-axis) on a Likert-type scale ranging from 1 to 7 (higher scores indicate a higher susceptibility; the horizontal line at 4 indicates the neutral mid-point).

Table 3. Means and standard deviation of individual susceptibility to persuasion

Strategy	*M*(*SD*)	Strategy	*M*(*SD*)	Strategy	*M*(*SD*)
Reciprocity	5.4(±1.3)	Authority	3.6 (±1.5)	Consensus	4.2 (±1.3)
Scarcity	3.9 (±1.5)	Commitment	5.6 (±1.1)	Liking	5.4 (±1.2)

Note. *M* = mean, *SD* = standard deviation.

5 Discussion

In the following section, we first discuss the *perceived persuasiveness* of the 17 strategies by elaborating on the most interesting strategies (i.e., the most and least PS as well as a group of strategies that rely on social interaction). We follow up by addressing *individual susceptibility to persuasion* and how it differs from participants' *perceived persuasiveness*.

Perceived persuasiveness of the 17 strategies. The analysis of our online survey data revealed a significant difference in the *perceived persuasiveness* of the 17 PS. *Personalization* was perceived as the most PS for PwCOPD. This could suggest a need to account for individual requirements due to individual-specific disease conditions. This highlights the need to establish an appropriate activity plan in line with each person's physical abilities. *Liking*, on the other hand, was perceived as the least PS for PwCOPD. This strategy rests on the principle that people like people, who are familiar and similar to them [22]. Therefore, the strategy might work only for PwCOPD when the other person understands what it means to be living with this disease and be physically active (e.g., when the other person is also affected by the disease or familiar with COPD). Hence, further investigations are required to see if the social context might have an influence on the PS *liking*. Moreover, a worsening of the disease can make it difficult to maintain, let alone surpass past activity levels for which they might have previously received acknowledgement in the form of likes from others. Getting likes for underperforming could be perceived as demotivating for them. Thus, relying on 'social gratification' might put them on the spot what they rather like to avoid. Those PS that rely on some kind of interaction with other persons (i.e., *comparison*, *competition* or *cooperation*) showed to be averagely persuasive for PwCOPD. Bartlett et al. [9] found in their qualitative interviews, that PwCOPD had very diverse opinions about those social strategies with, for example, some people liking the idea of competitive activities and others not. Similarly, as can be seen from our own data (Fig. 2), the ratings of *perceived persuasiveness* varied greatly for the social strategies, resulting in an overall persuasiveness score close to the neutral mid-point of the scale. Interestingly, *competition* and *comparison* are increasingly used and widely appreciated in persuasive systems for the general population [17]. PwCOPD, who feel stressed by their symptoms, may disfavor the two strategies, giving them the feeling of losing control and drawing them out of the comfort zone [17].

Individual susceptibility to persuasion and how it differs from perceived persuasiveness. We found significant differences in participants' *individual susceptibility to persuasion*. PwCOPD showed high susceptibility to *reciprocity* ($M = 5.4$) and *liking* ($M = 5.4$). These two strategies, however, were the least persuasive ones when evaluating the respective storyboard implementations in terms of their *perceived persuasiveness* ($M = 3.3$ and $M = 3.2$, for *reciprocity* and *liking* respectively). Similarly, *authority* had the lowest susceptibility score ($M = 3.6$) but was perceived as slightly above average persuasive in the storyboard implementation ($M = 4.3$). It appears that

the *perceived persuasiveness*, as measured by the scale of Drozd et al. [21], and *individual susceptibility to persuasion*, as measured by the STPS [16], both assess distinct aspects of persuasiveness and are more diverse as expected.

