Combining Behavior Change Intentions and User Types to Select Suitable Gamification Elements for Persuasive Fitness Systems

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Abstract. The motivational impact of gamification elements differs substantially across users. To account for these differences, we investigate Hexad user types and behavior change intentions as factors to personalize gamifed, persuasive fitness systems. We conducted an online study (N=179), measuring the perceived persuasiveness of twelve gamification elements using storyboards. Results show the applicability of the Hexad user type in the Physical Activity domain. Besides replicating correlations between gamification elements and user types, we also found correlations which were hypothesized in literature, but not yet shown. Our main contribution is to show that behavior change intentions influence the perception of gamification elements in general and affect the set of relevant elements for each user type. Since a static set of elements has been suggested for each user type so far, this is an important finding, leading to potentially more effective personalization approaches.

Keywords: Personalization · Gamification · Physical Activity

1 Introduction

Gamification, the use of game elements in non-game contexts [5], has been successfully used to engage users in various domains [9,11]. Among these, the Health domain is one of the most prominent [8], with gamification being frequently used to motivate people to lead a more active lifestyle [26]. Given that an increasing number of people lead sedentary lifestyles [24], investigating gamification for behavior change in this domain is important. While in general most gamified systems have been shown to be successful when adopting a "one-size-fits-all" approach [8, 26], research has also found negative results [4, 9, 26]. This is unsurprising, given that the motivational impact of game elements differs substantially across users [3, 29]. Therefore, understanding how to personalize gamified systems has gained attention as a topic for research. To personalize gamified systems, static factors like personality [11], age [1, 2] or gender [18] have been shown to influence the perception of game elements. Also, the Hexad model [15], a user type model specifically developed for gamified interventions, was shown to be a useful factor for tailoring gamified, persuasive systems [20, 30]. However, psychological models like the Transtheoretical Model of Behavior Change

("TTM") [23] suggest that the behavioral intention to perform a behavior dynamically changes, with people passing through several qualitatively different, successive stages of change ("SoC"). When individuals progress through these stages, the type of motivation changes from extrinsic to intrinsic as behavioral regulation becomes more self-determined [17]. This potentially affects the perception of gamification elements. Therefore, the SoC might play an important role in personalizing gamified, persuasive interventions. Yet, to our knowledge, this has not been researched so far. In this paper, we contribute to this open question by using a storyboard-based approach, illustrating frequently used gamification elements for persuasive systems in the Physical Activity domain. After ensuring that these storyboards illustrate the intended gamification elements, we conducted a user study confronting participants with the aforementioned gamification elements (N=179) and correlated their answers to their user type and TTM level.

With our findings we reproduce the set of relevant gamification elements for Hexad user types from previous research, showing its applicability in the Physical Activity context. We also found correlations between gamification elements and user types, which were hypothesized in literature, but not yet shown. As our main contribution, our results show that the SoC indeed influences the perception of gamification elements in general and changes the set of relevant gamification elements for each user type. This implies that the set of relevant gamification elements does not remain stable for each user type, but dynamically changes when behavior intentions change. This finding is important, as, so far, a static set of gamification elements has been suggested for each user type [30], not taking into account the dynamic process of behavior change [23].

2 Background and Related Work

After introducing the Hexad- and the Transtheoretical models, related work about individualizing gamified systems is presented in this section.

2.1 Hexad User Type Model

The Hexad user types model [15] was specifically developed for gamified systems [20]. It was shown to be an effective personalization tool for persuasive systems [20]. Also, a questionnaire was created and validated [28]. The Hexad consists of six user types that differ in the degree to which they are driven by their needs for autonomy, relatedness and competence (as defined by the Self-Determination Theory (SDT) [25]). **Philanthropists ("PH")** are socially-minded, like to bear responsibility and share knowledge with others. They are driven by *purpose*. Similarly, **Socializers ("SO")** are socially-minded, but they are more interested in interacting with others. *Relatedness* is most important for them. **Free Spirits ("FS")** are satisfied when acting without external control, with *autonomy* being most important for them. **Achievers ("AC")** are satisfied when overcoming difficult challenges or learning new skills. *Competence* is most important for them. **Players ("PL")** are out for their own benefits, and will do their best to earn rewards. *Extrinsic rewards* are most important for them. Lastly, **Disruptors ("DI")** are driven by disrupting systems and by testing its boundaries. Triggering *change* is most important for them.

