



CATOLICA
LISBON
BUSINESS & ECONOMICS

Bocconi

Gamification in Digital Mental Health

– effects of reward points and social comparison on users' intrinsic motivation, self-efficacy judgments, and willingness to recommend

Christina Marie Scheunemann

Dissertation written under the supervision of Professor Sofia Jacinto

Dissertation submitted in partial fulfilment of requirements for the International Master of Science in Management, at Universidade Católica Portuguesa and for the Master of Science in Marketing Management at Bocconi University, 04/04/2023.

Gamification in Digital Mental Health – effects of reward points and social comparison on users' intrinsic motivation, self-efficacy judgments, and willingness to recommend

Christina Marie Scheunemann

Abstract

As gamified mobile health apps dominate the market, they are promised to motivate healthy habits and behaviors effectively and efficiently. While researchers have studied the effects of gamification in a multitude of contexts, its effects in digital mental health are still unclear. This thesis aims to understand whether the promises of gamification are also applicable in mobile mHealth, specifically stress management. For this purpose, this thesis studies the effects of two gamification elements: social comparison and achievement-related gamification, in the form of collectible reward points on users' intrinsic motivation, self-efficacy judgments, and willingness to recommend the app. The experiment was conducted in a 2 achievement-related gamification (on vs. off) x 2 type of reward (social vs. individual) between-subjects design in the context of a fictitious stress management app. The results found no main effects of achievement-related gamification on the dependent measures, suggesting that collecting reward points might not be an effective tool in mobile mHealth. In contrast, social comparison positively influences users' perceptions about their competence and marginally influences the control they feel over their stress. Based on the results, we conclude that social gamification may be an effective but controversial tool in eliciting feelings of control and that those can, in turn, can make it more likely that users will recommend the app.

Keywords: gamification, reward points, mhealth, self-determination theory, self-efficacy

Gamification in Digital Mental Health - efeitos dos pontos de recompensa e comparação social na motivação intrínseca dos utilizadores, juízos de auto-eficácia e vontade de recomendar

Christina Marie Scheunemann

Abstrato

As aplicações móveis de saúde, incluindo a gamificação, dominam o mercado e prometem motivar hábitos saudáveis de forma eficaz e eficiente. Embora os investigadores tenham estudado os efeitos da gamificação numa multiplicidade de contextos, os seus efeitos nas aplicações de saúde mental ainda não são claros. Esta tese visa compreender se as promessas da gamificação são também aplicáveis na gestão do stress móvel. Para este efeito, esta tese estuda os efeitos de dois elementos da gamificação numa concepção 2x2 entre sujeitos: a gamificação relacionada com a realização (on vs. off) e o tipo de recompensa (social vs. individual) no contexto de uma aplicação fictícia de gestão do stress. As variáveis dependentes incluem a motivação intrínseca dos utilizadores, os juízos de auto-eficácia e a vontade de recomendar. Os resultados não encontraram efeitos principais da gamificação relacionada com os resultados nas medidas dependentes, sugerindo que a recolha de pontos de recompensa pode não ser uma ferramenta eficaz na mHealth. Em contraste, a comparação social influencia positivamente as percepções dos utilizadores sobre a sua competência e influencia marginalmente o controlo que sentem sobre o seu stress. Com base nos resultados, concluímos que a gamificação social pode ser eficaz mas controversa para suscitar sentimentos de controlo.

Palavras-chave: gamificação, pontos de recompensa, saúde móvel, teoria da autodeterminação

Table of Contents

1. Introduction	4
2. Literature Review	7
2.1. Gamification	7
2.2. Gamified mobile health	8
2.3. Classification and comparison of gamification elements.....	11
2.3.1. Achievement-related gamification	11
2.3.2. Social-related gamification	13
2.3.3. Immersion-related gamification.....	16
3. Theoretical Framework	18
3.1. Self-Determination Theory.....	20
3.2. Intrinsic Motivation	20
3.3. Self-Efficacy and Perceived Control.....	22
3.4. Willingness to recommend	24
4. Methodology	25
4.1. Design	25
4.2. Materials and Measures	25
4.2.1. Scenario	25
4.2.2. Independent variables	26
4.2.3. Dependent variables	28
4.2.4. Control variables	29
4.2.5. Demographic variables	30
4.3. Procedure.....	31
5. Results	33
5.1. Participants.....	33
5.3. Main and Interaction Effects.....	37
5.4. Linear Regression and Mediation Analysis	45
5.5. Additional Analyses	48
6. Discussion.....	50
6.1. Theoretical Contribution	54
6.2. Managerial Contributions.....	55
6.3. Limitations.....	57
7. Conclusion.....	59
8. Appendix.....	61
9. References	81

1. Introduction

Digital health is gaining increasing relevance and importance for consumers, businesses, researchers, and politics. The European Union and World Health Organization, for example, have recently developed a digital health action plan for the sustainable adoption of digital health solutions in Europe until 2030 (World Health Organization, 2022). Among others, this includes evidence-based investments in digital technologies to deliver care. In this environment of political and financial support, business opportunities are vast and continue to grow as new technologies and innovations emerge. Businesses that can provide effective and appealing solutions and services will likely be well-positioned for success in this rapidly evolving field.

However, there are still gaps in the evidence on digital health. More research is needed to fully understand user perceptions, motivations, and behavioral intentions in mobile health apps. For example, it can be observed, that despite the strongly growing supply and demand of those apps, most users stop their usage of them soon after their first trial (Vaghefi & Tulu, 2019). To keep users engaged and motivated longer, researchers have identified gamification as promising strategy. Gamification refers to the usage of game elements in non-game contexts, such as mobile health apps (Deterding et al., 2011). It can make mobile apps more engaging and fun, intrinsically motivating users to use them to improve their health and well-being (Johnson et al., 2016). Intrinsic motivation can be defined as individuals' drive to engage in activities out of enjoyment or for their own sake and not for external rewards or pressures (Ryan & Deci, 2000a). Eliciting it is relevant, especially in health and wellbeing applications, because intrinsically motivated activities are more sustainable in the long term (Teixeira et al., 2012) and can improve users' mental and social well-being directly (Ryan et al., 2008; Ryan & Deci, 2000a).

Advocates of gamification have identified several other potential benefits of applying gamification in health and well-being contexts. For example, it helps users stay on track with their health goals, leading to improved health outcomes such as increased physical activity, better nutrition, and medication adherence (Johnson et al., 2016; Mazeas et al., 2022). Also, as gamification becomes increasingly popular in healthcare, understanding and utilizing it in mobile health can lead to a competitive advantage for healthcare providers and companies by providing an enhanced user experience and more engaging and effective health treatments.

Extensive research has been done on gamification in the past decade to understand if its promised effects on engagement, motivation, and behavior change can be proven across industries and various contexts. While some studies have reported positive effects, others have found little to no impact or negative effects (Cheng et al., 2019; Johnson et al., 2016; Krath et al., 2021). The inconsistency can be explained first by the fact that the body of gamification research is broad and scattered. Differences in implementation, gamification design, and outcome measurements lead to inconsistent results. Second, it is essential to note that the effectiveness of gamification depends on several factors, such as the context, health behavior, target population, and used game elements (Johnson et al., 2016). More research is needed to determine specific conditions under which gamification is most effective. To facilitate that, it is helpful to differentiate between gamification elements and categorize them into three groups (1) achievement-related, (2) social-related, and (3) immersion-related gamification (Koivisto & Hamari, 2019).

Applying those three groups to its framework, this thesis aims to examine gamification in the context of mobile mental health. The goal is to study two gamification elements, first, achievement-related gamification in the form of collectible reward points and second, social comparison, on users' intrinsic motivation, self-efficacy judgments in regulating emotions, and willingness to recommend a fictitious stress management app. An experiment was conducted manipulating both game elements in a 2 achievement-related gamification (on vs. off) by 2 type of comparison (social vs. individual) between-subjects design. In the social comparison condition, users get feedback that they have performed better than other anonymous app users. In the contrasting individual comparison condition, users get the feedback that they performed better than their previous performance in previous weeks.

There are four dependent measures included in this thesis. First, it will be examined how both types of gamification influence users' intrinsic motivation to use the app based on the theoretical foundation of the self-determination theory (SDT), a well-researched theory of motivation by Ryan & Deci (2000a, 2000b). As only a few studies have researched this specific relationship, this thesis will provide new insights into the contextual factors that can influence the relationship between game elements and intrinsic need satisfaction. Additionally, this thesis examines how achievement-related reward points and social comparison affect app users' perceptions of their stress level and stress management. Specifically, dependent variables include perceived control and perceived competence in managing their stress; the latter is

measured within the theoretical framework of Self-Efficacy. Finally, the likelihood of app recommendation and users' expectations of perceived enjoyment and fun are analyzed to gain practical insights for industry recommendations. In total, this thesis proposes the following research questions:

RQ1: What are the effects of gamification, and how can the multitude of game elements be structured and differentiated?

RQ2: How do achievement-related gamification and social comparison affect users' intrinsic motivation to use a mobile self-help app for stress management?

RQ3: How do achievement-related gamification and social comparison affect users' self-efficacy judgments and willingness to recommend a mobile self-help app for stress management to friends and families?

The structure of this thesis is as follows. First, an overview of gamification and its effect in various contexts, mainly mobile health, will be provided. Second, currently used gamification elements will be classified into three groups, achievement-, social-, and immerse-related gamification. Each group and its elements will be discussed in their effects and motivational structure. Third, the research model and theoretical frameworks of self-determination theory and self-efficacy will be introduced, followed by the hypotheses. Subsequently, the experiment design and data collection will be explained in detail, followed by the data analysis. Finally, the results will be discussed, providing theoretical and managerial insights and further research opportunities.

2. Literature Review

2.1. Gamification

While the concept of gamification has been around for decades, the term itself was first introduced by Nick Pelling, a game designer from the UK, in 2002. He described gamification as the application of game-like user interfaces to make electronic transactions more enjoyable. Since its initial introduction, gamification has been a rapidly evolving field and is now widely considered to be the use of game elements in many different non-game contexts, such as business, education, and health (Deterding et al., 2011).

Even though there currently are a multitude of different game elements, gamification, in general, promises to motivate and engage users to achieve specific goals or outcomes (Bitrián et al., 2021; Koivisto & Hamari, 2019). Those possible effects have been studied by many researchers across contexts and industries. For example, in the workplace by Perryer et al. (2016) who studies its application to improve employee engagement, motivation, productivity, and performance in various industries such as warehousing (Passalacqua et al., 2020), finance, retail, and manufacturing. Furthermore, in education, gamification makes online courses more interactive and engaging for elementary school students (Ioannou, 2019), as well as increases learning performance (Putz et al., 2020; Zainuddin, 2018) and engagement in higher education students (Barata et al., 2017; Krath et al., 2021; Zainuddin et al., 2020). This especially became relevant as education switched to online learning environments or blended formats due to COVID-19, and students struggled to stay engaged and motivated.

After analyzing existing research, it is evident that gamification is continuously expanding its already vast field of application. Its effects are studied in various methodological setups, including experimental studies, survey research, etc. However, when reviewing the overall evidence available on the effects of gamification in-depth, it is essential to note that existing research fails to conclusively provide evidence for the positive effects of gamification. A review of 24 empirical studies on gamification found mixed results (Hamari et al., 2014). Possible limitations of those studies that influenced the wide range of results were their measurement of outcomes through interviews and surveys. Additionally, both Hamari et al. (2014) and Johnson et al. (2016) criticized their low to moderate quality of evidence. The following chapter will dive into research on gamification applied in mobile health and unravel its effects in detail.

2.2. Gamified mobile health

Mobile health (mHealth) is defined as a “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices” (World Health Organization, 2011). With the continuous innovation of new technology and the widespread adoption of smartphones (Bhavnani et al., 2016), mobile apps that deliver immediate and personalized health services are becoming increasingly popular and important to mobile app developers and researchers. Until 2025 the mobile health market alone is estimated to reach an estimated global market size of 247 billion US dollars (Statista, 2023). This can be explained by the global rise of illnesses like cardiovascular diseases and the growing awareness among consumers that illnesses may be prevented by addressing behavioral risk factors, including an unhealthy diet, obesity, physical inactivity, harmful tobacco and alcohol (World Health Organization, 2021). In addition, the growing general awareness of health and well-being in society also drives individuals to utilize personal health-tracking apps to monitor their eating habits and maintain a healthy diet (Vaduganathan et al., 2022).

Despite their popularity, mobile health apps have also been criticized. Studies identified concerns about unregulated mHealth app content and inconsistencies in the accuracy and standards for app integration with devices and health data reporting tools (Aitken & Lyle, 2015). The lack of standardization and regulation in mHealth apps also leads to privacy concerns and risks of data breaches, unauthorized access to sensitive health information, and the potential for third-party exploitation of personal health information (Benjumea et al., 2020).

As mHealth apps continue to evolve and increase in popularity, gamification has progressively been integrated as a design strategy when developing behavior change support systems in health and well-being (Oinas-Kukkonen & Harjumaa, 2009; Wallenburg & Bal, 2019a). Researchers have studied those gamified mHealth apps in a variety of targeted health benefits: gamified apps that motivate and engage children to establish healthy eating behavior (Chow et al., 2020), gamified rehabilitation and physical therapy apps benefit users by decreasing unnecessary healthcare utilization, medication overuse, and increase patient empowerment (Allam et al., 2015). A considerable amount of literature has also been published, for example, on gamification in apps supporting medication and chronic disease self-management, specifically for users struggling with diabetes (Attef & Harris, 2020; Baranowski et al., 2019; Miller et al., 2016). Gamified disease management has also reached a specific relevance recently with gamified COVID-19 tracking and educational apps where game elements like points, badges,

and leaderboards are used to encourage users to share their health status with others or engage in healthy behaviors, such as wearing a mask or maintaining social distance (de Souza Gaspar et al., 2020; Suppan et al., 2021).

However, by far the most common and most researched fields in mobile health gamification are, first, diet, weight loss, and fitness trackers and, second, gamified mobile apps to deliver mental health interventions and mental health support (Yang et al., 2019). Specifically, apps like *Pacifica* or *Happify* use game elements such as challenges, progress tracking, and rewards to encourage users to engage in activities that increase mental well-being. Other examples include *Headspace*, which encourages daily meditation, while *Sleep Cycle* promotes healthy sleep habits. Stress Management, on the other hand, is supported by apps like *Mindshift* and *Stress Less with Andrew Johnson*. These apps motivate people to engage in daily stress management habits like journaling, mindfulness exercises, and stress tracking.

Several studies suggest that gamification can provide immediate positive reinforcement and effectively increase user engagement, motivation, and retention in health and fitness mobile apps (Koivisto & Hamari, 2019a; Mazeas et al., 2022a; Xu et al., 2022). In 2014, a comparison of 132 apps across 13 different health behavior constructs and six core components of health and fitness showed that the inclusion of gamification elements was significantly associated with the total motivation score (Lister et al., 2014). In detail, Shameli et al. (2017) found that the use of elements, such as challenges, rewards, and social comparison, significantly impacted users' physical activity levels, increasing the amount of walking users did. In addition, social interaction, such as the ability to challenge friends, share progress, and receive support, is a particularly potent motivator in this context, with users who had friends using the app showing a more significant increase in physical activity compared to those who did not (Cotton & Patel, 2019; Shameli et al., 2017).

However, the existing research fails to conclusively show consistently positive results. The following systematic literature reviews each give an overview of the studies on gamification and its mixed effects. While Hamari et al. (2014) systematically reviewed 24 empirical studies on gamification and found mixed effects, the review was primarily focused on non-health gamification contexts such as education. 2 years later, however, Johnson et al. (2016) reviewed 19 empirical papers specifically on gamification in health and well-being and confirmed Hamari et al. (2014)'s previous mixed findings. The study found that only 59% suggested positive

effects of gamification on health and well-being, while 41% suggested mixed results. Detailed examination of the studies' limitations shows that most collected data from surveys and interviews and only had low to moderate quality of evidence, according to both Johnson et al. (2016) and Hamari et al. (2014).

Further limitations are that in the rare empirical study in the health context, the used surveys measured non-health outcomes such as continued use intention for the gamification service and the intention to recommend service to others (Hamari & Koivisto, 2013). Seaborn & Fels (2015) suggests the necessity for further empirical mixed-methods research to support the initially reported positive effects. Comparative studies with controls are also required to determine the impact of gamification compared to other approaches. Most recently, however, a systematic review and meta-analysis of the research by Mazeas et al. (2022) concluded that there is a statistically significant positive effect, and that gamification is not only efficient in changing behavior to increase physical activity levels but also more effective compared to other behavioral interventions. However, it is essential to note that more research and rigorous experimentation are needed in this area and that doing so could decrease the previously found effects of gamification (Koivisto & Hamari, 2019a).