5.1 Implications for Designing Persuasive Systems for PwCOPD

Based on the results from our study in which we investigated the *perceived persuasiveness* and *individual susceptibility to persuasion* of PwCOPD, we can derive several implications for the future development of persuasive systems targeting specifically PwCOPD. In the following we provide examples of how the strategies could be implemented. These are based on our experiences from working with PwCOPD. Our analysis shows which PS were perceived as significantly above (below) average with respect to their persuasiveness by PwCOPD and are thus most (least) suitable in the design of persuasive systems targeting the group. Based on the experience from running the study and the evaluation results, we provide the following suggestions:

(1) A physical activity plan and suggestions for physical activity that are personalized to the individual needs of PwCOPD are more effective than generic recommendations. Physical activity recommendations should especially account for each person's health status as this hugely affects their motivation to engage in physical activity (*personalization*).
(2) In addition, the persuasive technology should be designed to allow the PwCOPD to adapt the suggested physical activity plan to her/his individual needs (*customization*). A defined daily or weekly physical activity goal could be presented as a virtual contract by the persuasive system. Our findings reveal that there is a higher motivation to comply to the plan when the person committed herself/himself to a goal (*commitment*). However, additional reminders to meet their physical activity goals are useful (*reminder*). Ideally, those reminders should account for the person's current symptoms, which could vary on a day-to-day basis. Specifically, exacerbations, which are acute deteriorations of the disease, have to be considered when giving recommendations or reminders. The detection of an exacerbation in clinical practice relies on the patient's self-reporting of symptoms, such as dyspnea, cough and increased sputum. Assessing those indicators allows a technology to recognize upcoming exacerbations, thus, give recommendations and reminders accordingly [23].
(3) Setting time limits to achieve goals is further motivating for PwCOPD. This could be implemented by informing them about how much time they have left to achieve this goal (*scarcity*). This strategy is suited to be combined with reminders or rewards, which both showed to motivate PwCOPD (*reminder*, *reward*).
(4) A persuasive system that provides the person's activity data and feedback in a visually appealing and understandable way is further motivating. For PwCOPD, not only their activity data but also their subjectively indicated symptoms and physiological data (e.g., oxygen saturation, pulse) could be presented. Overviews and retrospectives as well as correlations of data (e.g., the more you walk, the better you feel) could help them to understand the importance of regular physical activity (*self-monitoring*).

(5) Information and suggestions coming from an authority figure are more persuasive for PwCOPD (compared to information that is not provided by an authority figure). In case of COPD, recommendations could be presented in a persuasive system not only from physicians but also from acknowledged COPD institutions such as the Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) [24], the European Respiratory Society or the American Thoracic Society [25] (*authority*).
(6) Two of the 17 PS were perceived as below average in persuasiveness by PwCOPD and are thus not suitable for this target group: *liking* and *reciprocity*. Thus, we would recommend avoiding these two strategies when designing persuasive systems for PwCOPD.

6 Conclusions

With this research, we extend the existing literature of persuasive technology in healthcare by presenting findings from an online study that investigated *perceived persuasiveness* of widely-used PS for PwCOPD (who have been majorly neglected by researchers), with the goal of increasing their physical activity level. To the best of our knowledge, this study is the first research in the domain of persuasion that is focused on PwCOPD.

Our results have several implications for the future development of persuasive systems for PwCOPD. Our research shows that PwCOPD perceive the individual strategies to be significantly different in their persuasiveness. Thus, it is beneficial to employ only those strategies that were rated above average in *perceived persuasiveness*. Based on our findings, we offer some suggestions on how the strategies can be implemented to motivate PwCOPD.

Further research is necessary to see if those findings apply only to the target behavior of increasing physical activity or if the outcomes can be generalized to other target behaviors. Our findings additionally need to be verified in the real-life context of PwCOPD to investigate their validity and reliability and to gather more details on the impact of persuasive systems for PwCOPD. Further research should investigate if the ascertained differences in *perceived persuasiveness* and *individual susceptibility to persuasion* pertain also to people without COPD. A limitation is that the results are based on implementations of PS in the form of storyboards, which differ from real-world implementations in the form of applications for mobile devices.

Acknowledgements. This research has partly been funded by the Vienna Business Agency under contract no. ID 1605387 (SmartCOPDTrainer).