2.2 Transtheoretical Model

The Transtheoretical Model by Prochaska et al. [23] describes the process of intentional behavior change. It posits that behavior change involves progress through five stages of change. In the **Precontemplation** stage, the subject has no intention to take action in the foreseeable future (usually 6 months), while subjects in the **Contemplation** stage intend to take action within the next 6 months. Subjects in the **Preparation** stage intend to take action in the immediate future (usually 30 days), and have taken some behavioral steps yet. In the **Action** stage, the subject has changed their behavior for less than 6 months, while in **Maintenance**, subjects have changed their behavior for more than 6 months. When individuals progress through these stages, their motivation becomes more intrinsic as behavioral regulation becomes more self-determined [17]. We expect that this has an effect on the perception of gamification elements.

2.3 Individualization of Gamified Systems

Individualizing gamified systems has been shown to be appreciated [13] and more effective than traditional "one-size-fits-all" approaches [4, 12]. Consequently, research has been conducted on how gamified systems can be individualized. For instance, Jia et al. [11] investigated the relationship between personality traits and perceived preferences for several motivational affordances. They found multiple significant correlations (e.g. that Extraverts tend to be motivated by points, levels, and leaderboards) which help to personalize gamified systems. Similarly, Orji et al. [19] studied how personality traits can be used to tailor persuasive strategies within systems for health. They found that individuals' personalities indeed influence the perceived persuasiveness of persuasive strategies (which were explained using storyboards). Studies also revealed age [1, 2] and gender as factors influencing the perception of motivational affordances [18, 22]. For instance, Birk et al. [2] found that motivations to engage in games change with increasing age, from focusing on performance towards focusing on enjoyment, which is supported by findings from Altmeyer et al. [1]. Complementing these findings, Oyibo et al. [22] found relationships between age and gender for the game elements rewards, competition, social learning and comparison. One of the most promising approaches to personalize gamified systems is using the Hexad user types model [30], as it is the only model that was specifically developed for gamified systems (rather than for games) [20]. Also, the applicability of this model for gamified, persuasive systems has been shown [20]. Research has been carried out to examine whether different Hexad user types prefer different game elements or motivational affordances. Indeed, Tondello et al. [30] found several significant correlations between Hexad user types and the perception of game elements. In a follow-up work, Tondello et al. [29] propose a conceptual framework for classifying game elements based on an exploratory factor analysis of participants' preferences. In line with the previous study, they found several correlations to the Hexad user types. Furthermore, Orji et al. [20] showed that the Hexad user types play a significant role in the perception of persuasive strategies to change risky alcohol behavior. Thus, the Hexad user type model offers great potential for tailoring gamified, persuasive systems. However, the Hexad framework (and all aforementioned factors) does not take into account the dynamic process of behavioral intentions, which has been shown to affect the type of motivation a user develops towards an activity [17]. In this paper, we aim to reduce this gap by investigating whether the SoC has an effect on the perception of gamification elements in the Physical Activity context.

3 Gamification Elements, Storyboards and Validation

For the storyboards, we ensured to have at least one gamification element for each user type, based on [15, 30]. This resulted in twelve different storyboards (showing the gamification elements as stated in Table 1). These were created using the guidelines by Truong et al. [31]. We decided to use storyboards since they provide a common visual language that is easy to understand and do not involve game- or technology-specific knowledge [21]. Due to space restrictions, only two storyboards are included in this paper (see Figure 1). However, all created storyboards can be found on figshare[3].