It is not only the areas of application where gamification is applied that are expanding. In smartwatches, gamification elements like leaderboards and challenges are employed to track and encourage physical activity (Cho et al., 2021; Zhao et al., 2015). Also, game elements like rewards or badges are used to reward users for reaching fitness goals. Some smartwatch apps also incorporate social features, like social comparison, which have been proven effective in increasing adult physical activity levels (Cho et al., 2021).

Gamification in healthcare does not only target patients. Increasingly trendy is its application in the education of healthcare professionals, where it promises to improve learning outcomes by strengthening learning behaviors and attitudes (Gentry et al., 2019; van Gaalen et al., 2021). The newly coined term digital practitioner refers to healthcare professionals who embrace mobile apps and gamification in their treatment of patients to extend and possibly improve their work (Hammedi et al., 2017; Phillips et al., 2019; Wallenburg & Bal, 2019). However, a systematic review of the literature suggests that even though the consistent effect of gamification in this context is promising, it warrants further investigation as most studies were descriptive or clarification studies that did not include control groups (van Gaalen et al., 2021).

All in all, the research in gamification is plentiful, but much work is still to be done to unify a very divided research discipline. More empirical studies are needed to examine how users react to gamification in different contexts. Furthermore, it is essential to note that gamification is only an umbrella term comprising many different gamification strategies and elements. Differentiating between those elements and understanding how they differ in their approach and effect on users is essential to apply them effectively. This is especially important as not all gamification elements are equally effective. Various health goals may require different motivational strategies that effectively promote healthy behavior change. By understanding how these types of gamification can be used in mobile apps, designers and developers can more effectively design and implement gamification strategies tailored to their users' specific needs and goals. The following paragraphs will differentiate between and examine the various game elements summarized under the term gamification.

2.3. Classification and comparison of gamification elements

When researching mobile health apps in the app store, it is evident that many different gamification elements are in use. To better understand how those different types of gamification can impact user motivation and behavior change, it is essential to differentiate between them (Koivisto & Hamari, 2019b; Schmidt-Kraepelin et al., 2020). Congruently to the three underlying motivational factors for online play found by Yee (2006), gamification elements can be categorized into three corresponding groups (1) achievement-related, (2) social-related, and (3) immersion-related gamification (Koivisto & Hamari, 2019). As each group differs in its approach, goal, and motivational design, it consequently may result in a different effect on the user. The following paragraphs will introduce and differentiate the most common game elements and their effect on intrinsic motivation, the satisfaction of its underlying needs, and behavior change within the context of mobile apps.

2.3.1. Achievement-related gamification

Achievement-related gamification refers to using gamification elements to motivate users to achieve specific goals or milestones. This type of gamification is often used in fitness and productivity apps to help users track their progress and set goals. It can provide users with a sense of accomplishment through completing tasks or acquiring virtual rewards (Werbach & Hunter, 2015, 2012). Several types of achievement-related elements exist, but according to

Hamari et al. (2014), points and leaderboards are the most commonly used in mobile apps, followed by badges and achievements.

Points can be accumulated by the app user for certain activities within the app and are used to measure users' behavior and progress and provide granular numerical feedback (Sailer et al., 2017). They are also used to reward users for successfully completing a task (Werbach & Hunter, 2015, 2012). When analyzing achievement-related gamification in the form of collectible points in their effect on fulfilling basic psychological needs, Sailer et al. (2017) found that the inclusion of points in mobile apps positively affects the satisfaction of users' needs of autonomy, competence, and relatedness, which in turn positively influences users' motivation. Nishihara et al. (2020), for example, also found a positive effect of collectible reward points on users' motivation to perform consistent blood tests to help manage their diabetes.

Levels or **progress bars** are frequent achievement-related elements as they reflect users' advancement in mobile apps. Because users can see their progress and the missing actions needed to reach the new level, progress bars motivate a continued use of the app (Zichermann & Cunningham, 2011). Sailer et al. (2017) found that progress bars can increase the sense of achievement and that this sense of achievement is positively related to user motivation.

Badges and **leaderboards** can provide users with visual and cumulative feedback on their accomplishments (Werbach & Hunter, 2012). Researchers are divided, however, on their actual effect on intrinsic motivation and the satisfaction of its underlying needs. Van Roy & Zaman (2019) found that badges do increase feelings of competence, autonomy, and social relatedness. In contrast, Sailer et al. (2017) found mixed effects that suggest that while badges and leaderboards increase users perceived competence, they do not satisfy users' need for autonomy. The difference in findings may be a result of limitations as van Roy & Zaman (2019)'s study is based on focus groups and surveys instead of experiments. When analyzing the effects of badges on not only motivation but behavior outcomes, Hassan et al. (2019) found that badges increase goal-related behavior. However, critics have also noted that the effect and effectiveness of badges depend on their design and usage. Studies show that badges that are challenging to earn, have clear criteria for earning them, and have a clear visual representation are more effective in increasing user engagement and motivation. For example, Abramovich et al. (2013) found that badges tied to specific tasks and giving progress feedback on the task are more

effective in increasing user engagement than badges not tied to specific tasks or do not give feedback.

Similarly to badges, leaderboards are also commonly used to engage users by displaying their accomplishments compared to others. Indeed, research has shown that leaderboards represent a competitive indicator of progress and have been found to effectively achieve their goal of increasing user engagement and motivation in the context of physical exercise progress and other mobile health apps (Sailer et al., 2017; Hamari et al., 2014). However, using leaderboards can also lead to increased competition among users, which can cause negative effects such as cheating, decreased intrinsic motivation, and increased pressure on users, especially when users are rated at the lower end of the leaderboard (Werbach & Hunter, 2012).

Overall, the literature suggests that leaderboards can effectively increase user engagement and motivation when implemented and used appropriately. When comparing all the mentioned achievement-related gamification elements with each other, Hamari et al. (2014) found that overall, points, badges, and leaderboards have the strongest effect in engaging and motivating users than the other achievement-related gamification elements. Supporting those findings, Sailer et al. (2017) suggest that points and leaderboards positively affect motivation and satisfaction, while badges have a weaker effect.

2.3.2. Social-related gamification

Social-related gamification refers to using gamification elements that involve social interaction in, for example, multiplayer games and social networks. Apart from social networks, they can also include social competition and collaboration or team features to create a sense of community among users (Morschheuser, Riar, et al., 2017; Riar, 2020; Riar et al., 2022). This type of gamification is often used to increase user engagement and motivation by providing the mentioned sense of community and social support and enabling users to satisfy their individualistic or social-psychological needs of social relatedness (Riar et al., 2022). In the domain of mobile health, social-related features have been especially popular in fitness and exercise apps. Chen & Pu (2014) and Hamari et al. (2014) for example, have found that social incentives can increase physical activity, improve self-efficacy and increase social support in mobile fitness applications. The three main social-related gamification elements are 1) collaboration and team elements, 2) social network features, and 3) social comparison or competition.

Cooperation or collaboration game elements usually introduce teams and define a group of app users that work together towards a shared goal (Werbach & Hunter, 2012). By motivating users to work together, tasks become more enjoyable and engaging, which can lead to increased motivation and participation (Riar, 2020). This game element can also create a sense of shared purpose and community among individuals, which can further motivate them to cooperate and work together. A systematic review of 51 cooperative-based studies by Riar et al. (2022) found that most of the studies suggest positive effects of cooperation game elements on user engagement and system usage as user performance. Cooperation game elements also facilitate behavior change in work (Morschheuser, Maedche, et al., 2017; Morschheuser & Hamari, 2018), crowdsourcing (Morschheuser, Hamari, et al., 2017), and pro-environment behavior (Wemyss et al., 2018). However, even though the literature on this topic is growing, it remains unclear how gamification motivates cooperation in mobile health and how effective it is in cooperative settings.

Social network elements enable users to share content and interact with others through messages, blogs, and chat options. In addition, social networks provide the opportunity for users to announce their goal commitments. Goal-setting theory by Locke & Latham (2002) suggests that when users publicly commit to a goal, their commitment to it and their self-efficacy are strengthened, improving user performance. Research confirms the positive effect of social network interaction on health behavior performance in gamified health management apps (Yang & Li, 2021). Previous studies have also found that interaction with others, for example, through a game feature that allows sharing progress with friends, increases user engagement and motivation (Aparicio et al., 2012; Kapp, 2012). Hamari & Koivisto (2015) has studied social influence in the context of exercise gamification and found that social influence and positive recognition not only increase how much people are willing to exercise but also increase their attitudes and willingness to use gamification services. Additionally, this study suggests that the more friends a user has in the app, the larger the effects are. While the previously mentioned studies only analyzed the direct effect of social networks, Yang & Li (2021) researched its moderating effects and suggested that social interaction positively moderates the relationship between achievement rewards and performance. When mobile app users can communicate their achievements, it increases their perceived self-efficacy and strengthens the mentioned relationship. It is important to note, however, that while Hamari et al. (2014) align

with the previously discussed findings, they specify that the ability to compare progress with others (social comparison) has a positive effect.

Social comparison refers to the innate motivation to evaluate themselves by comparing themselves to others (Festinger, 1954). Every individual possesses the tendency to assess their attitudes, abilities, and status in relation to others and does so quickly, subconsciously, and implicitly (Gilbert et al., 1995). As a result, any mobile app that provides information about others' health behavior may elicit social comparison (Arigo & Suls, 2018). This poses a problem for gamification research, as many elements, including message features and leaderboards, can be classified as social comparison. This leads to a research gap in the current literature as there are inconsistencies and overlaps in how social comparison is defined that limit the reliability of its evidence. Nevertheless, it is essential to highlight that not only social network features facilitate social comparison and competition but also leaderboards, defined as a competitive indicator of progress (Sailer et al., 2017). Studying the effects of social comparison, Hamari et al. (2014) found that leaderboards increase user engagement and motivation in exercise apps. Other researchers also frequently report the strong motivating effect social comparison can have (Seaborn & Fels, 2015). However, other researchers have concerns about implementing it. Adverse effects can include feelings of anxiety and stress, a decrease in self-determination and autonomy, and potential disengagement from the app if the social pressure becomes too intense (Oinas-Kukkonen & Harjuma, 2009).

Overall, researchers are undecided on the effect of social comparison. (Arigo et al., 2020) found positive effects in the context of physical activity. In contrast, Kuppens et al. (2008) found that social comparison can lead to negative emotions such as envy and resentment, as well as lower self-esteem and motivation. Oinas-Kukkonen & Harjuma (2009) also found that social pressure is not intrinsically but extrinsically motivating. A decrease in users' intrinsic motivation may lead users to focus more on competing with others rather than on personal goals or enjoyment. In addition, social comparison may decrease users' motivation and engagement when they feel discouraged or dissatisfied with their own progress or achievements. Buunk et al. (2016), for example, found that social comparison has both positive as well as negative effects on individuals' satisfaction with their own social lives, depending on whether they compared themselves favorably or unfavorably to others.

2.3.3. Immersion-related gamification

Immersion-related gamification describes using gamification elements that create a sense of immersion in a non-game context like a mobile app. Examples of immersion-related gamification include storytelling and narrative structures as well as app customization or personalization and avatars to increase personal relevance and immerse the app user in a self-directed, inquisitive activity. App developers hope to increase engagement and motivation by making the the experience more enjoyable and engaging for the user and providing users with an immersive and engaging experience.

Storytelling. The research on the effects of immersion-related gamification is promising. Hamari et al. (2014) finds that the use of storytelling and fantasy can enhance the effectiveness of gamification by making users feel like they are part of a story or adventure. Bormann & Greitemeyer (2015) supports those findings and confirms that story elements effectively increase users' engagement and satisfy app users' needs for autonomy and relatedness, as described in the self-determination theory. Congruently, in-game storytelling or narratives can give mobile app users a sense of meaning in their app usage and a sense of voluntary participation (Rigby & Ryan, 2011; Sailer et al., 2017). Similarly, the two other main types of immersion-related gamification, avatars (Peng et al., 2012) and customization (Kim et al., 2015), give app users freedom of choice and induce feelings of autonomy.

Customization is defined as an opportunity where “users themselves modify some aspect of an interface to a certain degree to increase its personal relevance” (Marathe & Sundar, 2011). Marathe & Sundar (2011) asserts that customization is a way for people to assert their identity, express themselves, and signal it to others. By being able to meet their own needs and preferences, app users feel a sense of personal agency, which itself is said to positively affect other psychological outcomes (Sundar, 2008). Another opportunity to meet ap users' identity-related needs is avatars.

Avatars represent self-selected visual representations of players within the game or gamification environment, which are chosen or even created by the player (Peng et al., 2012). When users select an avatar that looks like them, they are more likely to feel closer to it, adopt its perspective, and be persuaded by the information presented by the avatar (Possler et al., 2022). Kang & Kim (2020) found that avatar customization significantly enhances the self-perception of users in digital services and that it improves persuasion by reducing the defensive

processing of self-threatening health information. This can be especially helpful in mobile health apps, which inherently might come with a social stigma. In the context of health and well-being Clark et al., (2019) analyzed 14 studies and found significant main effects of avatar customization in seven of those studies. The evidence, therefore, suggests that health promotion can be achieved with the use of avatars to represent the app user, alter self-perception, and model healthy behaviors. Rheu et al. (2020) confirm the effectiveness of avatars in eliciting healthy behaviors if the avatars are similar to the user and customizable. Consequently, gamification designers should focus on providing opportunities for self-expression and customization to meet their identity-related needs.

Overall, this chapter has provided a thorough answer to the first research question, “What are the effects of gamification, and how can the multitude of game elements be structured and differentiated?”. The presented overview of the commonly used game elements showed that they can be classified into three groups, each with different characteristics and motivational strategies. The following research aims to understand better how achievement-related gamification and social comparison affect users’ intrinsic motivation, perceived control, self-efficacy, and willingness to recommend the app in order to answer the remaining research questions:

RQ2: How do achievement-related gamification and social comparison affect users’ intrinsic motivation to use a mobile self-help app for stress management?

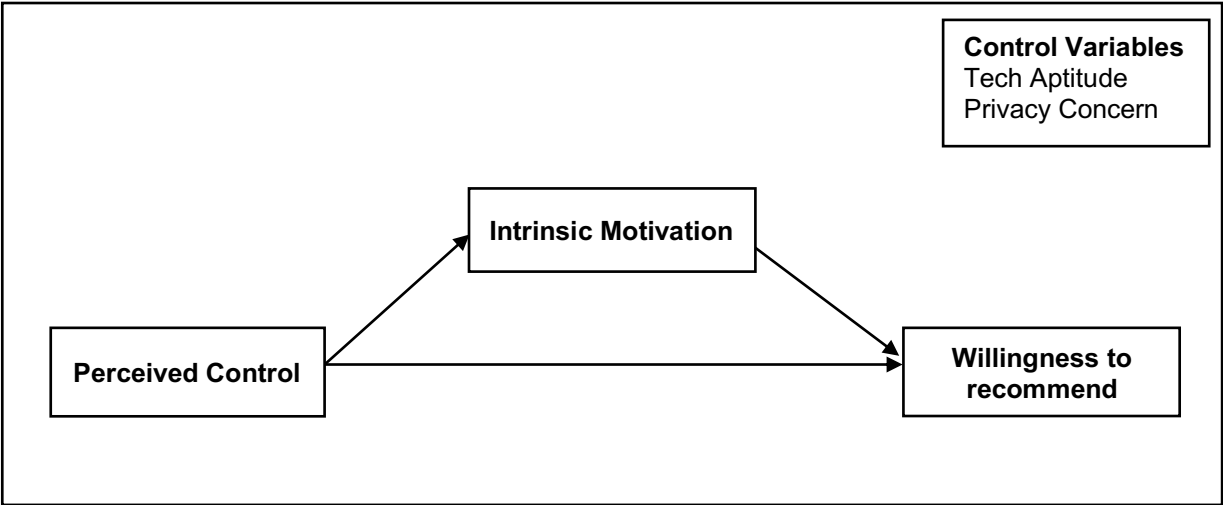
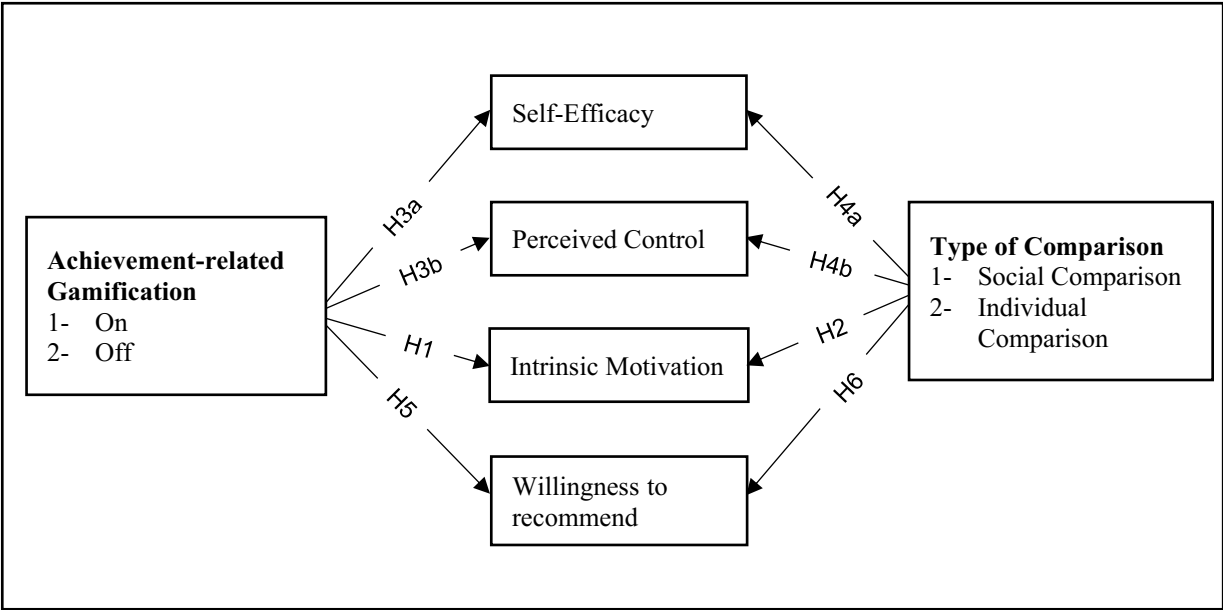
RQ3: How do achievement-related gamification and social comparison affect users' self-efficacy judgments and willingness to recommend a mobile self-help app for stress management to friends and families?