References

1. Buist, A.S., McBurnie, M.A., Vollmer, W.M., Gillespie, S., Burney, P., Mannino, D.M., Menezes, A.M.B., Sullivan, S.D., Lee, T.A., Weiss, K.B., Jensen, R.L., Marks, G.B., Gulsvik, A., Nizankowska-Mogilnicka, E.: International variation in the prevalence of COPD (the BOLD Study): a population-based prevalence study. Lancet **370**(9589), 741–750 (2007)
2. World Health Organization (WHO): Burden of COPD. http://www.who.int/respiratory/copd/burden/en/. Accessed 31 Jan 2018

3. Gibson, G.J., Loddenkemper, R., Lundbäck, B., Sibille, Y.: Respiratory health and disease in Europe: the new European lung white book. Eur. Respir. J. **42**(3), 559–563 (2013)
4. Wilkinson, T.M.A., Donaldson, G.C., Hurst, J.R., Seemungal, T.A.R., Wedzicha, J.A.: Early therapy improves outcomes of exacerbations of chronic obstructive pulmonary disease. Am. J. Respir. Crit. Care Med. **169**, 1298–1303 (2004)
5. Halpin, D.M.G., Laing-Morton, T., Spedding, S., Levy, M.L., Coyle, P., Lewis, J., Newbold, P., Marno, P.: A randomised controlled trial of the effect of automated interactive calling combined with a health risk forecast on COPD using EXACT PRO. Prim. Care Respir. J. **20** (3), 324–331 (2011)
6. Watz, H., Pitta, F., Rochester, C.L., Garcia-Aymerich, J., ZuWallack, R., Troosters, T., Vaes, A.W., Puhan, M.A., Jehn, M., Polkey, M.I., Vogiatzis, I., Clini, E.M., Toth, M., Gimeno-Santos, E., Waschki, B., Esteban, C., Hayot, M., Casaburi, R., Porszasz, J., McAuley, E., Singh, S.J., Langer, D., Wouters, E.F., Magnussen, H., Spruit, M.A.: An official European respiratory society statement on physical activity in COPD. Eur. Respir. J. **44**, 1521–1537 (2014)
7. van Boven, J.F.M., Chavannes, N.H., van Der Molen, T., Rutten-van Mölken, M.P.M.H., Postma, M.J., Vegter, S.: Clinical and economic impact of non-adherence in COPD: a systematic review. Respir. Med. **108**(1), 103–113 (2014)
8. Matthews, J., Win, K.T., Oinas-Kukkonen, H., Freeman, M.: Persuasive technology in mobile applications promoting physical activity: a systematic review. J. Med. Syst. **40**(3), 1–13 (2016)
9. Bartlett, Y.K., Webb, T.L., Hawley, M.S.: Using persuasive technology to increase physical activity in people with chronic obstructive pulmonary disease by encouraging regular walking: a mixed-methods study exploring opinions and preferences. JMIR **19**(4), e124 (2017)
10. Yoganathan, D., Kajanan, S.: Persuasive technology for smartphone fitness. In: PACIS 2013 Proceedings, Paper 185 (2013)
11. Leidy, N.K., Kimel, M., Ajagbe, L., Kim, K., Hamilton, A., Becker, K.: Designing trials of behavioral interventions to increase physical activity in patients with COPD: insights from the chronic disease literature. Respir. Med. **108**, 472–481 (2014)
12. Voncken-Brewster, V., Moser, A., van der Weijden, T., Nagykaldi, Z., De Vries, H., Tange, H.: Usability evaluation of an online, tailored self-management intervention for chronic obstructive pulmonary disease patients incorporating behavior change techniques. JMIR Res. Protoc. **2**(1), e3 (2013)
13. De Vries, H., Mesters, I., Van De Steeg, H., Honing, C.: The general public's information needs and perceptions regarding hereditary cancer: an application of the integrated change model. Patient Educ. Couns. **56**, 154–165 (2005)
14. Van Der Weegen, S., Verwey, R., Spreeuwenberg, M., Tange, H., Van Der Weijden, T., De Witte, L.: The development of a mobile monitoring and feedback tool to stimulate physical activity of people with a chronic disease in primary care: a user-centered design. JMIR Mhealth Uhealth **1**(2), e8 (2013)
15. Bartlett, Y.K., Sheeran, P., Hawley, M.S.: Effective behaviour change techniques in smoking cessation interventions for people with chronic obstructive pulmonary disease: a meta-analysis. Br. J. Health. Psychol. **19**, 181–203 (2014)
16. Kaptein, M., De Ruyter, B., Markopoulos, P., Aarts, E.: Adaptive persuasive systems. ACM Trans. Interact. Intell. Syst. **2**(2), 25p (2012). Article 10
17. Orji, R., Vassileva, J., Mandryk, R.L.: Modeling the efficacy of persuasive strategies for different gamer types in serious games for health. User Model. User-Adap. Inter. **24**, 453–498 (2014)

