Leaderboards in Gamified Information Systems for Health Behavior Change: The Role of Positioning, Psychological Needs, and Gamification User Types

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Abstract

Leaderboards are widely used in gamified information systems (IS) for health behavior change (HBC) to evoke both instrumental and experiential outcomes within users. In literature, however, they are often discussed controversially as they are perceived positively by some users but discouraging by others. In this work, we investigate under which circumstances users' position on the leaderboard influences their attitudes toward an mHealth app. Based on self-determination theory and the gamification user types hexad, we conducted an online experiment among 179 potential users. The results support our hypotheses that positioning influences perceived competence and relatedness, which alongside perceived autonomy positively impact users' attitude. Yet, our findings do not support the assumption that the relationship between needs and attitude is moderated by gamification user type. This finding reinforces recent research which questions the effectiveness of user type-based gamification and calls to focus on general need satisfaction.

Keywords: health behavior change, gamification, leaderboards, ranking, user types

1. Introduction

Unhealthy behaviors like sedentary living have become a prominent health risk factor in modern societies (World Health Organization, 2022). To support people in achieving lasting health behavior change (HBC), practitioners and researchers have developed various information systems (IS) (Romanow et al., 2012), many of which come in the form of mobile applications. An essential factor for successful HBC lies in an individual's motivation to sustain newly acquired behaviors. Accordingly, research has recently witnessed a rise of gamified IS for HBC, which use game design elements in non-

game contexts to engage users by providing them with enjoyable experiences while simultaneously fostering instrumental health outcomes (Liu et al., 2017).

One commonly implemented game design element in gamified IS for HBC is leaderboards (Lister et al., 2014), which are incorporated to stimulate social comparison and competition among users (Wu et al., 2015). Research on the effects of leaderboards has yielded mixed results (Werbach & Hunter, 2020). These inconclusive findings may be caused by differences in users' perceptions of leaderboards' motivational values (Jia et al., 2017). For instance, individuals appearing in top positions on leaderboards reported high perceived motivation (Jia et al., 2017), while low ranked individuals are likely discouraged, especially when they score high on the openness personality trait (Orji et al., 2017). Studies provide valuable insights into the influence of leaderboard positioning and personality traits on the motivational outcomes of leaderboards in gamified IS for HBC. Yet, extant research falls short in explaining how a user's position on a leaderboard influences their attitude towards a gamified IS for HBC, which is relevant for their intentions to engage with it over a sustained period of time (Ajzen & Fishbein, 1980).

In this work, we take a step toward addressing this gap in literature by investigating the effects of individuals' leaderboard positions on attitude toward gamified IS for HBC. We draw on self-determination theory (SDT), which is a prevalent theoretical lens in gamification research. SDT postulates the presence of three fundamental needs for optimal psychological functioning and well-being: autonomy, competence, and relatedness (Deci & Ryan, 2008b; Ryan & Deci, 2000). Besides, we also take the potential effect of personality traits on users' attitudes into account. While existing research has relied on general user personality concepts, we investigate user types that have specifically been developed for the context of gamification (Tondello et al., 2019). We pose the following research questions (RQs):

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RQ1: *How does a user's position on a leaderboard influence their attitude toward a gamified IS for HBC?*
RQ2: *What is the role of gamification user types in this relationship?*

To answer our RQs, we conducted an online experiment among 179 potential users. As a research context, we chose a mobile health application (mHealth app) supporting physical activity (i.e., step count tracking), as it is one of the most prevalent application areas of leaderboards in gamified IS. We contribute to gamification research by answering the call for more theory-driven research explaining the behavioral effects of single game design elements (Nacke & Deterding, 2017) and more research on the usefulness of user types for adaptive gamification designs (Schöbel et al., 2021). For research on social comparison mechanisms in gamified IS, we contribute by demonstrating that better positioning on a leaderboard is generally more beneficial for users as it leads to higher levels of need satisfaction and more positive attitudes.