3. Theoretical Framework

Researchers have studied gamification through many different theories and frameworks to understand the different aspects of gamification and its effects on users. According to the systematic meta-review done by Krath et al. (2021), there are in total 118 theories that have been used to explain gamification. The following chapter will introduce the research model and the theoretical concepts of self-determination and self-efficacy theory that were applied in this thesis as they are the most relevant to meet the proposed research goal.

The research goal of this study is to understand the effects of achievement-related gamification in the form of collectible reward points and social. To achieve this goal, this thesis applies the theoretical constructs of self-determination and self-efficacy theory into a 2 achievement-related gamification (on vs. off) x 2 type of comparison (social vs. individual) between-subjects design in the context of a fictitious stress management app. In the following chapter we hypothesize the effects expected from the mentioned two independent variables, achievement-related gamification, and type of comparison, on the four dependent variables: users' intrinsic motivation to use a mobile self-help app for stress management, users perceived control and self-efficacy to regulate their stress using the app, as well as their willingness to recommend the mobile app to others. The research model in Figure 1 provides an overview over the main effects we will analyze. In addition, we will hypothesize in this chapter that users' willingness to recommend depends on their intrinsic motivation to use the app, as well as their perceived control they feel over their stress while using it. To test this hypothesis, we developed a mediation model in which intrinsic motivation mediates the relationship between perceived control and willingness to recommend (please see Figure 1 for the Mediation Model). The following chapter will provide more detailed descriptions over the hypotheses and the underlying theories of self-determination and self-efficacy that support them.

Figure 1 *Research Models: Direct effects of achievement-related gamification and type of comparison and Mediation Model (below)*



3.1. Self-Determination Theory

One of the most influential theoretical frameworks in gamification research is the self-determination theory (SDT) (Krath et al., 2021). The framework was first developed by Ryan & Deci (2000a) and has since evolved into a meta-theory of human motivation. It describes motivation not only in terms of quantity but also quality and introduces three distinct psychological needs: competence, autonomy, and relatedness. (1) Competence describes peoples' need to feel capable in their actions, (2) autonomy is the need to feel in control of their actions or life. Lastly, (3) relatedness refers to the need to feel connected to others. The satisfaction of the mentioned needs is important for an individual to develop intrinsic motivation (Ryan & Deci, 2000b). SDT differentiates between intrinsic and extrinsic motivation (Ryan & Deci, 2000b) and predicts that when these needs are met, people experience more intrinsic motivation, engagement, and well-being. Contrarily the theory states that when these needs are not met, people have a higher likelihood to feel extrinsic motivation and disengagement (Ryan & Deci, 2000a). This thesis will include variables that reflect the mentioned needs of motivation, which will be described in depth later in this chapter. It will include 1) *Perceived control* over one's future stress level to reflect the need for autonomy; 2) *Self-Efficacy* to reflect users perceived competence in managing one's stress; 3) *Social Comparison* to reflect the need for relatedness with other app users. Lastly, *Intrinsic Motivation* will be included as an additional dependent measure.

3.2. Intrinsic Motivation

Intrinsic motivation is a critical factor in the abovementioned self-determination theory. It refers to the drive to engage in action for its own sake rather than for external rewards or pressures. In the context of SDT, intrinsic motivation was first studied in 1975 by the researcher Edward L. Deci and has since been considered a fundamental concept of psychological well-being and optimal functioning. Eliciting intrinsic motivation has many benefits. Ryan & Deci (2000) determined that intrinsic motivation is the most productive factor influencing people's behavior. Teixeira et al. (2012) and (Ryan et al., 2008) also determined that intrinsically motivated actions may improve users' mental well-being and are more sustainable. While some studies that were discussed in the systematic review of the literature by Johnson et al. (2016) employed descriptive and non experimental designs, the positive effects were also confirmed in other studies using experimental and cross sectional designs. Intrinsic motivation has also been confirmed to increase participation in mobile apps, facilitating stress management and

stress prevention (Ahtinen et al., 2013). Overall, for a mobile self-help health app trying to encourage users towards stress-relieving behaviors, eliciting intrinsic motivation is, therefore, very important.

In the context of gamification research, studies have shown that gamification can elicit both extrinsic and intrinsic motivation, depending on how it is designed and which game elements are implemented. Some game elements, such as personalized goal-setting and progress tracking, can elicit intrinsic motivation and, in turn, improve outcomes like improved mental health, as they are designed to align with an individual's values and goals (Xi & Hamari, 2019). In contrast, researchers have found that achievement-related game elements that include rewards like points and badges increase extrinsic motivation while decreasing intrinsic motivation, as they are designed to motivate individuals through the promise of external rewards (Richter et al., 2015). The rationale is that by collecting rewards, the motivating drive now is collecting rewards instead of doing the activity “for its own sake” (Ryan & Deci, 2012). Congruently with the SDT framework and the current literature, this thesis hypothesizes

H1: Achievement-related gamification in the form of reward points in a mobile stress management app will lead to lower perceived intrinsic motivation to use the app than no implemented gamification.

The SDT by Ryan & Deci (2012) proposes that when people feel connected to others, it fulfills their need for relatedness, which in turn will lead to an increase in intrinsic motivation. Mobile apps that include social-related gamification, including the element of competition, have been found to be more effective in satisfying the need for relatedness (Xi & Hamari, 2019). Every individual possesses an innate motivation to evaluate themselves by comparing themselves to others. The tendency to do so is referred to as social comparison (Festinger, 1954). By means of social comparison, individuals assess their attitudes, abilities, and status in relation to others (Gilbert et al., 1995). This thesis will therefore include the type of comparison as an independent variable with the following two conditions: Social comparison will rate the app user's performance in comparison to other fictional anonymous app users. In contrast, individual comparison will compare the app user to his or her previous weeks' performances.

When analyzing social-related game elements, it is important to differentiate between elements of social connectedness (collaboration) and social comparison (competition). Cooperation

gamification elements satisfy users' need for relatedness to others and motivate intrinsically (Riar et al., 2022b) by providing the mentioned sense of community and social support. Congruently, also game elements eliciting social-related competition can satisfy the need for relatedness (Xi & Hamari, 2019) and increase intrinsic user motivation (Hamari et al., 2014). It is essential to note that some researchers have voiced concerns about using social comparison in mobile health and have raised potential adverse effects (Oinas-Kukkonen & Harjumaa, 2009). However, congruently to the established self-determination theory and the majority of the research, this thesis hypothesizes the following while taking the mentioned concerns and negative effects into consideration in the discussion chapter:

H2: Social comparison in a mobile stress management app will lead to higher perceived intrinsic motivation than individual comparison.

As previously stated, intrinsic motivation is dependent on the satisfaction of three underlying needs: perceived competence describes the need to feel capable in one's actions, autonomy describes the need to feel in control of one's own life, and, lastly, relatedness refers to the need to feel socially connected to others. Researchers have been applying SDT to measure whether game elements increase perceived competence, autonomy, and relatedness and, in turn, increase intrinsic motivation and well-being among users. Studies have shown that elements such as choice, progress feedback, autonomy support, and social connectedness can increase the level of autonomy, competence, and relatedness of users (Bormann & Greitemeyer, 2015; Kim et al., 2015; Peng et al., 2012; Xi & Hamari, 2019). While the positive effects of social-related gamification were previously discussed, the following paragraphs will focus on fulfilling the remaining two needs. Perceived competence will be implemented into this thesis as a dependent variable approximated by self-efficacy. The need for autonomy will be implemented as a dependent variable approximated by the perceived control users feel over their stress.

3.3. Self-Efficacy and Perceived Control

Social cognitive approaches for motivation all include some consideration of the perceived capability or competence to perform a behavior. For example, the self-determination theory from Deci & Ryan (2000) and the self-efficacy theory from Bandura (1977, 1978) both include a similar variable at their fundamental level. In SDT, the variable is called perceived competence and is defined as peoples' need to feel capable and effective in their actions. In contrast, self-efficacy is a construct from psychology that refers to an peoples' belief in their

capability to successfully do a certain task or achieve a certain goal (Liu et al., 2020). In past research, including in gamification, both variables, perceived competence and self-efficacy have been used and studied interchangeably. Consequently, this thesis will consider them interchangeably as well and define the variable as the mobile app users' perceived competence to manage their stress. Self-efficacy theory states that perceived self-efficacy determines how much effort people expend and how long they will persist if obstacles occur (Bandura, 1978). Theory and research support the idea that self-efficacy is an essential motivational construct affecting intrinsic motivation, effort, persistence, and achievement (Schunk & DiBenedetto, 2020, 2021). To motivate users to use a mobile self-help app for stress management, eliciting self-efficacy in their users is, therefore, an important goal.

According to Bandura (1977), self-efficacy beliefs are acquired through four primary sources of information: performance accomplishments, verbal persuasion, vicarious experience, and physiological and emotional states. Performance accomplishments refer to the individual's past experiences of successfully performing a specific task. When an individual is successful, their perceived self-efficacy for that task increases. Research confirms this connection and shows that gamification elements that give users positive feedback and rewards for their performance accomplishments enable users to measure and demonstrate their success, leading to a formation of perceived competence (Peng et al., 2012; Xi & Hamari, 2019). In addition, they satisfy people's natural need to feel self-mastery and growth (Deci & Vansteenkiste, 2004; Rigby & Ryan, 2011). (Peng et al., 2012). Compared to other gamification elements, achievement-related progress feedback was found to have the strongest influence on competence (Xi & Hamari, 2019).

The third Source of information through which self-efficacy beliefs are acquired is vicarious experience (Bandura, 1977, 1978). Vicarious experience refers to the individual's observation of others successfully performing a specific task. When an individual observes someone similar to themselves successfully performing a task, their self-efficacy for that task increases. This is known as social learning or observational learning. Research has shown that achievement-related gamification, including progress feedback and points, has a strong positive effect on the satisfaction of autonomy (Xi & Hamari, 2019). Therefore, this thesis also hypothesizes:

H3: Achievement-related gamification in the form of reward points in a mobile stress management app will lead to higher perceived self-efficacy (H3a) and higher perceived control (H3b) in the management of one's stress than no implemented gamification.

H4: Social comparison in a mobile stress management app will lead to higher perceived self-efficacy (H4a) and higher perceived control (H4b) in the management of one's stress than individual comparison.

As discussed, the self-determination model from Ryan & Deci (2000) proposes that intrinsic motivation depends on the satisfaction of the underlying needs of perceived competence, autonomy, and relatedness. Therefore, we hypothesized that intrinsic motivation depends on the perceived control users have over their stress and that intrinsic motivation mediates the relationship between perceived control and willingness to recommend the stress management app to friends and colleagues.

H7: Intrinsic motivation to use the app mediates the relationship between users perceived control over their stress and users willingness to recommend the app.

3.4. Willingness to recommend

The willingness to recommend the app to friends and colleagues is measured by the Net Promoter Score. This metric was developed by (Reichheld, 2003) and is widely used in market research. Since its development, it has incurred critiques from academic researchers that question its validity as a measure of consumer mindset and future sales growth predictor (Baehre et al., 2022). However, despite the limitations, the NPS remains almost ubiquitous in practice and will be considered an essential dependent variable in this thesis.

H5: Achievement-related gamification in the form of reward points in a mobile stress management app will lead to a higher willingness to recommend the app than no implemented gamification

H6: Social comparison in a mobile stress management app will lead to a higher willingness to recommend the app than individual comparison.

4. Methodology

4.1. Design

This study is intended to examine the effects of reward points and social comparison in mobile mental health apps. Particularly, this includes user perceptions and motivations in the context of a fictitious self-help app to manage stress and anxiety. To answer the research question of the effect of achievement-related gamification, we manipulated the locus of the reward, comparing achievement-related external rewards in the form of gamified collectible points. To answer the research question of the effect of social comparison, we manipulated the type of comparison to be either with one's past progress or with other fictitious and anonymous app users. The following study design is 2 achievement-related gamification (on vs. off) x 2 comparison type (social vs. individual), the two factors being manipulated between participants. The 2 x 2 factorial experimental design was embedded in an online survey questionnaire that also included five dependent variables, as well as control and demographic variables (see Appendix 2 for questionnaire).

4.2. Materials and Measures

4.2.1. Scenario

In the online questionnaire, participants were given information about a fictitious mobile self-help app for stress management. Each participant was shown two screenshots of the app, the first reflecting the app homepage and the second screenshot presenting a feedback screen with a congratulatory message. The first screenshot displaying the homepage proposes four possible activities to relieve stress and encourage the user to participate. In the achievement-related gamified version of the app, a reward point game mechanic is added (see Figure 2). After the respondents clicked continue in the survey, they were instructed to imagine having used the app for a few weeks. After that, they were presented with a second mobile app screenshot displaying a congratulatory message. The content of that congratulatory message also varied depending on the experimental condition to which the participant was randomly assigned (see Figures 3 and 4). The mockups of the mobile self-help stress management app were developed on Canva. Canva is a graphic design website that can be used to create creative assets like social media images, websites, and posters.

4.2.2. Independent variables

Achievement-related gamification (On vs. Off): The independent variable has two conditions. In the On condition, the mobile app was gamified and included collectible achievement reward points. Participants were presented with the stimuli of a fictitious mobile stress management app screenshot highlighting an in-app game feature with the goal of collecting reward points for doing the proposed stress-reducing actions. In the Off condition, participants were presented with the stimuli of a similar app screenshot, this time non-gamified. Here the screenshot displayed identical stress-reducing actions with the goal of increasing well-being. Instead of collecting reward points, the goal and reward in the Off condition is the health outcome directly: to feel better and having improved one's well-being.

Figure 2 *Stress management app with Achievement-related Gamification On (left) and Off (right)*



Type of Comparison (Social vs. Individual): After instructing the participants to imagine having used the app for a few weeks, they were presented with the second independent variable through a second mobile app screenshot. The second variable Type of Comparison also has two conditions. Depending on their randomly assigned condition, the participants were presented with a slight variation in the screenshot contents. In the social comparison condition, the screenshot highlights the user’s great performance compared to other fictitious anonymous app users. In the individual comparison condition, the screenshot highlights their great performance compared to their own performance from previous weeks.