18. Busch, M., Mattheiss, E., Reisinger, M., Orji, R., Fröhlich, P., Tscheligi, M.: More than sex: the role of femininity and masculinity in the design of personalized persuasive games. In: Meschtscherjakov, A., De Ruyter, B., Fuchsberger, V., Murer, M., Tscheligi, M. (eds.) PERSUASIVE 2016. LNCS, vol. 9638, pp. 219–229. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-31510-2_19
19. Orji, R., Nacke, L.E., DiMarco, C.: Towards personality-driven persuasive health games and gamified systems. In: Proceedings SIGCHI Conference on Human Factors Computer System (2017)
20. Cialdini, R.B.: Harnessing the science of persuasion. Harv. Bus. Rev. **79**(9), 72–81 (2001)
21. Drozd, F., Lehto, T., Oinas-Kukkonen, H.: Exploring perceived persuasiveness of a behavior change support system: a structural model. In: Bang, M., Ragnemalm, E.L. (eds.) PERSUASIVE 2012. LNCS, vol. 7284, pp. 157–168. Springer, Heidelberg (2012). https://doi.org/10.1007/978-3-642-31037-9_14
22. Cialdini, R.B.: The science of persuasion. Sci. Am. **284**(2), 76–81 (2004)
23. Leidy, N.K., Wilcox, T.K., Jones, P.W., Jones, P., Roberts, L., Powers, J.H., Sethi, S., Donohue, J., Eremenco, S., Erickson, P., Martinez, F., Patrick, D., Rennard, S., Rodriguez-Roisin, R., Schünemann, H.: Standardizing measurement of chronic obstructive pulmonary disease exacerbations: reliability and validity of a patient-reported diary. Am. J. Respir. Crit. Care Med. **183**(3), 323–329 (2011)
24. Vestbo, J., Hurd, S.S., Agustí, A.G., Jones, P.W., Vogelmeier, C., Anzueto, A., Barnes, P.J., Fabbri, L.M., Martinez, F.J., Nishimura, M., Stockley, R.A., Sin, D.D., Rodriguez-Roisin, R.: Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease GOLD executive summary. Am. J. Respir. Crit. Care Med. **187**(4), 347–365 (2013)
25. Celli, B.R., Decramer, M., Wedzicha, J.A, Wilson, K.C., Agustí, A., Criner, G.J., MacNee, W., Make, B.J., Rennard, S.I., Stockley, R.A., Vogelmeier, C., Anzueto, A., Au, D.H., Barnes, P.J., Burgel, P.R., Calverley, P.M., Casanova, C., Clini, E.M., Cooper, C.B., Coxson, H.O., Dusser, D.J., Fabbri, L.M., Fahy, B., Ferguson, G.T., Fisher, A., Fletcher, M.J., Hayot, M., Hurst, J.R., Jones, P.W., Mahler, D.A., Maltais, F., Mannino, D.M., Martinez, F.J., Miravitlles, M., Meek, P.M., Papi, A., Rabe, K.F., Roche, N., Sciurba, F.C., Sethi, S., Siafakas, N., Sin, D.D., Soriano, J.B., Stoller, J.K., Tashkin, D.P., Troosters, T., Verleden, G.M., Verschakelen, J., Vestbo, J., Walsh, J.W., Washko, G.R., Wise, R.A., Wouters, E.F., ZuWallack, R.L.: An official American Thoracic Society/European Respiratory Society statement: research questions in COPD. Eur. Respir. J. **45**, 879–905 (2015)