2. Background

2.1. Leaderboards in Gamified Information Systems for Health Behavior Change

Leaderboards are one of the most common game design elements as part of the infamous points, badges, leaderboards triad (Werbach & Hunter, 2020). They constitute a numbered ranking system that shows users their position and performance compared to others (Miller et al., 2016). Leaderboards have been extensively integrated into gamified IS for HBC as they offer great motivational power, mainly by stimulating social comparison (Wu et al., 2015). To this end, social comparison is often regarded as a more effective motivation than objective measurements like step counts (Li et al., 2019). However, social comparison can also decrease motivation when it is perceived as forced (Miller & Mynatt, 2014) or when individuals are unable to convert motivation into actual physical activity (Jia et al., 2017). These findings lead to a standing of leaderboards as a double-edged sword and some research has been done in order to understand under which circumstances leaderboards are a suitable element of gamified IS for HBC. Researchers have also explored the effects of various leaderboard design decisions, including what rank an individual is placed on (Jia et al., 2017) or how similar individuals on the leaderboard are in terms of characteristics and performance (Fallon et al., 2020). Likewise, research has investigated the impact of various affective-cognitive outcomes, including attitude toward physical activity (Chen et al., 2017),

self-efficacy (Wu et al., 2015) or envy (Fallon et al., 2020). Research has also highlighted the importance of user characteristics like social comparison orientation (Li et al., 2019) or users' familiarity with pertinent apps (Östlund, 2020). Despite this, only few studies have actively investigated the influence of personality traits on leaderboard effects. Using the Big Five Factor Model, Jia et al. (2017) found that individuals' personality traits have significant impacts on how they perceive the presented leaderboards. Their work illustrates the essential role of personality traits for leaderboard effects and emphasizes the importance of conducting more research in that area. We seek to extend this work by drawing on the gamification user type hexad model (Tondello et al., 2019) that is specifically developed for gamification.

2.2. Basic Psychological Needs as proposed by Self-Determination Theory

SDT is a macro theory of human motivation that addresses issues like personality development, self-regulation, and universal psychological needs (Deci & Ryan, 2008b, 2013). It is the most popular theoretical lens in gamification research (Krath et al., 2021). A core tenet of SDT is that it does not treat motivation as a unitary construct, but rather proposes two types of motivation: intrinsic motivation, which involves engaging in activities because they are inherently relevant and satisfying; and (2) extrinsic motivation, which involves engaging in activities to achieve results that are distinct from the activity itself (Deci & Ryan, 2008a). Literature suggests that game design elements can support both extrinsic and intrinsic motivation (Schaffarczyk & Ilhan, 2019).

SDT proposes the presence of three basic psychological needs, which support intrinsic motivation (Deci & Ryan, 2008b; Ryan & Deci, 2000): (1) *autonomy* (i.e., the experiences of one's own behavior as self-determined rather than controlled by some outside source), (2) *competence* (i.e., the experience of effectiveness and mastery), and (3) *relatedness* (i.e., the experience of feeling connected and significant to others). Research generally acknowledges that gamified IS lend themselves well to satisfying these three needs (Savolainen et al., 2020). Several studies have engaged in investigating the influence of leaderboards on perceived autonomy, competence and relatedness in other contexts than HBC. These studies present contradictory results: while some studies found positive effects (Sailer & Sailer, 2021), others found no significant effects (Mekler et al., 2017), and again others even identified negative effects of leaderboards (Hanus & Fox, 2015). These contradictory findings highlight that the effects

of leaderboards on the three SDT needs remain inconclusive. In this study, we seek to shed light onto this specifically in the context of gamified IS for HBC.

2.3. The Gamification User Type Hexad

With the maturing of gamification research came an increasing call for overcoming one-size-fits-all approaches and moving toward adaptive designs (Schöbel et al., 2021). Especially, personality trait models have been useful to group users of gamified IS. Researchers have, for example, applied the Big Five Factor model (Jia et al., 2017) or Bartle's Player Types (Park et al., 2021). More recently, the Gamification User Types Hexad has emerged (Tondello et al., 2019). The model has been applied to customize gamified IS in various contexts, including fitness apps (Altmeyer et al., 2021), healthy eating applications (Altmeyer et al., 2020) or energy preservation (Kotsopoulos et al., 2018). The proposed user types are personifications of individuals' intrinsic and extrinsic motivations as proposed by SDT (Ryan & Deci, 2000). A description can be found in Table 1.