Figure 3 *Stress management app with Achievement Gamification On and Social Comparison (left). Stress management app with Achievement Gamification On and Individual Comparison (right).*

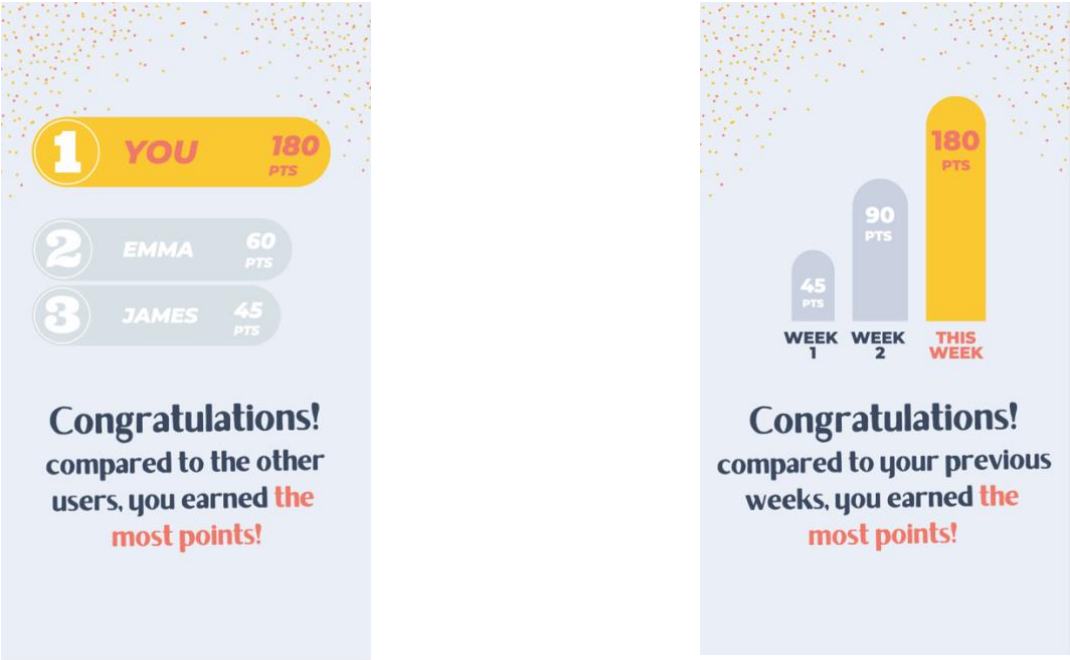
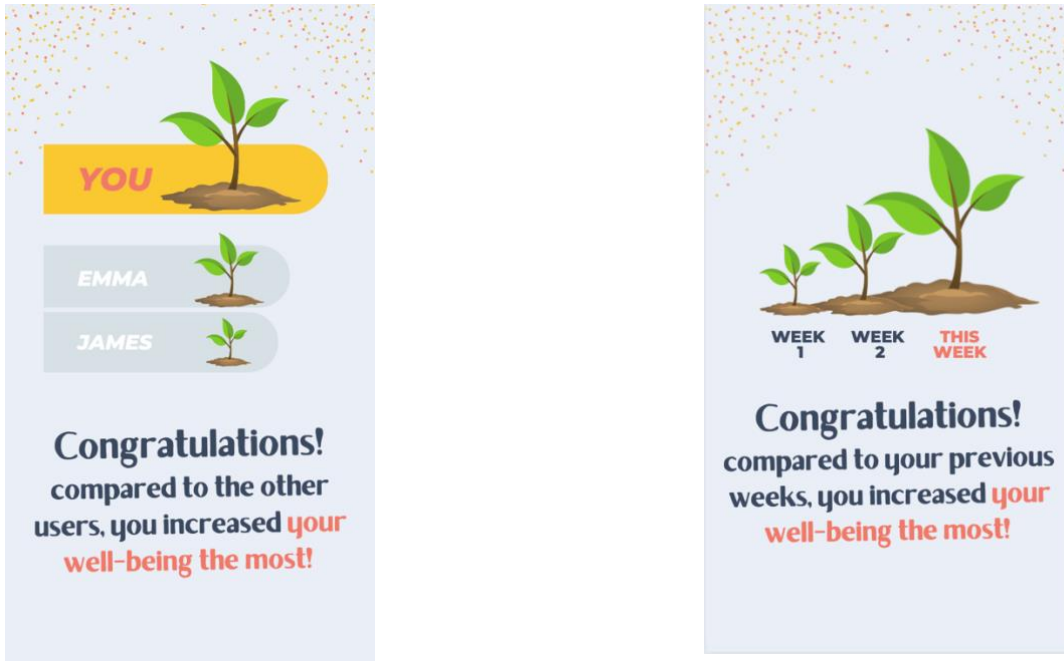


Figure 4 *Stress management app with Achievement Gamification Off and Social Comparison (left). Stress management app with Achievement Gamification Off and Individual Comparison (right).*



4.2.3. Dependent variables

The effects of both independent variables are measured on five dependent variables. First, users' intrinsic motivation to use the app on the subscales of participants' interest and perceived fun, motivation, and helpfulness of the app. Second, users perceived self-efficacy (competence) in managing their stress when using the app. Third, users perceived control over their stress. Lastly, the survey measures the willingness to recommend the app to friends and colleagues based on Net Promoter Score. Not included as a dependent but as an exploratory qualitative variable, a question for further recommended devices for mobile health apps is also included.

Intrinsic Motivation: Intrinsic motivation is measured on four subscales, including users' interest, perceived fun, motivation, and helpfulness of the app. Participants were asked, "How do you feel about using this app for stress management?" prompting them to rate their agreement with the following on a 7-point rating scale from 1 (Not at all) to 7 (Extremely): It will be interesting to use, It will be fun to use, It will be motivating, It will be helpful. The subscales have been adapted from relevant parts of the Intrinsic Motivation Inventory (IMI),

which has been used in several previous experiments related to intrinsic motivation and self-regulation (Deci et al., 1994; Plant & Ryan, 1985; Ryan, 1982). Among other subscales, the IMI scores participants on their interest and enjoyment as well as value and usefulness while performing a given activity. This is also reflected in the design of the questions for this survey.

Self-Efficacy: Self-Efficacy is measured on three subscales that assess participants' self-reported capability to manage stress after imagining using the app. Participants were asked, "How capable do you feel managing stress by using this app?". They were prompted to rate their agreement with the following on a 7-point rating scale from 1 (Not at all) to 7 (Extremely): I can manage stress effectively, Compared to others I manage stress well, I believe my anxiety will decrease in the future. The first question focuses on their own perceived effectiveness in managing stress, while the second focuses on their perceived stress-management capability compared to others. The last item focuses on the participants' belief that their stress and anxiety will decrease in the future. In the end, the overall self-efficacy score of each participant was calculated as the average score of each item. The subscales were adapted from the 10-item general self-efficacy (GSE) scale developed by (Schwarzer, 1992), which assesses one's beliefs in their ability to control and respond to environmental challenges.

Perceived Control: To measure the perceived control that respondents feel over their stress, participants were asked, "To which extent do you believe that you control your anxious feelings?". The participants were prompted to rate on a 7-point rating scale from 1 (Not at all) to 7 (Extremely).

Willingness to Recommend: The willingness to recommend the app to friends and colleagues is measured by the Net Promoter Score. This metric is widely used in market research and is based on a single question that asks participants, "On a scale from 0-10, how likely are you to recommend this app to a friend or colleague?"

4.2.4. Control variables

To better understand the effect of gamification and feel confident that the obtained results are not dependent on other relevant variables such privacy concern, technological aptitude, previous stress-management app usage, perceived stress, and amount of smartphone usage.

Privacy Concern: Participants were asked, "How concerned are you about data privacy when using mobile apps?" They were asked to rate on a 7-point rating scale from 1 (Not concerned at all) to 7 (Extremely concerned).

Technological Aptitude: Participants were asked: "How confident do you feel in your technology skills?" They were asked to rate on a 7-point rating scale from 1 (Not confident at all) to 7 (Extremely confident).

Previous Stress-Management App Usage: Participants were asked: "Have you ever used an app for stress management?" This variable is measured as a nominal variable, giving the choice of: Yes, No, Prefer not to answer.

Perceived Stress: Respondents' perceived stress level was measured using the Perceived Stress Scale 4 (PSS-4) developed by Cohen et al. (1983). Participants were asked: "In the last month, how often did you feel stressed or had anxious thoughts?" They were asked to rate on a 7-point rating scale from 1 (Not often at all) to 7 (Extremely often).

Smartphone Usage: Participants were asked: "How many hours a day do you use your smartphone?" This variable is measured as an ordinal variable, giving the choice of: Less than 1 hour, Between 1-3 hours, More than 3 hours.

Manipulation Check: To measure whether participants fully understood the scenario and their assigned condition, they were asked: "The app included?": A comparison with others, A comparison with your past weeks, A set of fitness goals, Not sure.

4.2.5. Demographic variables

Age: This variable is measured as an ordinal variable, classifying age into seven categories: < 18; 18-24; 25-34; 35-44; 45-54; 55-64; > 65. However, in further analysis only respondents aged 18 – 44 are considered.

Gender: (Yee, 2006) found that the motivations for playing online games are different for men and women, with men being more motivated by competition and achievement and women being more motivated by social interaction and personal expression. Therefore, this demographic variable might influence users' perception of the different gamified conditions. It is measured

as a nominal variable, classifying gender into five categories: male; female; non-binary/third gender; prefer to self-describe; prefer not to say.

Education: It is measured as an ordinal variable, classifying the education of respondents into seven categories: Some high school or less; High school diploma or GED; Some college, but no degree; Associates or technical degree; Bachelor's degree; Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.); Prefer not to say.

Employment: It is measured as a nominal variable, classifying the employment status of respondents into 7 categories: Working full-time; Working part-time; Unemployed and looking for work; A homemaker or stay-at-home parent; Student; Retired; Other.

Marital Status: It is measured as a nominal variable, classifying marital status into five categories: Single, never married; Married or domestic partnership; Widowed; Separated or divorced; Prefer not to say.

Country of Residence: Respondents were able to select their country of residence from a drop-down menu of 1357 countries and regions. It is measured as a nominal variable, classifying each of the countries and regions separately.

4.3. Procedure

The data for the quantitative analysis was collected through an online survey designed on the platform Qualtrics. Before publication, the survey was pre-tested on a small group of respondents to eliminate potential misunderstandings and ambiguity in the questions. Afterward, the survey was distributed online in January of 2023 through the social media channels WhatsApp, Facebook, Instagram, and through survey-sharing websites.¹ Participation in the survey was entirely voluntary for all respondents.

After a short introduction to the survey, respondents were informed of the anonymity and privacy of their participation and asked to provide their consent. Afterward, participants were asked to take a moment to think about their recent stressful experiences and how they applied strategies to take breaks and feel better. This helps the participant to immerse themselves emotionally into this scenario to relate better to the experiment topic of stress management.

¹ Websites include www.surveycircle.com and www.surveyswap.io

Through a randomizer, participants were then forwarded to one of four experimental conditions. For each condition, participants started the survey by being presented with a scenario where they downloaded a mobile app to relieve stress. The participants were then presented with their first app mockup, which depending on their assigned condition, is either a gamified or non-gamified stress management app. In the condition Achievement-related Gamification On, app users had the goal of collecting gamified reward points for performing stress-relieving actions. In comparison, users that were assigned to the condition Achievement-related Gamification Off, were presented with a non-gamified app where improving one's own well-being was the goal. Through a Qualtrics timer, survey participants were forced to stay on the page displaying the scenario and the app mockup for five seconds. This is to make sure that participants read carefully and understand the design.

After clicking continue, participants were instructed to imagine that after using the app for a few weeks, they received a congratulatory notification. Depending on the users' assigned condition, the mockup of the congratulatory message compared their performance either to the other anonymous app users or their own past performance. Here, another Qualtrics timer was utilized. Survey participants could only advance in the survey once a seven-second timer was counted down.

Afterward, respondents continued through the survey to the dependent measures, which included first users' intrinsic motivation to use the app, measured on questions about participants' interest and perceived fun, motivation, and helpfulness of the app. Second, users perceived self-efficacy in managing their stress when using the app. Third, users perceived control over their stress. Lastly, the survey measures the willingness to recommend based on Net Promoter Score, which will provide some context for business recommendations. Not included as a dependent but as an exploratory qualitative variable, a question for further recommended devices for mobile health apps is also included. Subsequently, participants were then asked six questions for control variables, specifically privacy concern, technological aptitude, previous app usage for stress management, perceived stress, and smartphone usage. After a manipulation check and collection of the demographic measures, including Age, Gender, Education, Employment Status, Marital Status, and Country of residence, the survey ended with thanking the participants for their participation. An open field for further qualitative feedback, comments, or open questions was added at the end.

5. Results

5.1. Participants

In total, 384 responses were collected. In the subsequent balancing of the sample, participants were excluded from the analysis according to three criteria: First, 39 (10%) incomplete responses with missing data; second, 85 (22%) respondents that were outside of the targeted age range of 18 – 44 years or took less than 175 seconds (2.9 min) to complete the survey, as this is an insufficient timeframe to immerse into the scenario and consider the questions adequately. Lastly, 60 (16%) respondents who failed the manipulation check of the type of comparison (social vs. individual) in the way that they answered “comparison with other” in the individual condition and “comparison with past weeks” in the social condition. For the following statistical analysis, a final dataset of 200 respondents remained, randomly distributed over the four experimental conditions of the 2 achievement-related gamification (on vs. off) x 2 comparison type (social vs. individual) design.

The distribution of gender was equally distributed in the sample, with 47% of the sample being female and 50% being male. While 47% of the sample is partnered or married, 43% of the sample is single, therefore slightly overrepresented in the sample. For the demographic variables of education level and employment, a slight unbalance can be found in the distribution. 57% of the sample have an education level equal to or higher than a bachelor's degree, in comparison to the European Union, where 30% attained tertiary education (Statista, 2022). We can therefore see that the distribution of achieved education levels of the sample does not reflect that of the European Union by being over-proportionally educated. The majority of the sample is full- or part-time workers (77%), while students, with 15% of the sample, are being overrepresented in comparison to the European average (Eurostat, 2022). The sample is international, with more than 10 countries represented. However, most of the sample are from Germany (50%), Italy (22%), the UK (13%), and the USA (5%). Appendix 1 presents a complete overview over the descriptive statistics of the complete sample.

5.2. Controls

Four control variables were included into this study. They included 1) perceived stress, to understand how often respondents felt stressed or anxious in the past month. 2) previous stress management app usage to understand whether respondents had used a mobile app to manage their stress before, 3) technological aptitude to measure how confident participants feel in their technology skills, and privacy concern to understand how concerned respondents feel about their data privacy when using mobile apps for stress management.

The sample as a whole felt moderately often stressed or anxious in the past month ($M = 4.86$, $SD = 1.38$), and more than half (56%) of the sample had previously used a mobile app for stress management. In terms of technological aptitude, the sample feels moderately confident in their technological skills ($M = 5.30$, $SD = 1.22$), with more than half of the sample (56%) using their smartphone three or more hours per day. When using mobile apps, the sample is moderately concerned about their data privacy ($M = 5.18$, $SD = 1.50$).

One-way ANOVA analyses were conducted to understand whether there is a difference in the means of the variables perceived stress, technological aptitude, and privacy concern depending on their previous app use. The results show no statistically significant effect of previous app use on perceived stress ($F(1, 197) = .35$, $p = .708$), so it appears that respondents' perceived stress frequency did not differ significantly between the respondents who have used an app for stress management before and those who haven't. Moreover, the results show no statistically significant effect of previous app use on technological aptitude ($F(1, 197) = 1.01$, $p = .365$). This suggests that respondents' technological aptitude did not differ significantly between the respondents who have used an app for stress management before and those who haven't. However, the ANOVA analysis did find a statistically significant difference in the means of privacy concern depending on their previous stress management app use ($F(1, 196) = 5.78$, $p < .005$). Users that have used an app for stress management before reported significantly higher levels of privacy concern ($M = 5.24$, $SD = 1.47$) in comparison to users who have not ($M = 5.19$, $SD = 1.47$) or who prefer not to say ($M = 2.33$, $SD = .58$).

To understand the relationship between previous stress management app use and smartphone usage, a chi-square test of independence was conducted. However, the relationship between these variables was not significant ($\chi^2(4, N = 200) = 3.30$, $p = .509$). Users who use their phones

more hours per day were not more likely to have used a mobile app for stress management before.

Further chi-square tests of independence were conducted to understand the relationships between the demographic variables age, gender, education, employment, marital status, and previous stress management app use. Only two relationships were significant. The results show that there is a significant relationship between employment and previous app use, $\chi^2(12, N = 200) = 30.60, p = .002$. The Cramer's V index is 0.28, which means that the relation between the two variables is relevant but not very strong. The results also show a significant relationship between marital status and previous app use $\chi^2(10, N = 200) = 25.96, p = .004$. Here, the Cramer's V index is 0.26, which also means that the relation between the two variables is relevant but not strong. It can be deduced that respondents that are married or in a domestic partnership are more likely to have used a mobile stress management app before.

However, for the other demographic variables, their relationship with the previous stress management app use was not significant. The percentage of participants that have used a stress management app before did not differ by age, $\chi^2(4, N = 200) = 4.19, p = .381$, gender, $\chi^2(6, N = 200) = .80, p = .992$, nor education $\chi^2(12, N = 200) = 11.38, p = .497$. The results imply that neither the age, gender, nor education of users influenced whether they have used a mobile app for stress management before.