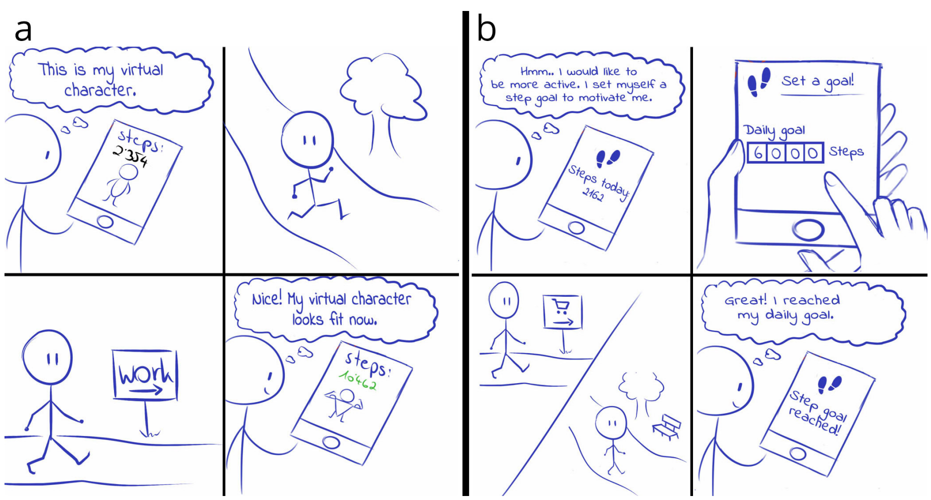

Fig. 1. Virtual Character (a) and Custom Goal (b) storyboards

[3] https://doi.org/10.6084/m9.figshare.7380902.v1

Table 1. Gamification elements included in the main study, a short textual description explaining what is depicted in the corresponding storyboard and the user types ("PT") we expect to be positively affected by them based on [15, 30].

Gamification Element	Short Storyboard Description	Expected PT
Virtual Character	*The appearance of a virtual character is linked to the amount of steps walked.*	AC, PL
Custom Goal	*The user sets herself a custom step goal.*	AC, FS
Personalized Goal	*The system personalizes the users' step goal.*	AC
Challenge	*The user manages to reach a demanding goal.*	AC
Badges	*The user reaches her goal three times, unlocking a new badge.*	AC, PL
Points	*The system rewards the user with points for walking steps.*	PL, AC
Rewards	*After reaching the step goal three times, the user receives a coupon code.*	PL
Knowledge Sharing	*The user helps another user in a forum by answering a question.*	PH
Unlockable Content	*After reaching the step goal three times, the app unlocks a new feature .*	FS
Cheating	*The user decides to cheat by driving a car to reach her step goal.*	DI
Social Collaboration	*A group of users have to collaborate, to reach their shared step goal.*	SO
Social Competition	*A group of users are shown on a leaderboard, competing for the top position.*	SO, PL

3.1 Storyboard Validation

To ensure that participants understand the storyboards, we conducted a qualitative pre-study in the lab.

Method After answering demographic questions, the printed storyboards were shown to each participant in random order. A semi-structured interview followed in which all sessions were conducted by one researcher and audio recordings were made. First, participants were asked to describe the storyboards in their own words. When necessary, the interviewer asked questions to prompt participants to identify which activities are depicted by the storyboards. Questions included: *"What is the character's goal?"* and *"What means does the character use to achieve her goal?"*. Afterwards, participants were given a short textual summary of each gamification element. They were asked to assign each of the storyboards its respective element by placing the aforementioned pieces of paper (holding the textual summaries) next to the respective storyboard. Next, interviews were transcribed and analyzed by two independent raters ("R1", "R2").

They received the transcriptions for each storyboard, without revealing which gamification element was described by the participants. Their tasks were to evaluate which element was being described and to rate how well the element was understood on a 5-point scale (1-very poor to 5-very well).

Results 8 German participants took part (4 female, average age 21.75). To ensure that the ratings can be interpreted objectively, we calculated the interrater agreement and found it to be Kappa=0.75, which is considered as substantial [16]. Analyzing the ratings of the two independent raters, we found that the participants understood the storyboards very well ($M_{R1} = 4.90$, $Min_{R1} = 4$; $M_{R2} = 4.86$, $Min_{R2} = 4$). This was supported by the fact that both raters successfully assigned the correct game element based on participants' storyboard descriptions. Regarding users assigning the textual summaries to the respective storyboard, only one assignment was incorrect. However, this wrong assignment was not due to a misunderstanding of the game element, but due to the participant misreading the descriptions of one of the game elements. The participant assured us that the storyboard and respective game element were clear to him.