Table 1: User Types proposed by Hexad Model

User Type	Motivated by	Description
Achievers	Competence	Seek to progress within a system by completing (difficult) tasks and achieving goals
Free Spirits	Autonomy	Like to explore within a system. Want to express themselves without external control
Socializers	Relatedness	Want to interact with others and create social connections
Philan-thropists	Purpose	Are altruistic and are willing to help others without expecting rewards
Players	Extrinsic rewards	Will go to great lengths to obtain rewards within a system (e.g., a badge)
Disruptors	Change	Seek to alter the status quo and like to test a system's boundaries

When personalizing a gamified IS, an intuitive way to use the Hexad model is to elicit the target users' prevailing user types and choose adequate game design elements (Tondello et al., 2019). By doing so, studies have shown promising results with regard to increasing user acceptance (Böckle et al., 2018) or user performance (Lopez & Tucker, 2021). However, the benefits of the hexad model for gamification research are not that clear. There exists some skepticism whether the design efforts of personalizing a gamified system based on the hexad model is worth the motivational and behavioral effects, especially since recent studies do not report any benefits from doing so (Weber et al., 2023).

3. Research Model and Hypotheses

In this study, we aim to understand the influence of individuals' leaderboard position and gamification user types on their attitude toward gamified IS for HBC. To develop our research hypotheses, we draw on the literature on SDT (Deci & Ryan, 2008b), particularly the three basic psychological needs autonomy, competence, and relatedness and the gamification user types hexad (Tondello et al., 2019). Based on the hypotheses, we have conceptualized our research model as depicted in Figure 1.

Leaderboards constitute a source of "comparative feedback" (Codish & Ravid, 2014), meaning they provide individuals with information about their performance in relation to those of others (Nebel et al., 2017). They allow for two types of social comparison (Festinger, 1957): (1) upward comparison with individuals who have performed better and thus rank higher on the leaderboard, and (2) downward comparison with individuals who have performed worse and thus rank lower on the leaderboard. The higher an individual ranks on the leaderboard, the more likely they engage in downwards comparison since more individuals are ranked below them. This downward comparison is more likely to satisfy the need for competence because in relation to those lower on the leaderboard, a highly ranked individual appears to have performed better, which indicates higher levels of skill and capabilities (Velez et al., 2018). Accordingly, we hypothesize:

H1a: *Better leaderboard position will lead to higher levels of perceived competence.*

The downward comparisons supported by a high position on the leaderboard have been found to lead to positive emotions, including optimism, satisfaction, or self-esteem (Velez et al., 2018) and even stimulate prosocial behavior and willingness to give or help (Schlosser & Levy, 2016). These positive feelings in turn have been linked to the SDT need of relatedness (Fajans, 2006). Besides to supporting more downwards comparison, better positions on the leaderboard also support less upwards comparison. Extant research has found that upward comparison may lower an individual's self-esteem and make them feel incompetent or inferior (Swallow & Kuiper, 1988), which can lead to negative feelings toward others like envy or resentment (Fallon et al., 2020; Wheeler & Miyake, 1992). Such negative feelings may ultimately cause individuals to distance themselves from other users on the leaderboard and thus decrease relatedness. We hypothesize:

H1b: *Better leaderboard position will lead to higher levels of perceived relatedness with other users of the leaderboard.*
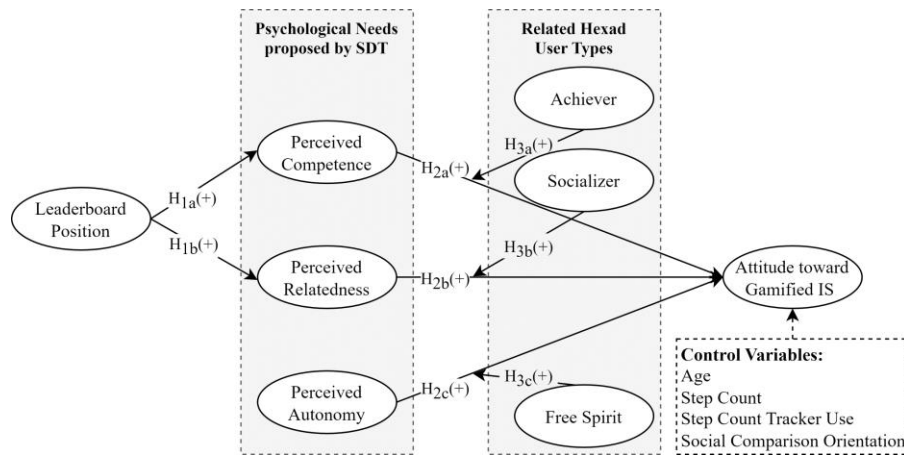
Figure 1: Research Model

SDT proposes that intrinsic motivation for a specific activity is fostered by the satisfaction of three psychological needs autonomy, competence, and relatedness. Support of these psychological needs promotes psychological well-being, satisfaction, and the experience of further positive motivational consequences (Vlachopoulos & Michailidou, 2006). In line with extant SDT research , we argue that the experience of high satisfaction of the three basic needs for psychological functioning contributes to the affective component of an individual's attitude (Ajzen & Fishbein, 1980) toward the use of a gamified IS for HBC. Thus, we hypothesize:

H2a: *Higher levels of perceived competence lead to a more positive attitude toward the gamified IS.*

H2b: *Higher levels of perceived relatedness with other users of the leaderboard lead to a more positive attitude toward the gamified IS.*

H2c: *Higher levels of perceived autonomy in using the gamified IS lead to a more positive attitude toward the gamified IS.*

Three of the six hexad user types (i.e., free spirit, achiever, and socializer) directly relate to the three basic psychological needs from SDT (Tondello et al., 2019). For each of these user types, one psychological need is particularly important regarding intrinsic motivation and the degree to which individuals draw enjoyment and satisfaction from using a gamified IS. Individuals scoring high on the free spirit dimension seek freedom to express themselves and act without external control (Orji et al., 2018). Accordingly, they will assess a system positively if they have the feeling that it enables them to act autonomously. Achievers seek the feeling of achievement when using a gamified system, thereby having a more positive attitude toward a gamified IS, if it affords high levels of perceived competence. Socializers want to interact with others and create social connections (Orji et al., 2018). They will have a more positive attitude when the system

provides the means to feel connected to others. Overall, we argue that these three user type dimensions have an accentuating moderating effect on the relationship between the psychological need by which they are driven and their attitude toward gamified IS for HBC. We hypothesize:

H3a: *An individual's score on the achiever dimension will positively moderate the relationship between competence and attitude toward gamified IS.*

H3b: *An individual's score on the socializer dimension will positively moderate the relationship between relatedness and attitude toward gamified IS.*

H3c: *An individual's score on the free spirit dimension will positively moderate the relationship between autonomy and attitude toward gamified IS*

4. Online Experiment

To test our hypotheses, we employed a scenario-based experimental approach. As a scenario, we chose the tracking of daily steps via an mHealth app as the targeted health behavior since such features have been widely implemented in gamified IS and are often augmented with social comparison features (Fallon et al., 2020). Furthermore, using step counts as a research context allowed us to utilize real user data within our online experiment since many smartphones nowadays automatically track daily steps, which made this information available to participants. We determined that a remote online experiment would be the most appropriate choice for our study, as it closely mimicked the intended utilization of an mHealth app for step count tracking, which is in a private environment without any observation. We considered ex ante recommendations for common method bias in the experimental and survey design (Podsakoff et al., 2003). Participants were recruited via social media. We classified the study to involve minimal risk to

participants and thus did not seek ethics board approval in accordance with the common practices at our institution. However, we followed the guidelines for ethical principles provided by our institution, especially with regard to the protection of participants' data.