Correlation analyses were conducted to assess the linear relationships between the control variables: perceived stress, technological aptitude, and privacy concern, and the four dependent variables, intrinsic motivation, self-efficacy, perceived control, and willingness to recommend. The complete results, including Pearson correlation values and descriptives, can be seen in Table 2. The results show that for most of the control variables, there is a linear positive dependence with at least one dependent variable. However, with $|r| < .3$, most positive correlations are weak. Out of all analyzed control variables, only technological aptitude has moderate positive correlations with dependent variables. Most notably, the results show that technological aptitude has a moderate positive correlation with intrinsic motivation ($r(198) = .386, p = <.001$), self-efficacy ($r(198) = .350, p = <.001$), and willingness to recommend ($r(198) = .340, p = <.001$). A weak positive linear relationship can also be observed between

technological aptitude and perceived control ($r(198) = .268, p = <.001$), privacy concern ($r(198) = .198, p = .005$), and perceived stress ($r(198) = .169, p = .017$).²

To analyse the two remaining control variables, previous stress management app usage and smartphone usage, an independent-sample t-test was run. No significant difference was found between the achievement gamification on ($M = 1.93, SD = .998$) and off ($M = 1.81, SD = .97$) groups for the control variable previous stress management app use ($t(198) = -.86, p = .195$). No significant differences were also found between the achievement gamification on ($M = 2.41, SD = .668$) and off ($M = 2.49, SD = .705$) groups for the control variable smartphone usage ($t(197) = .872, p = .192$). This suggests that neither variable previous stress management app usage nor smartphone usage plays a role in the effect of achievement-related gamification on the main dependent variables intrinsic motivation, self-efficacy, perceived control, and willingness to recommend.

Table 2 Descriptive statistics and Pearson correlations for control and dependent variables

	M	SD	PS	TA	PRC	IM	SE	PEC
Perc. Stress (PS)	4.86	1.38						
Tech Aptitude (TA)	5.30	1.22	.169*					
Privacy Concern (PRC)	4.66	7.52	-.022	.198**				
Intrinsic Motiv. (IM)	5.04	1.27	.197**	.386**	.049			
Self-Efficacy (SE)	4.73	1.31	.143*	.350**	.081	.710**		
Perc. Control (PEC)	4.72	1.25	.041	.268**	.139*	.465**	.617**	
Willingness to recommend (WR)	6.65	2.22	.174*	.340**	.063	.610**	.547**	.422**

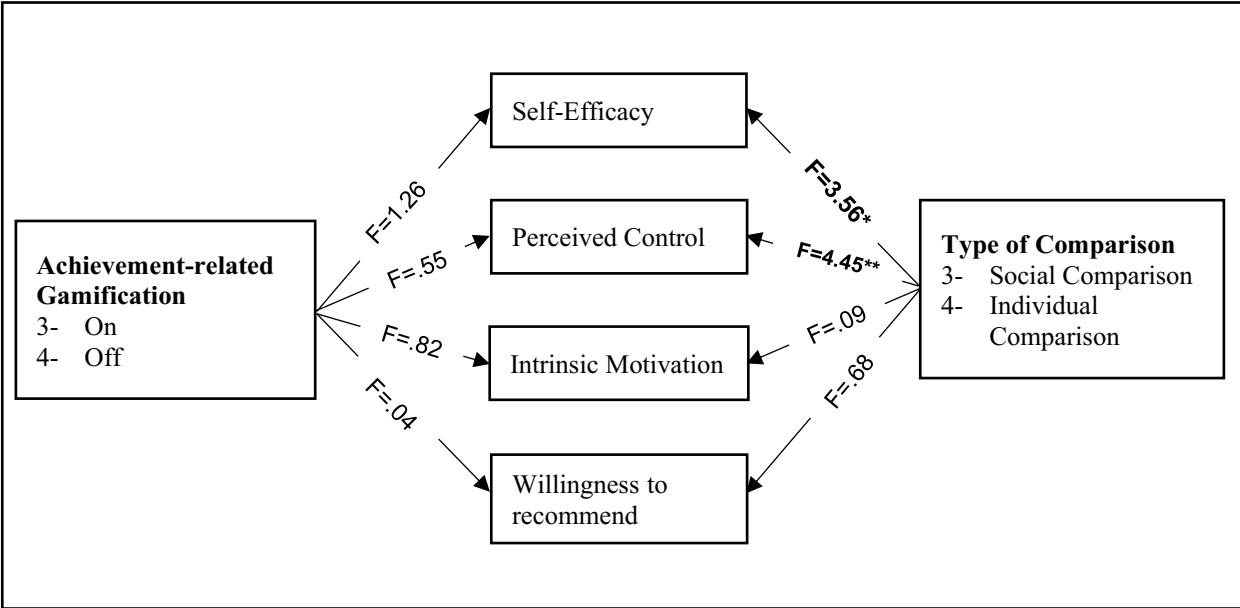
Note. $N = 200$ for each variable. * $p < .05$ (2-tailed), ** $p < .01$ (2-tailed).

² It is notable that there are also positive linear relationships between the dependent variables. The correlation analysis found a strong positive correlation between self-efficacy and intrinsic motivation ($r(200) = .710, p = <.001$). Also, a positive correlation can be found between self-efficacy and perceived control ($r(200) = .617, p = <.001$).

5.3. Main and Interaction Effects

The subsequent analyses will examine the hypotheses of the effects of achievement-related gamification (on vs. off) and type of comparison (social vs. individual) on the dependent variables, 1) intrinsic motivation, 2) self-efficacy, 3) perceived control, and 4) willingness to recommend the app. For this purpose, two-way ANOVAs were conducted, the overview over the resulting main effects are presented in Figure 4.

Figure 4 Model of the direct effects (* if $p < .1$, ** if $p < .05$)



5.3.1. Intrinsic Motivation

A two-way ANCOVA was conducted to test H1: “Achievement-related gamification in the form of reward points in a mobile stress management app will lead to lower perceived intrinsic motivation to use the app than no implemented gamification” and H2: “Social comparison in a mobile stress management app will lead to higher perceived intrinsic motivation than individual comparison”. The goal is to examine the effect of achievement-related gamification (on vs. off) and type of comparison (social vs. individual) on intrinsic motivation to use the app, controlling for technological aptitude and privacy concerns.

We found no main effect of achievement-based gamification on users’ intrinsic motivation controlling for technological aptitude and privacy concerns ($F(1, 193) = .82, p = .366; M_{Gon} = 5.07, SD_{Gon} = 1.23; M_{Goff} = 5.01, SD_{Goff} = 1.32$) and therefore fail to reject the null hypothesis. The sample of this thesis did not provide sufficient evidence to accept the abovementioned H1, as no statistically significant effect of achievement-related gamification on intrinsic motivation was observed.

Moreover, we found no main effect of type of comparison on intrinsic motivation controlling for technological aptitude and privacy concerns ($F(1, 193) = .09, p = .765; M_{Social} = 5.13, SD_{Social} = 1.36; M_{Ind} = 4.94, SD_{Ind} = 1.17$). Also here, we failed to reject the null hypothesis and do not have sufficient evidence to accept H2.

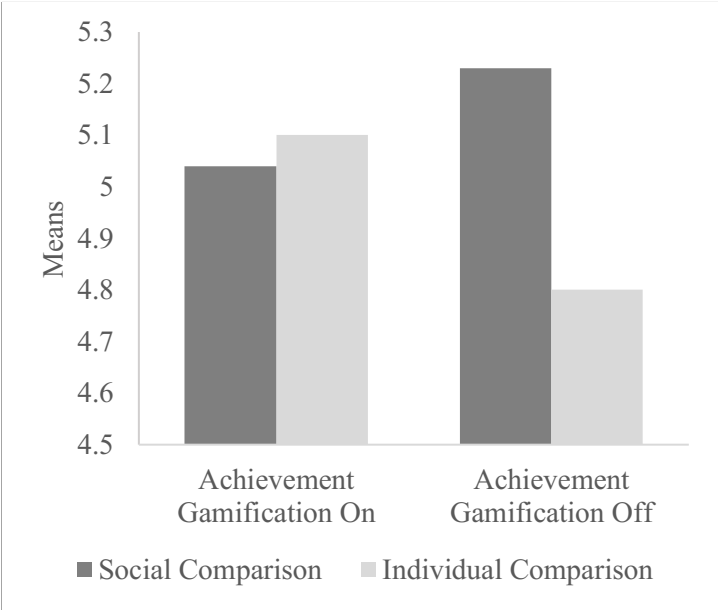
Table 3 Means and Standard Deviations of the Main Effects on Intrinsic Motivation, controlled for technological aptitude

	Achievement Gamification On		Achievement Gamification Off	
	Social Comparison M (SD)	Individual Comparison M (SD)	Social Comparison M (SD)	Individual Comparison M (SD)
Intrinsic Motivation	5.04 (1.36)	5.10 (1.09)	5.23 (1.36)	4.78 (1.25)

The results revealed that there was not a statistically significant interaction between the variables achievement-related gamification and type of comparison ($F(1, 193) = 2.69, p = .102$); however, the results allude to a potential tendency. To further analyse it an independent-samples t-test was run. The results found no statistically significant difference between social

and individual comparison when the app was achievement-related gamified ($t(98) = .24, p = .401$). However, when achievement-related gamification was not present, the one-sided statistically significant result suggest that social comparison may lead to a higher intrinsic motivation than individual comparison in a mobile app where no achievement-related gamification is present ($t(98) = -1.65, p = .05$). The result imply that users may feel more intrinsically motivated to use the app through social comparison when no achievement-related gamification is present.

Figure 5 Ratings for Intrinsic Motivation for the experimental conditions of achievement-related gamification and type of comparison



5.3.2. Self-Efficacy

To examine the effect of achievement-related gamification (on vs. off) and type of comparison (social vs. individual) on users' self-efficacy to manage their stress after using the app, a two-way ANOVA was conducted.

We found no main effect of achievement-based gamification on self-efficacy ($F(1, 196) = 1.26, p = .262; M_{Gon} = 4.83, SD_{Gon} = 1.15; M_{Goff} = 4.63, SD_{Goff} = 1.46$) and therefore fail to reject the null hypothesis. We do not have sufficient evidence to accept H3a: "Achievement-related gamification in the form of reward points in a mobile stress management app will lead to higher perceived self-efficacy and higher perceived control in the management of one's stress than no implemented gamification.", as there was no statistically significant effect of achievement-related gamification on self-efficacy observed.

We did find a marginally significant main effect of type of comparison on self-efficacy ($F(1, 196) = 3.56, p = .060; M_{Social} = 4.90, SD_{Social} = 1.39; M_{Ind} = 4.56, SD_{Ind} = 1.21$). We will reject the null hypothesis under the limitation that the p -value is defined through Fisher's paradigm, which defines the p -value as a continuum representing the strength against the null. We can therefore accept the hypothesis H4a: "Social comparison in a mobile stress management app will lead to higher perceived self-efficacy and higher perceived control in the management of one's stress than individual comparison." As predicted the social comparison group led to marginally significantly higher levels of self-efficacy ($M = 4.90, SD = 1.39, t(198) = -1.88, p = .031$ (one-sided)) than the Individual Comparison group ($M = 4.56, SD = 1.21$).

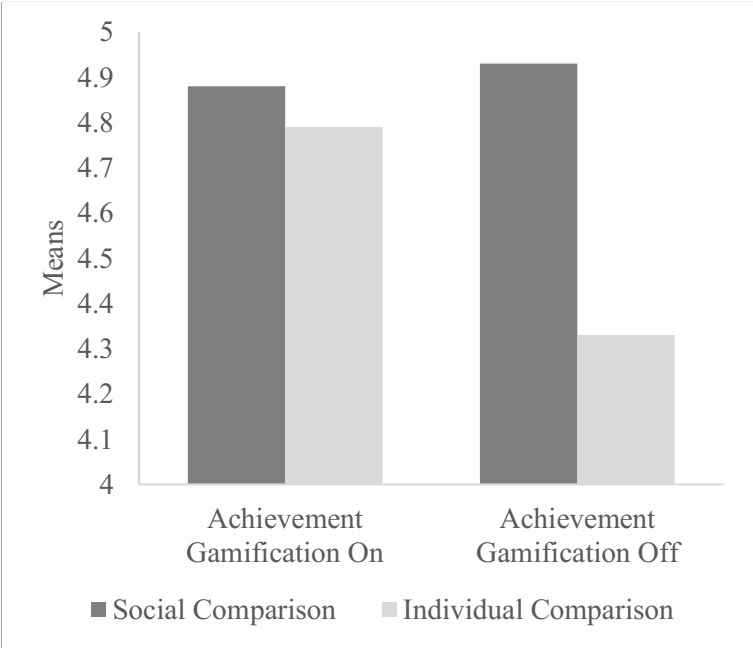
Table 4 Means and Standard Deviations of the Main Effects on Self-Efficacy

	Achievement Gamification On		Achievement Gamification Off	
	Social Comparison M (SD)	Individual Comparison M (SD)	Social Comparison M (SD)	Individual Comparison M (SD)
Self-Efficacy	4.88 (1.28)	4.79 (1.01)	4.93 (1.50)	4.33 (1.36)

The results also revealed that there was not a statistically significant interaction between the variables achievement-related gamification and type of comparison ($F(1, 193) = 2.45, p = .120$); however, the results allude to an interaction tendency. To further analyse it, an

independent-samples t-test was conducted. The results found no statistically significant difference between social and individual comparison when the app was achievement-related gamified ($t(98) = -.40, p = .344$ (one-sided)). However, when achievement-related gamification was not present, the one-sided statistically significant result suggest that social comparison may lead to a higher Self-Efficacy than individual comparison ($t(98) = -2.10, p = .019$ (one-sided)). The results suggest that in a non-achievement gamified app, users may feel more capable managing their stress with an app when it includes social comparison rather than individual comparison.

Figure 6 Means for Self-Efficacy resulting from the independent-samples t-test



5.3.3. Perceived Control

To test H3b: “Achievement-related gamification in the form of reward points in a mobile stress management app will lead to higher users’ perceived control in the management of one’s stress than no implemented gamification” and H4b: “Social comparison in a mobile stress management app will lead to higher perceived control in the management of one’s stress than individual comparison.”, a two-way ANOVA was conducted. The goal is to examine the effect of achievement-related gamification (on vs. off) and type of comparison (social vs. individual) on users’ perceived control over their stress.

We found no main effect of achievement-based gamification on users perceived control ($F(1, 196) = .55, p = .460; M_{Gon} = 4.79, SD_{Gon} = 1.18; M_{Goff} = 4.66, SD_{Goff} = 1.32$) and therefore fail to reject the null hypothesis. The sample of this thesis did not provide sufficient evidence to accept the abovementioned H3b as no statistically significant effect was observed.

However, it revealed a significant main effect of type of comparison on perceived control ($F(1, 196) = 4.45, p = .036; M_{Social} = 4.91, SD_{Social} = 1.26; M_{Ind} = 4.54, SD_{Ind} = 1.22$). We are able to reject the null hypothesis and accept H4b: “Social comparison in a mobile stress management app will lead to higher perceived control in the management of one’s stress than individual comparison.” As predicted the social comparison group led to significantly higher levels of perceived control ($M = 4.91, SD = 1.26, t(198) = -2.11, p = .018$ (one-sided)) than the individual comparison group ($M = 4.54, SD = 1.22$).

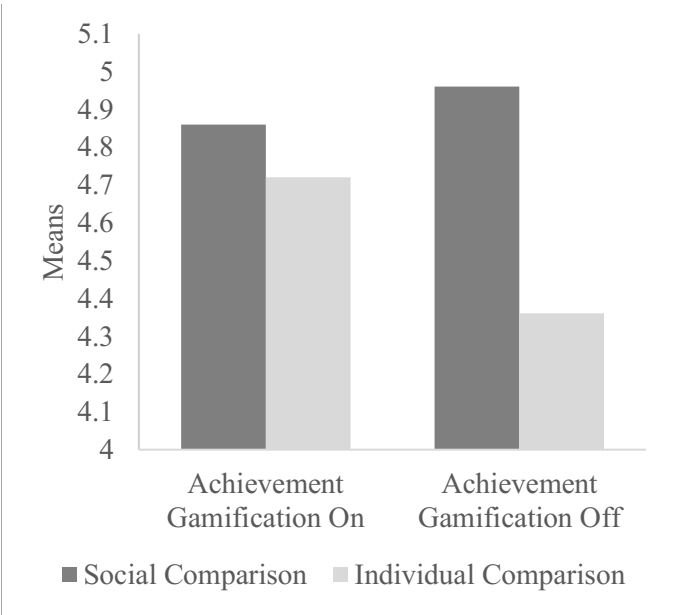
Table 5 Means and Standard Deviations of the Main Effects on Perceived Control

	Achievement Gamification On		Achievement Gamification Off	
	Social Comparison M (SD)	Individual Comparison M (SD)	Social Comparison M (SD)	Individual Comparison M (SD)
Perceived Control	4.86 (1.29)	4.72 (1.07)	4.96 (1.25)	4.36 (1.34)

A t-test test revealed that there was not a statistically significant interaction between the effects of achievement-related gamification and type of comparison ($F(1, 196) = 1.71, p = 0.191$); however, the results also here allude to an interaction tendency. To further analyse it, an independent-samples t-test was conducted. The results found no statistically significant

difference between social and individual comparison when the app was gamified ($t(98) = -0.59, p = 0.278$ (one-sided)). However, when Achievement-related Gamification was not present, the one-sided statistically significant result suggests that Social Comparison may lead to a higher Perceived Control than Individual Comparison ($t(98) = -2.32, p = .011$ (one-sided)). The result suggests that when confronted with a non-gamified app, users may feel more in control of their stress when it includes social comparison rather than individual comparison.