4 Main Study

We conducted an online survey, which was available in English and German. Participants were recruited via social media and Academic Prolific (paid 1.50 pounds). The study took 10-15 minutes to complete and was approved by our Ethical Review Board[4]. After asking for demographic data and gaming behavior, the TTM SoC was determined using a validated scale for the Physical Activity context [14]. For later analysis, participants were split into two groups: "Low-TTM" (participants who did not take action so far, having a SoC $<= 3$ [33]) and "High-TTM" (participants who did take action, having a SoC $>= 4$ [33]), according to the suggestions of Xiao et al. [33] on how to analyze the different TTM stages. Afterwards, participants' user type was determined using the Hexad User Types scale [30]. Finally, as the main part of the questionnaire, participants were shown the 12 storyboards in a randomized order. To measure the persuasiveness of each gamification element depicted in the storyboards, we adapted the perceived persuasiveness scale by Drozd et al. [6] in the same way as was done by Orji et al. [19]. The scale consists of four items to be answered on 7-point Likert scales. A Shapiro-Wilk test revealed that the persuasiveness items were not normally distributed, which is why we used non-parametric tests for our analysis. For correlation analysis, Kendall's τ was used, as it is well-suited for non-parametric data [10]. It should be noted that Kendall's τ is usually lower than Pearson's r for the same effect sizes. Therefore, we transformed interpretation thresholds for Pearson's r to Kendall's τ, according to Kendall's formula [32] (small effect: $\tau = 0.2$; medium effect: $\tau = 0.3$; large effect: $\tau = 0.5$).

[4] `https://erb.cs.uni-saarland.de/`, last accessed January 24, 2019

4.1 Results

We excluded three participants who are unable to exercise or answered all gaming related questions with "Strongly disagree", leading to 179 valid responses. Of these participants, 44.1% were male, 55.3% were female and 0.6% identified themselves as "nonbinary". Most participants (38%) were aged 18-24 years, followed by 25-31 (34.1%), 32-38 (17.3%), 39-45 (6.7%) and younger than 18 (1.7%). The remaining participants were aged 45 and older (1.7%). Participants claimed to have a passion for video games (M = 3.70, SD = 1.11, Mdn = 4.00) and to frequently play video games (M = 3.58, SD = 1.24, Mdn = 4.00).

Table 2. Persuasiveness of gamification elements in the Low- and the High-TTM group and results of Mann-Whitney-U tests comparing them ("Diff. sig."). Significant differences from the neutral choice are colored (green = positive, red = negative deviations)

	Low-TTM	**High-TTM**	**Diff. sig.**
Virtual Character	M = 4.05, SD = 1.77, Mdn = 4.50	M = 3.94, SD = 1.81, Mdn = 4.25	-
Custom Goal	M = 4.34, SD = 1.49, Mdn = 4.63	M = 4.70, SD = 1.55, Mdn = 5.25	-
Personalized Goal	M = 4.88, SD = 1.44, Mdn = 5.00	M = 4.93, SD = 1.38, Mdn = 5.25	.
Challenge	M = 4.32, SD = 1.65, Mdn = 4.75	M = 4.88, SD = 1.27, Mdn = 5.00	p = 0.045, Z = -2.00, U = 3173.50
Badges	M = 3.95, SD = 1.57, Mdn = 4.00	M = 4.46, SD = 1.40, Mdn = 4.75	p = 0.028, Z = -2.19, U = 3108.50
Points	M = 4.39, SD = 1.46, Mdn = 5.00	M = 4.52, SD = 1.43, Mdn = 4.50	-
Rewards	M = 5.16, SD = 1.48, Mdn = 5.25	M = 5.50, SD = 1.39, Mdn = 5.75	-
Knowledge Sharing	M = 4.06, SD = 1.52, Mdn = 4.25	M = 4.26, SD = 1.51, Mdn = 4.50	-
Unlockable Content	M = 4.70, SD = 1.49, Mdn = 5.00	M = 4.84, SD = 1.53, Mdn = 5.00	-
Cheating	M = 2.12, SD = 1.16, Mdn = 2.00	M = 2.35, SD = 1.44, Mdn = 2.00	-
Social Collaboration	M = 4.23, SD = 1.56, Mdn = 4.88	M = 4.81, SD = 1.61, Mdn = 5.25	p = 0.009, Z = -2.62, U = 2963.50
Social Competition	M = 4.09, SD = 1.74, Mdn = 4.50	M = 4.61, SD = 1.76, Mdn = 4.75	p = 0.048, Z = -1.98, U = 3180.50