After reading high-level study instructions, participants were asked to answer initial questions regarding their physical activity behavior including their use of mHealth apps for step count tracking and their average daily steps of the last month. Participants were instructed to retrieve real information on their step counts from their personal devices (e.g., smartphones, fitness trackers). If the information was not available to participants, we also allowed for the self-assessment of step counts. Furthermore, participants were asked to answer the hexad user type scale questions on a seven point Likert scale (Tondello et al., 2019). They were then presented with a leaderboard and assigned with a random rank between 1 and 10 (see Figure A-1). On the leaderboard, their real step count was presented in comparison to the step counts of nine other fictional users of the system. Based on their assessment of the leaderboard information, participants were asked to answer questions regarding their attitude toward the gamified IS, perceived autonomy when using the system, perceived competence of taking enough steps per day, and perceived relatedness to other users on the leaderboard. While answering these questions, the leaderboard information was still visible to participants. We adapted established scales from the literature and used multi-item scales to improve reliability and validity (see Table A-1). In the last part of the survey, participants were asked to answer demographic questions including gender, age, country of residency, level of education, marital status, and current employment status.

5. Results

Initially, 209 individuals finished the online experiment and survey. However, we excluded 28 cases in which participants did not pass an attention check or speeded through the survey. Moreover, two cases were eliminated as they entered unrealistic numbers for the average daily step counts. This left us with 179 valid responses. Overall, the average daily step count of participants was 5,985 with a median of 5,000 steps per day. 119 participants identified as female, 57 identified as male. Additionally, one participant identified as non-binary and two participants did not want to specify their gender. The average age of participants was 27.36 with a maximum of 72 and a minimum of 18 years. Overall, 88

participants were from English speaking countries and 81.56% of the participants said that they had been tracking their daily step counts at least for one month prior to the study, while 13.97% stated to never explicitly track their daily steps.

First, we used the survey results to validate the construct measurement scales. Two indicators of the free spirit dimension, two indicators for perceived relatedness, one indicator for perceived competence, and one indicator of the achiever dimension were eliminated from the analysis because they had outer loadings below .6 (see Table A-1). Cronbach's Alpha scores were above the recommended threshold of .7, only the Alpha value of the free spirit dimension was slightly below the recommended threshold. ($\alpha = 0.68$). However, we decided to keep the construct as it is widely used and established in the gamification literature. The heterotrait-monotrait ratio of correlations was below the recommended threshold of .85 for all constructs (Henseler et al., 2014). Further, the average variance extracted (AVE) for each construct was greater than the suggested minimum of .5, and the square root of each construct's AVE exceeded the inter-construct correlations, demonstrating adequate discriminant validity. All items loaded highest on their theoretical construct.

To assess our research model, we adopted PLS-SEM using the SmartPLS software, version 4.0.9.3. We tested the structural model by evaluating the direct effects and the explained variances (R^2). While assessing the model, we controlled for social comparison orientation (Gibbons & Buunk, 1999), age, step counts, and step count tracker use. The results show a positive significant effect of leaderboard position on perceived competence (.305; p < .001), **supporting H1a**, and a positive significant effect of leaderboard position on perceived relatedness (.168; p < .05), **supporting H1b**. Furthermore, we found positive significant relationships for the basic psychological needs of perceived competence (.232; p < .001), perceived relatedness (.258; p < .001), and perceived autonomy (.341; p < .001), indicating **support for H2a, H2b, and H2c**. The interaction effects of the hexad user type dimensions achiever (-.079; p = .224), socializer (.017; p = .795), and free spirit (-.088; p = .214) on the relationships between the respective psychological need and attitude toward gamified IS were not significant, which indicates **no support for H3a, H3b, and H3c**. We also found a positive significant effect of the control variable step count tracker use (.176; p < .01) on attitude toward gamified IS. The other control variables were not significant. In terms of R^2, our model explains 9.3% of perceived competence, 2.8% of perceived relatedness, and 49.3 % of attitude toward gamified IS.