Figure 7 Means for Perceived control resulting from the independent-samples t-test



5.3.4. Willingness to recommend

To test H5: “Achievement-related gamification in the form of reward points in a mobile stress management app will lead to a higher willingness to recommend the app than no implemented gamification” and H6: “Social comparison in a mobile stress management app will lead to a higher willingness to recommend the app than individual comparison.”, a two-way ANOVA was conducted. The goal is to examine the effect of achievement-related gamification (on vs. off) and type of Comparison (social vs. individual) on users’ willingness to recommend the app to friends or colleagues. It is essential to note that in contrast to other dependent variables, willingness to recommend was measured on a 0 – 10 scale, corresponding to the Net Promoter measurement scale.

We found no main effect of achievement-based gamification on willingness to recommend ($F(1, 196) = .04, p = .849; M_{Gon} = 6.62, SD_{Gon} = 2.17; M_{Goff} = 6.68, SD_{Goff} = 2.27$) and fail to reject the null hypothesis. We are not able to confirm H5 as the sample did not provide sufficient evidence to do so.

We also found no main effect of type of comparison on willingness to recommend ($F(1, 196) = .68, p = .411; M_{Social} = 6.52, SD_{Social} = 2.48; M_{Ind} = 6.78, SD_{Ind} = 1.92$). Due to the result, we fail to reject the null hypothesis and are not able to confirm H6.

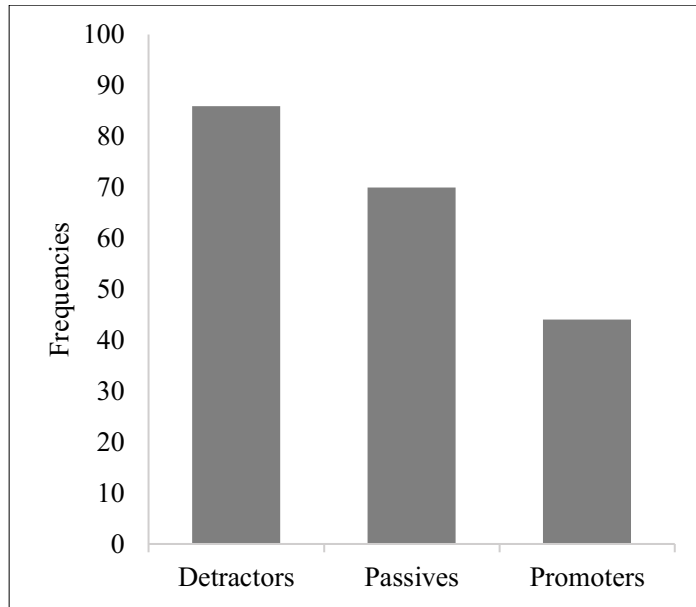
Furthermore, the results revealed that there was not a statistically significant interaction between the variables achievement-related gamification and type of comparison ($F(1, 196) = .004, p = .949$).

Table 6 Means and Standard Deviations of the Main Effects on Willingness to try

	Achievement Gamification		Achievement Gamification	
	On		Off	
	Social Comparison M (SD)	Individual Comparison M (SD)	Social Comparison M (SD)	Individual Comparison M (SD)
Willingness to try	6.50 (2.34)	6.74 (2.01)	6.54 (2.64)	6.82 (1.85)

The calculated Net Promoter Score is -21, please see Figure 8 for a distribution of the frequencies over the three groups, Detractors, Passives, and Promoters.

Figure 8 *Frequencies of Net Promoter Score Groups*



5.4. Linear Regression and Mediation Analysis

To understand the variables that influence the dependent variable willingness to recommend, a linear multiple regression analysis was performed. To set up the model and select the coefficients, we ran a t-test and found of all tested dependent variables, only intrinsic motivation, perceived control, and privacy concern to be significant (please see Table 7 for their results and *p*-values).

Table 7 *Unstandardized beta, standard error for the unstandardized beta, standardized beta, t-test statistics, p- and VIF values for the linear regression on willingness to recommend*

	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>	<i>VIF</i>
Intrinsic Motivation	.823	.114	.471	7.23	< .001	1.42
Perceived Control	.299	.110	.168	2.71	.007	1.28
Privacy Concern	.087	.087	.162	2.75	.007	1.16

Note. Dependent Variable: Willingness to recommend.

However, before eliminating other variables, we checked their multicollinearity, which revealed a VIF > 1.2, indicating a multicollinearity between the independent variables of this model. However, due to the VIF values being well below 5, suggesting a moderate correlation that is not severe enough to imply critical levels of multicollinearity, we proceed with the three dependent variables of intrinsic motivation, perceived control, and privacy concern. To check the goodness of the model, an f-test was conducted ($F(3, 195) = 46.81$; $R^2 = .42$; $R^2_{ad} = .41$; $p < .001$). With a p -value being lower than .05 and the adjusted r-squared being higher than .2, the results indicate that the model is capable of explaining the dependent variable, willingness to recommend.

Mediation Analysis

We hypothesized in H7: “Intrinsic motivation to use the app partially mediates the relationship between users perceived control over their stress and users’ willingness to recommend the app.” To test the hypothesized mediation model and analyze the relationship and mediation effect of intrinsic motivation, we consider privacy concern and technology aptitude as control variables (covariates). After checking the four assumptions: continuous measurements, normality, independence, and linearity, we analyzed the hypothesized mediation model using Hayes’ PROCESS macro model number 4 in SPSS.

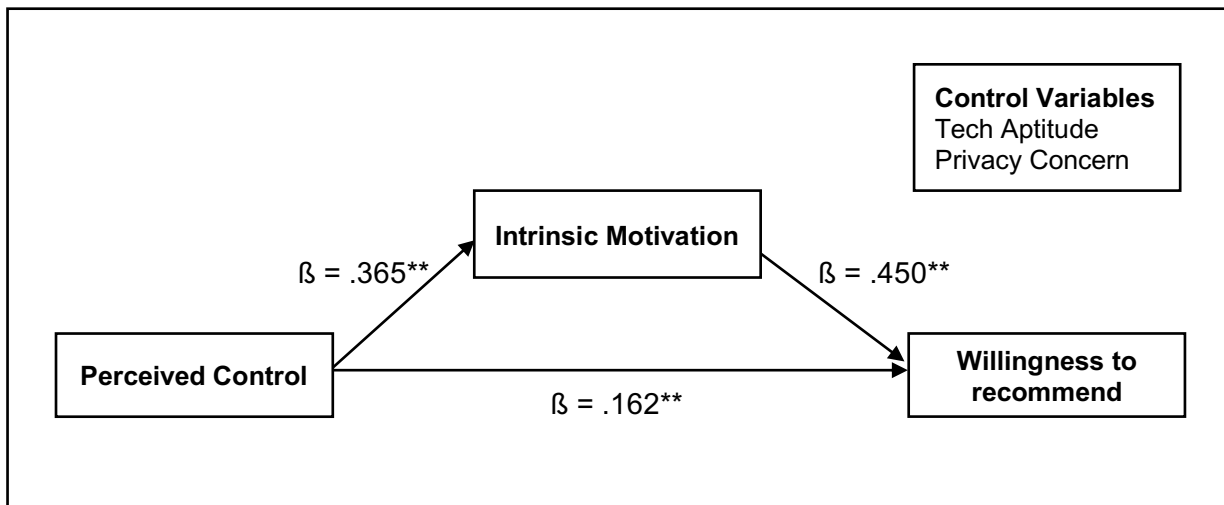
The results revealed a significant indirect effect of impact of perceived control on willingness to recommend ($B = 0.292$; $\beta = .164$), supporting H7. Furthermore, the direct effect of perceived control on willingness to recommend in presence of the mediator was also found significant ($B = 0.287$; $\beta = .162$; $p = .010$). Hence, intrinsic motivation partially and complimentary mediated the relationship between perceived control and willingness to recommend. Mediation analysis summary is presented in Table 8 and Figure 9. Furthermore, the results showed that perceived control has a significant impact on intrinsic motivation ($B = .371$; $\beta = .365$; $t = 6.00$; $p < .001$) and intrinsic motivation has a significant impact on willingness to recommend ($B = .787$; $\beta = .450$; $t = 6.70$; $p < .001$)

Table 8 Indirect and Total Effects of Perceived Control (PC), Intrinsic Motivation (IM), and Willingness to recommend (WTR) in the Mediation Model

		95% C.I. (a)						
Type	Effect	B	SE B	Lower	Upper	β	t	p
Indirect	PC→IM→WTR	.292	.081	.147	.465	.164	n/a	(b)
Com- ponent	PC→IM	.371	.062	.249	.493	.365	6.00	< .001
	IM→WTR	.787	.117	.555	1.02	.450	6.70	< .001
Direct	PC→WTR	.287	.110	.070	.505	.162	2.60	.010
Total	PC→WTR	.579	.112	.358	.801	.326	5.16	< .001

Note. (a) Significance of confidence intervals were computed using repeated samples to estimate indirect effects. (b) The indirect effect was tested using a percentile bootstrap estimation approach

Figure 9 Mediation Model showing standardized β ; **, if significant on <.05 level



5.5. Additional Analyses

5.5.1. Internal consistencies of measurement scales

Both variables intrinsic motivation and self-efficacy were measured with multiple Likert questions that together form a scale. To determine if the scale is reliable, we calculated Cronbach's alpha. The scale for intrinsic motivation consisted of 4 items ($\alpha = .89$), while the scale for self-efficacy consisted of 3 items ($\alpha = .86$). The results, displayed in Table 9, show that both scales, intrinsic motivation, and self-efficacy have good internal consistency. In addition, we can see for both scales that the removal of any question would result in a lower Cronbach's alpha, therefore we did not do so for our data analysis.

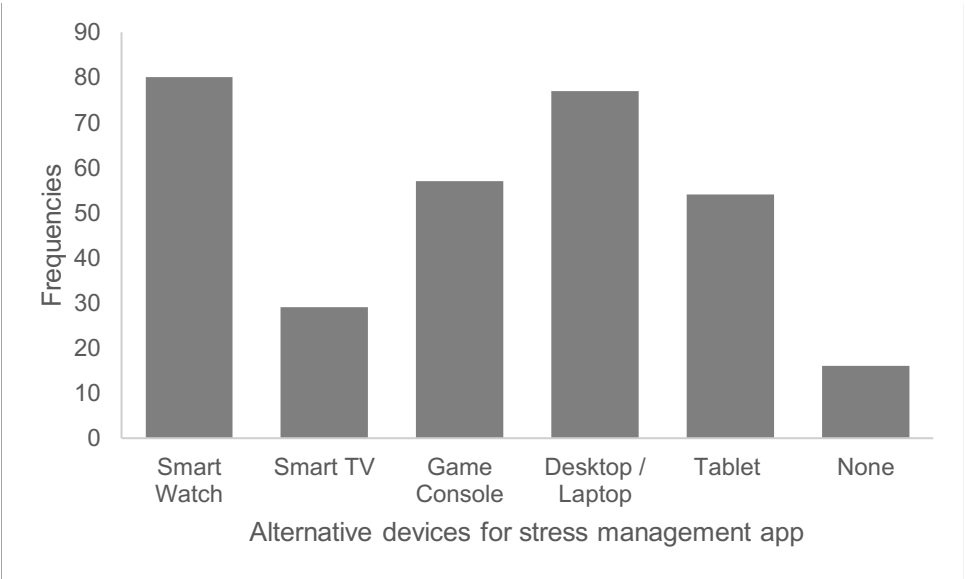
Table 9 *Item statistics for the scales intrinsic motivation and self-efficacy*

Scale	Question	<i>M</i>	<i>SD</i>	<i>R</i> ²	α if deleted
Intrinsic Motivation	App is interesting	5.05	1.53	.592	.854
	App is fun	5.10	1.44	.565	.862
	App is motivating	5.09	1.41	.584	.860
	App is helpful	4.93	1.47	.616	.850
Self-Efficacy	Self-Efficacy 1	4.64	1.39	.614	.777
	Self-Efficacy 2	4.60	1.46	.556	.816
	Belief in future stress	4.96	1.59	.523	.837

5.5.2. Alternative Devices

In the survey we asked respondents on which other platforms or devices they would appreciate an app for stress management in a multiple response multiple choice question. The results show that almost half of the sample (40%) would appreciate an app for stress management on smart watches, quickly followed by desktop/laptop with 39% and game consoles (29%) of the sample. The least popular device for a stress management app are smart tvs (15%). Please see Figure 10 for an overview over the frequencies.

Figure 10 Frequencies for other devices respondents would appreciate an app for stress management



6. Discussion

This thesis has examined the effects of achievement-related gamification through collectible rewards points and social comparison on users' motivation, perceptions of control and competence in managing stress, and willingness to recommend in the context of a mobile self-help stress management app. The results of the 2 achievement-related gamification (on vs. off) x 2 type of comparison (individual vs. social) between-subjects design indicate that neither achievement-related gamification in the form of reward points nor the type of comparison significantly influences users' intrinsic motivation to use a mobile self-help app to improve their stress levels. In addition, the results suggest no significant effects of achievement-related gamification on self-efficacy, perceived control, or willingness to try. However, for the second independent variable, type of comparison, the results indicate a statistically significant positive effect of type of comparison on perceived control as well as a marginally significant positive effect on self-efficacy. An interaction tendency furthermore suggests that when achievement-related gamification was not present, social comparison may lead to a higher self-efficacy than individual comparison. In a non-achievement gamified app, users may feel more capable managing their stress with an app when it includes social comparison rather than individual comparison.

Self-Efficacy, in literature and this thesis interchangeably used with the term perceived competence, has, in this thesis, been defined as the users perceived competence in managing their own stress after using the self-help stress management app. The results of the experiment showed that collecting points as a reward for participating in stress-relieving activities did not statistically significantly influence how capable mobile app users perceive themselves to be in stress management. This suggests that mobile app users do not seem to infer any beliefs about their own competence when they successfully collect reward points (achievement-related gamification on) instead of improving one's well-being directly (achievement-related gamification off). While this result mirrors the findings of other studies (de Croon et al., 2018; Jamshidifarsani et al., 2019), it does not confirm the theoretical assumptions of (Bandura, 1978) and the assumption of the self-efficacy theory that positive feedback enables users to measure and demonstrate their success and in turn, allows them to form positive self-efficacy beliefs. One reason behind the findings may be that certain achievement-related game elements, including points and badges, fail to provide tangible health-driven meaning in terms of participants' perceived competence and health skills (Al-Rayes et al., 2022; de Croon et al.,

2018; Sardi et al., 2017). It seems that the psychological distance between abstract reward points and tangible health outcomes may be too large to infer feelings of competence or control. The intangibility of the reward points may also impact their perceived distance to emotional well-being and users' perceived stress-management competence.

However, the results also showed that users might infer beliefs about their own stress-management competence when their performance on the stress-management app was compared to others (social comparison) and not their past performance (individual comparison). Users feel marginally significantly more competent when they have been compared to others vs. themselves. This is in line with self-efficacy theory (Bandura, 1978), which states that self-efficacy beliefs are acquired through vicarious experience and the observation of others. By comparing themselves to others, which is a quick and implicit tendency of individuals, they are able to evaluate their own abilities and relative status (Gilbert et al., 1995). The results of the marginally significant main effect implied that when assessing one's own competence in managing stress, past performance matters less than performance compared to others. App users may infer more self-affirming information from validating their performance against others. It is important to note that the found interaction tendency suggests that the effect described above is only statistically significant when achievement-related gamification is not present. When achievement-related gamification is present, the app's goal is to collect reward points instead of improving one's well-being directly. In this scenario, users inferred beliefs about their own stress-management competence did not depend on whom their performance was compared to.

Results of the regression analysis showed that there is a moderate positive linear relationship between the variables perceived control and self-efficacy. This confirms the assumption that both variables are theoretically related and that perceptions of control and competence can be inferred from each other. The results imply that mobile app users that feel more competent in managing their own stress also feel more in control of it. Similarly to its previously discussed effects on self-efficacy, achievement-related gamification in the form of reward points also did not make app users feel more in control over their stress. It seems that also, here, the psychological distance between intangible reward points and health behavior may be too large to infer feelings of control.