SoC and Gamification Elements After splitting participants into two TTM groups (as suggested in [33]), 72 participants were in the Low-TTM and 107 participants in the High-TTM group. To investigate whether the perceived persuasiveness changes between these groups, we performed a two-sided Mann-Whitney-U test for each gamification element. Also, a one-sample Wilcoxon signed rank test was performed against the value 4 on the 7-point scale to investigate which gamification elements were perceived as significantly better or worse than the neutral choice. Table 2 shows an overview of these tests and the means and medians of the perceived persuasiveness for each gamification element. Overall, we found that some gamification elements were perceived significantly differently from the neutral choice in the High-TTM group but not in the Low-TTM group. Also, significant differences for four gamification elements were found. Badges and Challenges, both building on the need for mastery or competence [15], were shown to be significantly more persuasive for users at high stages of change than for users at low stages. This is explainable by goal-setting theory (as both elements require reaching a goal), stating that goals are most effective when users are committed to them [27], which is unlikely for users in the Low-TTM group. Another reason could be that participants in Low-TTM considered themselves not to be able to reach those goals [7]. Moreover, Social Competition and Social Collaboration, both building on the relatedness motive [15] were perceived as significantly more persuasive in the High-TTM group. A potential reason for this includes the fear to not be able to keep up with other users [7], detrimentally affecting users' motivation. These findings show that the SoC on its own is a relevant factor that should be considered in tailoring persuasive, gamified interventions in the physical activity context.

Table 3. Kendall's τ and significance between the Hexad user types and the gamification elements. Bold entries represent expected correlations (Table 1). *p<.05, **p<.01

	AC	**DI**	**FS**	**PH**	**PL**	**SO**
Virtual Character	-	-	-	-	**.237****	.114*
Custom Goal	**.205****	-	**.132***	.119*	-	.106*
Personalized Goal	**.211****	-	-	.145**	-	-
Challenge	**.200****	-	.145**	-	.177**	-
Badges	**.122***	-	-	-	**.223****	-
Points	**.201****	-	.110*	.192**	**.169****	.105*
Rewards	.114*	-	-	.152**	**.250****	.109*
Knowledge Sharing	.123*	-	-	**.234****	-	.175**
Unlockable Content	.140**	-	**.143****	-	.163**	-
Cheating	-	**.157****	-	-	-	-
Social Collaboration	.147**	-	.153**	.145**	.216**	**.314****
Social Competition	.105*	-	-	-	**.370****	**.204****

Hexad User Types and Gamification Elements Table 3 presents the significant correlations of gamification elements to each user type. We found 16 positive correlations between user types and gamification elements out of 17 expected correlations (see Table 1). The positive correlation between the gamification element "Virtual Character" and the "Achiever" user type is the only correlation that was expected but not found. Given these results, we extend and replicate previous work [20,30]: We show the applicability of previous findings in the Physical Activity context and contribute evidence for previously hypothesized, but not yet shown correlations, i.e. between the Philanthropist and the gamification element "Knowledge Sharing" and between the Disruptor and the gamification element "Cheating" [30]. In addition to expected correlations, some unexpected

Table 4. Kendall's τ and significance between the Hexad user types and gamification elements for the Low- and the High-TTM group. Colored cells indicate that a correlation is significantly stronger in one group than in the other group. *p<.05, **p<.01

	Low-TTM						***High-TTM***					
	AC	**DI**	**FS**	**PH**	**PL**	**SO**	**AC**	**DI**	**FS**	**PH**	**PL**	**SO**
Virtual Character	.218*	-	-	-	-	-	-	-	-	-	.304**	.183**
Custom Goal	.192*	-	-	-	.171*	-	.215**	-	.178*	.194**	-	-
Personalized Goal	-	-	-	-	-	-	.253**	-	.178*	-	-	-
Challenge	.182*	-	-	-	-	-	.214**	-	-	-	.249**	-
Badges	-	-	-	-	.215*	-	.161*	-	-	.141*	.276**	-
Points	-	-	-	.213*	-	.191*	.250**	-	.200**	.170*	.195**	-
Rewards	-	-	-	-	.182*	-	-	-	-	.144*	.303**	-
Knowledge Sharing	-	-	-	-	-	-	.191**	-	-	.327**	-	.248**
Unlockable Content	-	-	.222*	-	-	-	.154*	-	-	-	.230**	-
Cheating	-	.222*	-	-	-	-	-	-	-	-	-	-
Social Collaboration	-	-	.191*	-	-	-	.153*	-	-	.185**	.285**	.343**
Social Competition	-	-	-	-	.316*	-	-	-	-	-	.422**	.206**

correlations were found. However, this is in line with previous research about the Hexad user types [20,30]. Also, all but one unexpected correlations are weak ($\tau < 0.2$), which suggests that their actual effect is negligible.