6. Discussion

6.1. Principal Findings

This research constitutes an attempt to better understand the effects of leaderboard positions on users' attitudes toward gamified IS for HBC (RQ1). We have put a special emphasis on the role of the three basic psychological needs as proposed in SDT (Deci & Ryan, 2008a) and embodied in the gamification user types hexad (Tondello et al., 2019) (RQ2). Our experiment yields various interesting findings. First, we found that better positions on the leaderboard were associated with higher levels of perceived competence to take a sufficient number of steps per day, but also with higher levels of perceived relatedness toward other individuals on the leaderboard. This strengthens our assumptions that if designed cautiously, leaderboards can foster the development of meaningful social ties between users of gamified IS. However, to do so, it is critical to prevent users from developing negative or even hostile feelings toward others like malicious envy or resentment (Fallon et al., 2020). Our results indicate that one way to do so is by providing users an opportunity for downwards comparison on the leaderboard. Second, our results also show that all three basic psychological needs as proposed in SDT are positively associated with individuals' attitudes toward gamified IS for HBC. This finding reinforces our theoretical assumption that optimal psychological functioning positively influences the affective component of attitude toward gamified IS. Third, we did not find empirical support for the hypothesis that the attitude of distinct gamification user types is influenced differently by the three basic psychological needs. This finding was surprising to us since the hexad gamification user types are personifications of their respective SDT needs. However, it might be the case that the different user types only influence how individuals form motivation, which does not necessarily transfer to attitudes or actual behavior.

6.2. Implications

Our work contributes to different research streams. For research concerned with the design of social comparison mechanisms in gamified IS for HBC, our results show that better positioning on a leaderboard is generally more beneficial for users as it leads to a more positive user experience. From an organizational perspective, this is highly relevant since attitudes toward a system are related to use intention and may ultimately also transfer to real usage behavior

(Venkatesh et al., 2003). However, we want to emphasize that downward comparison may also come with negative emotions that negatively influence user experience (Buunk et al., 1990), for example, when individuals pity others who perform badly (e.g., due to medical conditions) or when they fear to lose their own status in the future (Suls et al., 2002). In some settings, upward comparison may even be more desirable than downward comparison, for example, to provide individuals with hope and inspiration for self-improvement (Wood, 1989). For gamification research, our work also sheds more light onto the role of gamification user types regarding the influence of psychological needs on attitudes toward gamified IS. Extant gamification research has often emphasized the importance of adaptive gamification designs that are tailored to individual user types in order to unfold their full potential (Klock et al., 2020; Schöbel et al., 2021). However, more recently, some scholars have raised concerns about the usefulness and value of these user types when it comes to designing effective gamified IS. For example, Weber et al. (2023) did not find any difference regarding the effectiveness of a gamified system that was tailored to gamification user types in comparison to a non-tailored system. They even controversially discussed whether adaptive gamification is "just a theoretical fairytale" (p.1) and concluded that it is more effective to generally focus on psychological need satisfaction than gamification user types "which are abstractions of reality" (p.1). The results of our work support these statements.

For practice, our results provide support for the general assumption that leaderboards, although sometimes controversial, are a useful tool in evoking positive experiential outcomes in users of gamified IS for HBC (Liu et al., 2017). In particular, if leaderboards are designed in a way that they enable users to feel competent of their own achievements without developing negative feelings toward others, they can be a valuable feature in physical activity contexts. However, we also caution against overgeneralizing this finding toward other application contexts of gamification. For example, inserious health contexts like mental health social comparison mechanisms are often seen as more critical and rejected by users due to potential unintended outcomes (Hu et al., 2023).