Additionally, the results of the mediation analysis suggest that the willingness to recommend the app to other friends or colleagues depends both on users' perceived competence and their intrinsic motivation. Specifically, the results found that intrinsic motivation mediates the

relationship between perceived control and willingness to recommend. This supports the assumption of self-determination theory, which predicts that the satisfaction of the need for competence increases individuals' intrinsic motivation. However, it is to be noted that there might be other variables influencing users' willingness to recommend the app to friends and colleagues. There is still a social stigma attached to mental health, so users might feel uncomfortable suggesting it to others.

Motivation is a multiplex construct, and understanding the underlying mechanisms of motivation is a complex task, as evidenced by the vast amount of scientific research on the topic. Gamification researchers have recently begun to analyze how the multitude of game elements affect those underlying motivational mechanisms. The results of this thesis indicated that neither the presence nor absence of achievement-related gamification in the form of reward points nor the type of comparison significantly influences users' intrinsic motivation to use a mobile self-help app to improve their stress levels. However, this result is not unusual. Throughout the whole body of gamification literature, differences in study design, gamification design, health behavior context, and outcome measurement lead to inconsistent results (Cheng et al., 2019; Hamari et al., 2014; Johnson et al., 2016; Koivisto & Hamari, 2019a). It is, therefore, not uncommon for studies to not find significant effects on users' intrinsic motivation in the applied context of self-determination theory (Jamshidifarsani et al., 2019).

This thesis's finding that reward points do not significantly influence users' intrinsic motivation may also be rooted in the varying perceptions of reward points by different users. For example, collected qualitative data points towards opposing opinions, with one respondent stating that "reducing my stress feels more achievable if I can see and track my progress over the weeks with something like like points" (Male, 25 – 34 years old, Condition Achievement Gamification On_Individual Comparison). However, another respondent reported that "a points system and comparison to previous points adds stress, it is not motivating it is more likely to lead to a mental breakdown for me" (Non-binary/third gender, 25 – 34 years, Condition Achievement Gamification On_Individual Comparison). This difference may point towards a research gap that studies only recently have started to explore in mobile health: The influence of users' personalities or so-called "player types" on perceptions of gamification and perceived motivation (Klock et al., 2020).

Research has also stated that it is essential to implement gamification in a meaningful way (Zichermann & Cunningham, 2011). The results of this thesis imply that while collectible reward points might be useful in some contexts, it is doubtful if they can provide the necessary health-driven meaning that may be required for intrinsic motivation in stress management apps. This is supported by (de Croon et al., 2018; Nicholson, 2012), who introduced the concept of "meaningful gamification" and found that the collection of points can be equated to the collection of external rewards, which diminishes users' motivation in the activity. He suggests that points should be imbued with meaning and significance to mobile app users in order to increase intrinsic motivation. This indicates that the achievement-related reward points in this thesis did not feel meaningful enough to elicit an increase in users' intrinsic motivation to use the app for stress management.

Additionally, there seem to be controversies and counteracting effects of applying social comparison, specifically in the sensitive context of mobile mental health. The theory of self-determination suggests that when an activity fulfills people's need for social relatedness, it increases their intrinsic motivation to do that activity. Research has applied this construct to gamification and found positive effects of social-related gamification, specifically social comparison, on intrinsic motivation across different gamified contexts. For example, Hamari et al. (2014) and Arigo et al. (2020) found an increase in physical activity in exercise apps. However, in light of this thesis's statistically insignificant results of social comparison on the intrinsic motivation to use a mobile self-help stress management app, questions arise on the suitability of social comparison in mental health care. From the qualitative information collected in the survey, there seem to be negative effects of social comparison that counteract the expected positive effects. One respondent reported, "comparing key results to other people would make me feel even more stressed" (Female, Condition Achievement Gamification Off_Social Comparison). Other respondents echoed this sentiment and reported, "it feels strange to compete with others to see who can better cope with stress. It kind of generate stress itself" (Female, Condition Achievement Gamification On_Social Comparison).

It seems as if the effect of social comparison on intrinsic motivation is extremely complex, especially in the highly sensitive context of mobile health. Depending on the specific context in which the comparison takes place, social comparison can have both positive and negative effects on individuals' intrinsic motivation. Research supports this assumption, as Kuppens et al. (2018) found that the implementation of social comparison leads to negative feelings,

including anxiety and stress, a decrease in motivation, and potential disengagement from the app if the social pressure becomes too intense. (Oinas-Kukkonen & Harjumaa, 2009) also questions the use of social pressure as this study found that social pressure is not intrinsically but extrinsically motivating. App developers should take care in the design of mobile mental health apps to avoid negative effects on users' physical and mental health. When users feel stressed or anxious about their progress or achievements in comparison to others, it may completely neutralize the positive effects of 1) the mental health boost the app strives to achieve and 2) the positive effects social comparison seems to have on intrinsic motivation in less sensitive contexts like physical activity.

6.1. Theoretical Contribution

While previous research has applied various game elements to a multitude of health contexts, this thesis uniquely contributes to the current body of literature on gamification by applying two types of game elements in a mobile stress management app. In addition, this thesis combines both self-determination and self-efficacy theory to form a full picture of the effects of both types of gamification on not only intrinsic motivation but also perceived control and self-efficacy judgments of app users. As only a few studies have researched the relationship between reward points and social comparison on users' intrinsic motivation, this thesis provides new insights into the factors that may influence this relationship. By doing so, this thesis was also able to expand the theoretical frameworks of self-determination theory and self-efficacy to the context of mobile stress management.

This thesis also contributes to the stream of gamification literature that tries to apply game elements in different contexts to see whether its effects are transferrable across disciplines. The results provide additional evidence that achievement-related gamification and social comparison cannot easily be transferred across health and wellness disciplines. While reward points and social comparison were previously shown to be effective in increasing other health behaviors, this thesis provides a contribution by suggesting that neither achievement-related gamification nor social comparison is effective in increasing intrinsic motivation to reduce stress using a mobile app. In detail, this thesis found that there are opposing opinions of users on both types of gamification, which makes them controversial in their use for stress management.

Lastly, this thesis contributes to the current literature by adding evidence on the relationship between users' intrinsic motivation, perceived control, and their willingness to recommend the app to others. To my knowledge, no previous study has studied the relationship between these three variables with each other. By doing so, this thesis provides new insights into driving factors that compel mobile app users to recommend the app to friends and colleagues.

6.2. Managerial Contributions

This thesis has compiled substantial evidence that gamification is relevant for businesses looking to provide more engaging and motivating digital applications. Not only can gamification improve healthcare delivery, patient retention, and health outcomes, but it can also offer a competitive advantage for healthcare providers and tech companies. This thesis can guide informed business decisions about the types of game elements that are most suited for mobile health apps. This is especially important in the digital era, as high user retention rates threaten business viability. The return on user acquisition investments may be low, especially in mobile health apps, as most users stop their app usage soon after their first trial (Vaghefi & Tulu, 2019), with a median mobile mental health app retention rate of 3.9% after just 15 days (Baumel et al., 2019). Through its gathered literature, this thesis determined that to counteract this high user attrition rate, it is necessary to keep users engaged and motivated for longer. A proven way to do so is by increasing their intrinsic motivation (Teixeira et al., 2012). While, based on previous evidence, leaderboards and reward badged are recommended as the most efficient in doing so (Hamari et al., 2014), this thesis questions their use in mobile mental health.

In addition, this thesis provides information for policy decision-makers that are looking to make evidence-based investments in digital mobile health technologies. This includes, for example, the European Union and World Health Organization, who are currently looking for strategies to adopt digital health solutions until 2030 sustainably.

This thesis has compiled compelling evidence that gamification can be successful in promoting a healthy lifestyle and long-term behavior change toward healthy habits. Policy-makers should take note of the popularity and effectiveness of gamification in digital mobile health and include it in their 2030 digital health action plan. On the other hand, the results of this thesis show the need for patient-centric regulation of digital mental health. For example, while the results show that social comparison is effective in increasing users' self-efficacy and perceived control, this thesis found potential negative effects. Careful consideration of the impact potential misuse and wrongful application can have on users is needed, especially in the industry of mobile mental

health apps, which is, until now fairly unregulated. Based on the potential negative effects found in this thesis, consumer protection laws should be implemented to counteract privacy risks and potential harm to vulnerable app users looking for mental health support.

The findings of this thesis also have implications for gamification designers. Due to the insignificant main effects of reward points and social comparison on intrinsic motivation, this thesis does not recommend implementing those game elements into an app for stress management. Results of the regression analysis showed that there is a moderate positive linear relationship between self-efficacy and intrinsic motivation. This might imply that mobile app users that feel more competent in managing their own stress feel more intrinsic motivation to use the app. Therefore, this thesis recommends that app designers include encouraging feedback directly related to their health performance or health outcomes to improve intrinsic motivation and, in turn, user adherence. Furthermore, based on the mediated relationship between perceived control and willingness to recommend, this thesis encourages the use of gamification elements that increase feelings of control in their users. While, according to the found results, collecting rewards does not increase users' perceptions of control, other game features such as virtual avatars or app customization do.

This thesis also provides insights into users' willingness to recommend the mobile app to friends and colleagues and, with that, may guide businesses' user acquisition strategies when trying to launch a mobile stress management app. The results showed that neither social comparison nor reward points are impactful game elements to use for mental health app developers if they are trying to increase their user's willingness to recommend the app. However, it may be possible that social stigma around mental health decreases users' willingness to recommend the studied app. This shows that there are avenues for additional research to expand and strengthen the findings of this study.

Lastly, this thesis provides an idea for a business opportunity. After collecting information on which other technological devices users would appreciate an app for stress management on, the results show that almost one-third of the sample (29%) would like to see such an app on game consoles. While there are researchers who are looking into the development of interactive serious games for stress relief (Larsson, 2022), this is still, to our knowledge, a relatively untapped market.

6.3. Limitations

We acknowledge that this thesis has limitations. First, there was a lack of immersiveness in the survey. While users were presented with two screenshots, they were not able to collect reward points themselves. This might have influenced how respondents interacted with the survey and perceived their experience with the gamification elements. Gamification may depend on the playful experience it creates, which may not have been elicited in respondents through this survey. Second, the outcome measures of this study were self-reported and did not include any usage measurement. Future studies may use mobile app user data or log data for additional findings. Third, the recruitment of participants was mostly done online over social media and in survey exchange platforms. These recruitment characteristics may have influenced how respondents interacted with the survey and responded to the questions about the presented app. It is also important to add that there may be other factors that influence intrinsic motivation to use a mobile stress-management app. This study did not, for example, consider the cultural effects of respondents from different countries or the social stigma attached to mental health. Also, privacy concerns, although briefly mentioned as a control variable in this study, may have an important effect on the users' perceptions of mobile health apps.

Furthermore, this study examined only two of a multitude of game elements. This might lead to limitations as usually more than two game elements are applied in a mobile app at once with an overlap between elements as they affect users in conjunction. Last, we note that this study focused on intrinsic motivation to use the app and did not study behavior change or continued use. However, research has shown that continued use is an important determinant of successful health behavior change. For future studies, this may be an interesting area of further research.

6.4. Future Research

The research on gamification is perhaps oversaturated and understudied at the same time. Oversaturated because there exists a wide range of literature on gamification. Understudied because the effects of gamification depend on an overwhelming amount of different variables that researchers have not all yet analyzed. An important step was done in the past years to differentiate between various game elements that can be applied in mobile apps. However, more research is needed to identify possible correlations between the game elements and different healthcare conditions. Further studies are needed to extend and replicate current results in other healthcare conditions and across health behaviors and outcomes. This is important as game elements can have completely different effects depending on the health outcome it seeks to facilitate. While this study analyzed achievement-related reward points and social comparison, it did not analyze immersion-related gamification in the application of a mobile self-help stress management app. This leaves a research gap for future research. In addition, while this thesis tested the effects of positive rewards and feedback, future research can test the impact of negative feedback, such as losing points and a decrease in well-being.

Another interesting stream of future research regards the correlations between the game elements and their perceptions by users with different psychological profiles. For example, the same game element might be evaluated and perceived differently by individuals that are, for example, more susceptible to stress and social pressure in comparison to other users. All in all, more research needs to unify a very broad and divided field of research. It is important for future research to come to an agreement on implementation context, gamification design, and outcome measurements, as current inconsistencies lead to inconsistent results.

7. Conclusion

Gamification, commonly defined as “the use of game elements in non-game contexts” (Deterding et al., 2011), has been rapidly expanding and increasingly integrated into digital health and wellness. Gamified apps pledge to not only engage, motivate, and counteract high user attrition rates but also to improve users’ intrinsic motivation for long-term motivation and health behavior change. This thesis showed that gamification is often effective in achieving those objectives in a variety of contexts, including nutrition, physical activity, and medication adherence. However, the goal of this thesis was to extend the current research and understand whether the positive effects of gamification are also applicable in mobile mental health, specifically stress management apps. To achieve this goal, two game elements were applied in a fictitious mobile stress management app in a 2 achievement-related gamification (on vs. off) x 2 type of comparison (social vs. individual) between-subjects design.

In this thesis, we studied the effects of the two independent variables on four dependent measures. First, users’ intrinsic motivation to use the app was important as intrinsic motivation can not only motivate long-term behaviors but also improve well-being directly. Second, we analyzed self-efficacy and perceived control to understand how gamification affects the judgments and perceptions that mobile app users have about their own competence and control over their own emotions, in this case, stress. Lastly, we analyzed willingness to recommend the app to friends and colleagues, not only considering the direct effects of reward points and social comparison but also the mediating effect of intrinsic motivation on the relationship between perceived control and willingness to recommend. This variable was important, as user acquisition costs for mobile apps are a crucial business success determinant, and individuals trust recommendations from friends much more than recommendations from advertisements.

Overall, the results showed that the opportunity to collect reward points for participating in stress-relieving activities does not impact users’ intrinsic motivation, their perceived competence, or the control they feel over their emotions. Further analysis revealed contrasting opinions on reward points in the studied context. While some users felt motivated by their quantifiable progress that they were able to see, others felt overwhelmed by their presence. In addition, results suggest that game elements that focus on collecting rewards may also feel irrelevant to users’ looking for a specific health result, such as a reduction in stress. Overall, this thesis suggests that collecting reward points might be not an effective tool in mobile mental health, especially for stress management. While this may be due to additional factors such as

mental health stigma or cultural influences, it may also be because the effectiveness of gamification depends on several factors, including app design, health behavior, target population, and used game elements. We, therefore, suggest that additional research is needed to determine specific conditions under which gamification is most effective and also to understand the most helpful and motivating way to implement gamification to reduce stress.

In contrast, social comparison was revealed as effective tool in increasing users' judgments of their competence and the control they felt over their stress. It did, however, not affect users' intrinsic motivation to use the app. Further discussion revealed conflicting opinions on the appropriateness of social comparison in stress reduction. While some users may feel motivated by "looking better," other users may feel an increased sense of social pressure. Overall, the results highlight the importance of context in the implementation of gamification, specifically in mental health apps targeting vulnerable individuals. For app developers, this thesis suggests proceeding with caution when implementing game elements in stress management apps as they may elicit negative emotions in app users seeking mental health support. Similarly, for policymakers, this thesis suggests implementing additional consumer protection laws, protecting mobile app users from unregulated mHealth app content as well as unstandardized and untested mobile health apps, which may risk users' sensitive health information.

In conclusion, this thesis confirms that while gamification has been shown to be effective in other mobile health domains, the results do not seem to apply in the sensitive area of mobile mental health, specifically in stress management apps. Based on our results, we conclude that social gamification may be effective but controversial in eliciting feelings of control over ones emotions and that those feelings can, in turn, make it more likely that users will recommend the app further.

8. Appendix

Table 1 Frequencies and percentages of sociodemographic characteristics of participants

	Achievement Gamification On				Achievement Gamification Off				Full Sample	
	Social Comparison		Individual Comparison		Social Comparison		Individual Comparison			
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Gender										
Female	27	54.0	21	42.0	27	54.0	24	48.0	99	47.0
Male	20	40.0	28	56.0	22	44.0	24	48.0	94	49.5
Other	3	6.0	1	2.0	1	2.0	2	4.0	7	3.5
Marital status										
Single	30	60.0	19	38.0	18	36.0	19	38.0	86	43.0
Married/partnered	13	26.0	27	54.0	30	60.0	23	46.0	93	46.5
Divorced/widowed	5	10.0	3	6.0	1	2.0	6	12.0	15	7.5
Other	2	4.0	1	2.0	1	2.0	2	4.0	6	3.0
Education level										
Middle School	5	10.0	4	8.0	5	10.0	3	6.0	17	8.5
Highschool	19	38.0	23	46.0	10	20.0	15	30.0	67	33.5
Bachelor degree	15	30.0	17	34.0	18	36.0	21	42.0	71	35.5
Graduate degree	11	22.0	5	10.0	17	34.0	10	20.0	43	21.5
Prefer not to say	0	0.0	1	2.0	0	0.0	1	2.0	2	1.0
Employment										
Unemployed	1	2.0	2	4.0	2	4.0	1	2.0	6	3.0
Student	6	12.0	5	10.0	5	10.0	13	26.0	29	14.5
Employed	40	80.0	40	80.0	38	76.0	36	72.0	154	77.0
Retired	2	4.0	3	6.0	3	6.0	0	0.0	8	4.0
Other	1	2.0	0	0.0	2	4.0	0	0.0	3	1.5
Previous mHealth App Use ^a										
	28	56.0	25	50.0	34	68.0	24	48.0	111	55.5

Note. *N* = 200 (*n* = 50 for each condition).