SoC, Hexad User Types and Gamification Elements To investigate potential effects of the SoC on the set of suitable gamification elements for each user type, we compared correlations of gamification elements to user types between the Low- and the High-TTM group. Table 4 shows these correlations for both groups. The analysis revealed that the set of significantly correlating gamification elements is different in both groups, suggesting that taking the SoC into account when tailoring persuasive systems for user types should improve personalization. To emphasize this, we also investigated whether the strength of correlations differs significantly between the Low- and the High-TTM groups. For this, we converted Kendall's τ to Pearson's r according to Kendall's formula described in [32]. Afterwards, we applied Fisher's z-transformation to these coefficients to check for effects. Supporting the main hypothesis of this paper, we found multiple significant differences between the groups for all user types but the Disruptor. Gamification elements for which the correlation coefficient significantly increased on a user type level are colored green in Table 4. For example, we found that the correlation between the "Virtual Character" gamification element and the "Achiever" user type is significantly stronger in the Low-TTM than in the High-TTM group. Similarly, we found that social competition is positively affecting for Socializers only when being in a High-TTM stage. Besides the Disruptor, we found similar findings for all other user types. Therefore, these results should be considered when making decisions about which gamification elements should be included in a system, in order to enhance its persuasiveness.

Discussion and Limitations We investigated the effect of behavior change intentions on the perception of gamification elements in the Physical Activity domain. We contribute three main findings: First, we presented results about the individual impact of the SoC on the perception of each gamification element, leading to a set of well- and poorly perceived elements for each TTM group. We found that there are differences in this set, as many gamification elements are not perceived similarly across groups, showing that the SoC impacts their perception. This is supported by finding multiple significant differences between both groups, showing that considering the SoC for tailoring gamified, persuasive systems in the Physical Activity domain is important. Second, confirming previous findings [20, 30], we found 16 out of 17 expected correlations between gamification elements and Hexad user types. Besides validating previous findings in the Physical Activity context, we contribute a set of new correlations, which were expected in previous works [15,30], but have not been shown. This might be due to using storyboards rather than textual descriptions as in [30] and because of using a concrete context rather than a general context, also as in [30], potentially leading to a more concrete idea of how the elements work. Additionally, we examined the "persuasiveness" of gamification elements, whereas past work by Tondello et al. [30] investigated "enjoyment". Third, by analyzing the effect of the SoC on the set of relevant gamification elements for each user type, we show that even though the user type itself may remain stable [30], the set of relevant gamification elements does not. This is important, as so far a static set of elements has been suggested for each user type [30], not taking into account the dynamic process of behavior change intentions [23]. However, our work has several limitations that should be considered. First, we used storyboards to assess the persuasiveness of each gamification element. Therefore, validating our findings using real implementations is an important next step. Second, even though we investigated atomic gamification elements, some aspects of the realization of these gamification elements are inherently a matter of interpretation, affecting the external validity of our results when implementing gamification elements differently. Third, it should be noted that combining gamification elements may create different experiences for the user, which should be analyzed in future work. Fourth, our participants reported to have experience in games, which should be considered. Last, we cannot say whether our findings generalize to different contexts besides Physical Activity. Therefore, further research should be conducted about the SoC as a factor for personalization in different contexts.

5 Conclusion and Future Work

We investigated the effect of behavior change intentions on the perception of gamification elements in the Physical Activity domain, both on their own as well as for each Hexad user type. We conducted an online study (N=179) and replicated previous correlations between the Hexad model user types and gamification elements. This suggests the validity of previous results found in other domains [20] or in a general context [30]. Thus, we contribute a set of suitable gamification elements for each user type. Furthermore, we provide the first investigation of using behavior change intentions to personalize gamified, persuasive systems. As an overarching result, we show that the set of relevant gamification elements does not remain stable for each user type, but dynamically changes when behavior intentions change. This is important as, so far, a static set of gamification elements has been suggested for each user type [30]. In future work, gamification elements should be implemented to investigate in how far our findings are transferable to real implementations. Furthermore, our results suggest that investigating the effect of behavior change intentions in different contexts is worthwhile to consider in order to inform the design of persuasive systems.

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