6.3. Limitations and Future Research

Our study is limited by several factors. First, we only investigated attitude toward gamified IS as the dependent variable and did not measure actual behavior. While this constitutes a valuable starting point, extant research has pointed out the limitations

of IS research that investigates attitudes and intentions without looking into real behaviors (Limayem et al., 2007). We think future research could validate whether our findings also transfer to real behavior. Second, we only investigated three of the six gamification hexad user types. Although this selection is reasonable as we focused on those three user types that were conceptually developed based on the three SDT needs, future research could further investigate whether other user types may have an influence. Third, we only investigated the effects for an mHealth app as one particular type of gamified IS. While we think that our work yields interesting findings for IS literature and the investigation of mobile applications has a rich tradition in IS, results could differ for other types of IS (e.g., web-based systems). Lastly, we were limited by the cross-sectional design of our research, which only allowed us to gather data on psychological needs and attitudes at one point in time. Future research could develop longitudinal designs to investigate the effects of constant (or changing) leaderboard positions over a longer period of time, thereby eliminating potential novelty effects.

7. Conclusion

To sum up, this study aimed to investigate the influence of leaderboard positioning on individuals' attitude toward gamified IS for HBC and shed light into the role of perceived competence, autonomy, relatedness and gamification user types in this relationship. Our work yields interesting insights into the importance of leaderboard positioning in supporting the basic psychological needs of users and contributing to more positive use experiences. From a gamification research perspective, our findings did not provide any indication for the assumption that specific user types derive more value from specific psychological needs than from others. Thus, we support recent claims in literature (Weber et al., 2023) that adaptive gamification based on user types may sometimes not be worth the effort and that one-size fits all solutions can be similarly suitable if they manage to effectively support general psychological needs.

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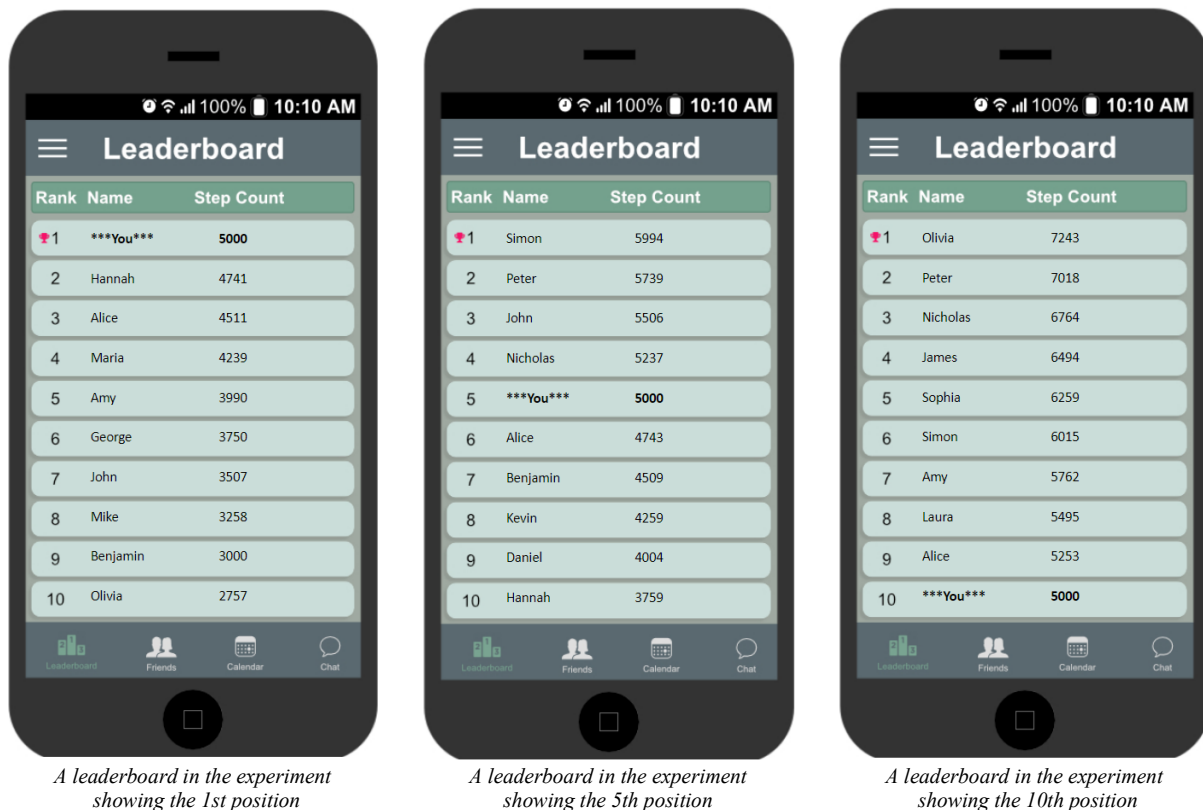
Appendix

A leaderboard in the experiment showing the 1st position

A leaderboard in the experiment showing the 5th position

A leaderboard in the experiment showing the 10th position

Figure A-1: Exemplary Leaderboards

Table A-1. Construct definitions, measurement scales, and outer loadings

Construct	Definition	Items	Loadings	Reference(s)
Perceived autonomy when using the gamified IS	The extent to which an individual sees their conduct of using gamified IS as voluntary and reflectively self-endorsed	I feel that I can decide when to use an mHealth app like this one.	.669	Standage et al. (2005)
		I feel that I have a say regarding the use of an mHealth app like this one.	.753	
		I feel that I use an mHealth app like this one because I want to.	.876	
		I feel a certain freedom of action when using an mHealth app like this one.	.845	
		I have some choice in what I want to do when using an mHealth app like this one	.871	
Perceived relatedness with others on the leaderboard	The extent to which an individual feels connected to others on the leaderboard	I felt really distant to those people on the leaderboard. (reversed)	.585*	McAuley et al. (1989)
		I really doubt that those people on the leaderboard and I would ever be friends. (reversed)	.713	
		I felt like I could really trust those people on the leaderboard.	.574*	
		I would like a chance to interact with those people on the leaderboard in the future.	.898	
		I would really prefer not to interact with those people on the leaderboard in the future. (reversed)	.714	
		It is likely that those people on the leaderboard and I could become friends if we interacted a lot.	.799	
		I feel close to those people on the leaderboard.	.643	
Perceived competence	The extent to which an individual experiences feelings of achievement, accomplishment, and mastery with regard to their step count.	I think I am pretty good at taking enough steps per day.	.892	McAuley et al. (1989)
		I think I am good at taking enough steps per day, compared to other people.	.914	
		After looking at this leaderboard, I felt pretty competent in taking enough steps per day.	.878	
		I am satisfied with my performance at taking enough steps per day.	.840	
		Taking enough steps per day is an activity that I couldn't do very well. (reversed)	.489*	
Attitude toward gamified IS	An individual's overall affective reaction to using the gamified IS	Using an mHealth app like this one is a good idea.	.859	Venkatesh et al. (2003)
		An mHealth app like this one makes taking enough steps more interesting.	.854	
		Using an mHealth app like this one is fun.	.907	
		I like using an mHealth app like this one.	.932	
Free Spirit	The extent to which an individual is motivated by autonomy, freedom, and self-expression	It is important to me to follow my own path.	.404*	Tondello et al. (2019)
		I often let my curiosity guide me.	.663	
		I like to try new things.	.982	
		Being independent is important to me.	.490*	
Achiever	The extent to which an individual is motivated by accomplishments, completing challenging tasks, and attaining goals	I like defeating obstacles.	.804	
		It is important to me to always carry out my tasks completely.	.860	
		It is difficult for me to let go of a problem before I have found a solution. [excluded from analysis]	.503*	
		I like mastering difficult tasks.	.662	
Socializer	The extent to which an individual is motivated by social interactions	Interacting with others is important to me.	.891	
		I like being part of a team.	.818	
		It is important to me to feel like I am part of a community.	.840	
		I enjoy group activities.	.860	

*Item was excluded from analysis