^a Reflects the number and percentage of participants answering “yes” to this question.

Online Questionnaire developed on Qualtrics

First, respondents were forwarded through a randomizer to allocate them to one of the four experimental conditions.

CS_randomizer

Q1

Welcome to my research study!

I am interested in understanding peoples' judgements about mobile apps focusing on well-being and mental health. The study should take you around 7 minutes to complete and participation is completely anonymous and voluntary.

Please be assured that your responses will be kept completely confidential and no identifying information will be collected. [SEPISEPI]

If you consent, please click this link to start the survey. (Where you will be able to collect SurveyCircle or SurveySwap.io completion codes)

[Start the survey](#)

BlockRandomizer: 1 - Evenly Present Elements

Standard: Gamification_Social comparison (1 Question)

Standard: Gamification_Individual comparison (1 Question)

Standard: No-Gamification_Social comparison (1 Question)

Standard: No-Gamification_Individual comparison (1 Question)

EndSurvey:

Page Break

Start of Block: 1 - Introduction

Q1 Introduction In this survey, you will be asked to think about your recent stressful experiences.

You will be presented with screenshots of an app that is focused on relieving stress and taking a break. Afterwards, we will ask you some questions about the app. Let's begin.

End of Block: 1 – Introduction

Through the randomizer, the respondents were forwarded to one of the four experimental conditions.

1) Experimental Condition: Gamification_Individual Comparison

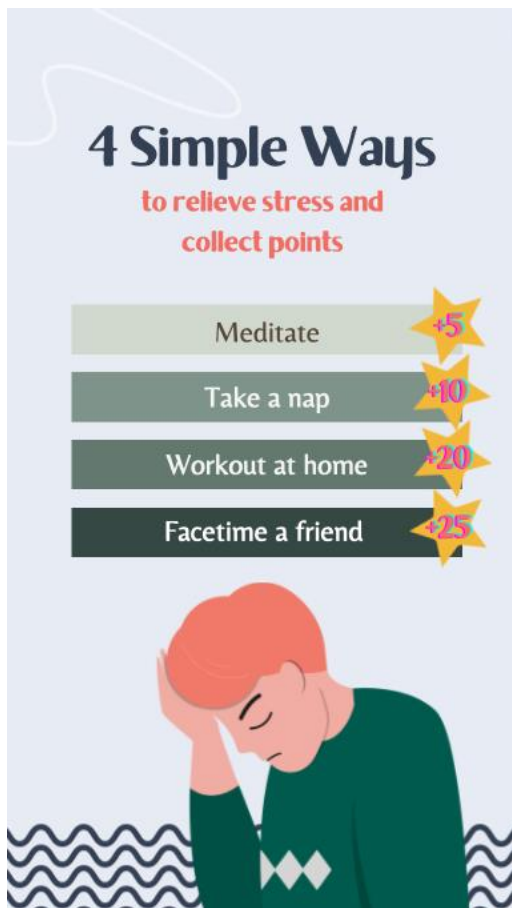
Start of Block: Gamification_Individual Comparison

Q2 Introduction 2 Now, please take a moment to think about your recent stressful experiences.

Think of how anxiety can sometimes be overwhelming and how you apply your own strategies to take breaks and feel better.

Page Break

Q3 Gamified Points Imagine you have downloaded the following app to relieve stress and collect reward points. You are able to choose and do any of the 4 suggestions.



Q26 Timer Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Q4 Individual Compar After using the app for a few weeks you receive the following notification. You have collected the most reward points this week compared to your previous efforts.



Q27 Timer 2 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

End of Block: Gamification_Individual comparison

2) Experimental Condition: Gamification_Social Comparison

Start of Block: Gamification_Social Comparison

Q2 Introduction 2 Now, please take a moment to think about your recent stressful experiences.

Think of how anxiety can sometimes be overwhelming and how you apply your own strategies to take breaks and feel better.

Page Break

Q3 Gamified Points Imagine you have downloaded the following app to relieve stress and collect reward points. You are able to choose and do any of the 4 suggestions.



Q26 Timer Timing

First Click (1)

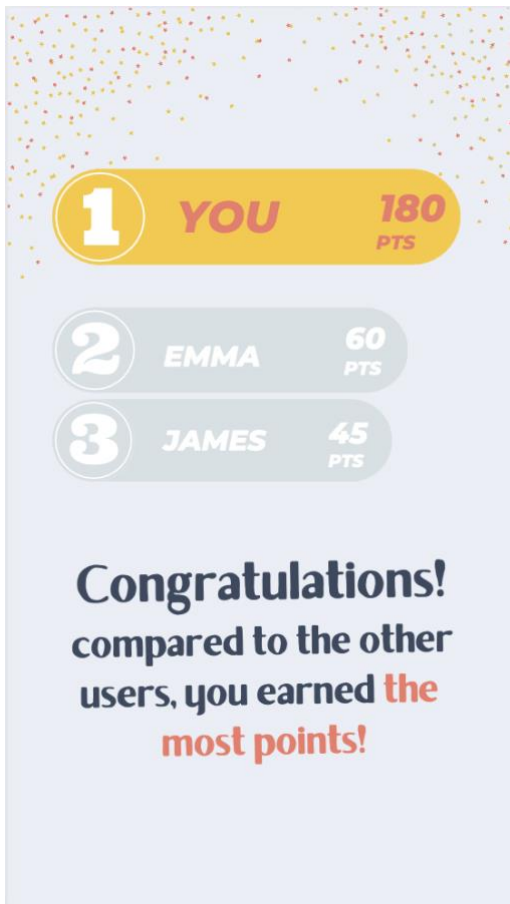
Last Click (2)

Page Submit (3)

Click Count (4)

Page Break

Q4 Social Comparison After using the app for a few weeks you receive the following notification. You have collected the most reward points compared to other anonymous app users.



Q27 Timer Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

End of Block: Gamification_Social Comparison

3) Experimental Condition: No Gamification_Individual Comparison

Start of Block: No Gamification_Individual Comparison

Q2 Introduction 2 Now, please take a moment to think about your recent stressful experiences.

Think of how anxiety was sometimes overwhelming and how in certain circumstances you feel the need for a break to feel better.

Page Break

Q3 No Gamification Imagine you have downloaded the following app to relieve stress and increase well-being. You are able to choose and do any of the 4 suggestions.



Q26 Timer Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Q4 Individual Compar After using the app for a few weeks you receive the following notification. You have increased your well-being the most this week compared to your previous efforts.



Q27 Timer 2 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

End of Block: No Gamification_Individual Comparison

4) Experimental Condition: No Gamification_Social Comparison

Start of Block: No Gamification_Social Comparison

Q2 Introduction 2 Now, please take a moment to think about your recent stressful experiences.

Think of how anxiety can sometimes be overwhelming and how you apply your own strategies to take breaks and feel better.

Page Break

Q3 No Gamification Imagine you have downloaded the following app to relieve stress and increase well-being. You are able to choose and do any of the 4 suggestions.



Q26 Timer Timing

First Click (1)

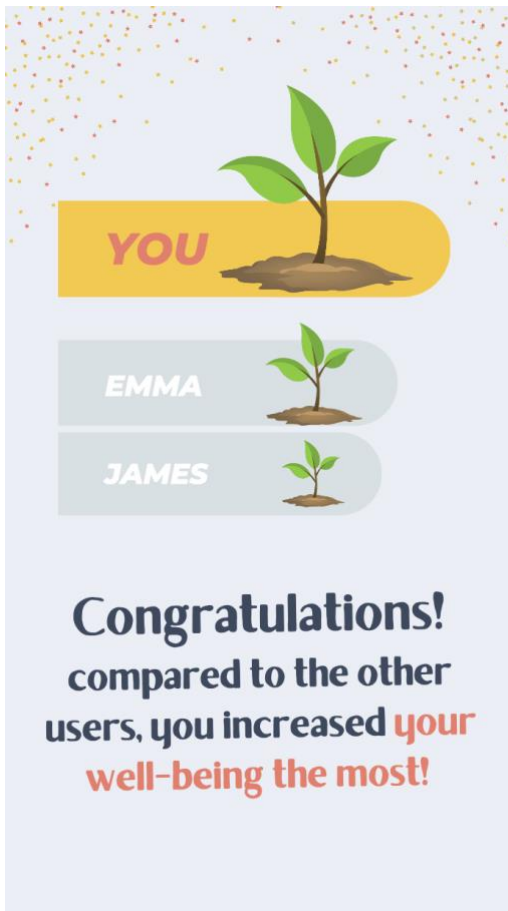
Last Click (2)

Page Submit (3)

Click Count (4)

Page Break

Q4 Social Comparison After using the app for a few weeks you receive the following notification. You have increased your well-being the most this week compared to the other anonymous app users.



Q27 Timer Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

End of Block: No Gamification_Social comparison

After being shown one of the four experimental conditions shown above, all respondents were then guided through the following rest of the questionnaire which is identical for all.

Start of Block: Dependent Variables



Q5 Intrinsic Motivat How do you feel about using this app for stress management?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
It will be interesting to use. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It will be fun to use. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It will be motivating. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It will be helpful. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q6 Self-Efficacy How capable do you feel managing stress by using this app?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
I can manage stress effectively. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compared to others, I manage stress well. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe that my anxiety will decrease in the future. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q7 Perceived Control To which extent do you believe that you can control your anxious feelings?

- No control at all 1 (1)
 - 2 (2)
 - 3 (3)
 - 4 (4)
 - 5 (5)
 - 6 (6)
 - Extreme control 7 (7)
-

Q8 Net Promoter On a scale from 0-10, how likely are you to recommend this app to a friend or colleague?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Page Break



Q9 Type Regulation For which reasons would you consider using this app?

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)
Other people want me to use it. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It could improve my life. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will feel bad about myself if I didn't try it. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It will look good to others if I use it. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Dependent Variables

Start of Block: Control Variables

Q10 Perceived Stress In the last month, how often did you feel stressed or had anxious thoughts?

- Not often at all 1 (1)
 - 2 (2)
 - 3 (3)
 - 4 (4)
 - 5 (5)
 - 6 (6)
 - Extremely often 7 (7)
-

Q11 Previous App Use Have you ever used an app for stress management?

- Yes (1)
 - No (3)
 - Prefer not to answer (2)
-

Page Break

Q12 Phone Usage How many hours a day do you use your smartphone?

- Less than 1 hour (1)
 - Between 1-3 hours (2)
 - More than 3 hours (3)
-

Q13 Alt Devices On which other devices would you appreciate an app for well-being and stress management? (You can select more than one)

- Smart Watch (1)
 - Smart TV (2)
 - Game console (3)
 - Desktop PC or Laptop (4)
 - Tablet (5)
 - None (6)
 - Other (7) _____
-

Page Break _____

Q14 Tech Aptitude How confident do you feel in your technology skills?

- Not confident at all 1 (1)
 - 2 (2)
 - 3 (3)
 - 4 (4)
 - 5 (5)
 - 6 (6)
 - Extremely confident 7 (7)
-

Q15 Privacy Concern How concerned are you about data privacy when using mobile apps?

- No concerned at all 1 (1)
 - 2 (2)
 - 3 (3)
 - 4 (4)
 - 5 (5)
 - 6 (6)
 - Extremely concerned 7 (7)
-

Page Break

Q16 Manipula Check 1 Just checking, do you remember the goal of the app earlier?

- Collecting points (1)
 - Improving your well-being (2)
 - Collecting money (4)
 - Not sure (3)
-

Q17 Manipula Check 2 The app included

- A comparison with others (1)
- A comparison with your past weeks (2)
- A set of fitness goals (3)
- Not sure (4)

End of Block: Control Variables

Start of Block: Demographics

Q18 Introduction 3 You are almost done. Now only a few questions about yourself.

Q19 Age How old are you?

- Under 18 (1)
 - 18-24 years old (2)
 - 25-34 years old (3)
 - 35-44 years old (4)
 - 45-54 years old (5)
 - 55-64 years old (6)
 - 65+ years old (7)
-

Q20 Gender How do you describe yourself?

- Male (1)
 - Female (2)
 - Non-binary / third gender (3)
 - Prefer to self-describe (4)
-
- Prefer not to say (5)
-

Page Break

Q21 Education What is the highest level of education you have completed?

- Some high school or less (1)
 - High school diploma or GED (2)
 - Some college, but no degree (3)
 - Associates or technical degree (4)
 - Bachelor's degree (5)
 - Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS etc.) (6)
 - Prefer not to say (7)
-

Q22 Employment What best describes your employment status over the last three months?

- Working full-time (1)
 - Working part-time (2)
 - Unemployed and looking for work (3)
 - A homemaker or stay-at-home parent (4)
 - Student (5)
 - Retired (6)
 - Other (7)
-

Page Break

Q23 Marital Status What is your marital status?

- Single, never married (1)
- Married or domestic partnership (2)
- Widowed (3)
- Separated or divorced (4)
- Prefer not to say (5)



Q24 Country In which country do you currently reside?

▼ Afghanistan (1) ... Zimbabwe (1357)

End of Block: Demographics

Start of Block: Thank you

Q25 Outro Thank you very much for participating in this survey. I really appreciate your time and effort. The surveyswap and surveycircle codes are available on the next page.

If you would like to leave any comments, further thoughts, or feedback, please do so below.

End of Block: Thank you

9. References

- Ahtinen, A., Mattila, E., Väلكkynen, P., Kaipainen, K., Vanhala, T., Ermes, M., Sairanen, E., Myllymäki, T., & Lappalainen, R. (2013). Mobile mental wellness training for stress management: feasibility and design implications based on a one-month field study. *JMIR MHealth and UHealth*, 1(2). <https://doi.org/10.2196/MHEALTH.2596>
- Aitken, M., & Lyle, J. (2015). *Patient Adoption of mHealth, Use, Evidence and Remaining Barriers to Mainstream Acceptance*. www.theimsinstitute.org
- Allam, A., Kostova, Z., Nakamoto, K., & Schulz, P. J. (2015). The effect of social support features and gamification on a Web-based intervention for rheumatoid arthritis patients: randomized controlled trial. *Journal of Medical Internet Research*, 17(1), e14. <https://doi.org/10.2196/JMIR.3510>
- Al-Rayes, S., al Yaqoub, F. A., Alfayez, A., Alsalman, D., Alanezi, F., Alyousef, S., AlNujaidi, H., Al-Saif, A. K., Attar, R., Aljabri, D., Al-Mubarak, S., Al-Juwair, M. M., Alrawiai, S., Saraireh, L., Saadah, A., Al-umran, A., & Alanzi, T. M. (2022). Gaming elements, applications, and challenges of gamification in healthcare. *Informatics in Medicine Unlocked*, 3(1), 100974. <https://doi.org/10.1016/J.IMU.2022.100974>
- Aparicio, A. F., Vela, F. L. G., Sánchez, J. L. G., & Montes, J. L. I. (2012). Analysis and application of gamification. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/2379636.2379653>
- Arigo, D., Brown, M. M., Pasko, K., & Suls, J. (2020). Social Comparison Features in Physical Activity Promotion Apps: Scoping Meta-Review. *J Med Internet Res*, 22(3), e15642. <https://doi.org/10.2196/15642>
- Arigo, D., & Suls, J. M. (2018). Smartphone apps providing social comparison for health behavior change: a need for better tailoring to person and context. *MHealth*, 4, 46–46. <https://doi.org/10.21037/mhealth.2018.09.10>
- Attef, M., & Harris, E. (2020). Using Gamified Solutions in Pediatric Diabetes Self-management: A Literature Review. *Advances in Intelligent Systems and Computing*, 968, 96–102. https://doi.org/10.1007/978-3-030-20470-9_12
- Baehre, S., O'Dwyer, M., O'Malley, L., & Lee, N. (2022). The use of Net Promoter Score (NPS) to predict sales growth: insights from an empirical investigation. *Journal of the Academy of Marketing Science*, 50(1), 67–84. <https://doi.org/10.1007/s11747-021-00790-2>
- Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037//0033-295X.84.2.191>

- Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behaviour Research and Therapy*, 1(4), 139–161. [https://doi.org/10.1016/0146-6402\(78\)90002-4](https://doi.org/10.1016/0146-6402(78)90002-4)
- Baranowski, T., Baranowski, J., Chen, T.-A., Buday, R., Beltran, A., Dadabhoy, H., Ryan, C., & Lu, A. S. (2019). Videogames That Encourage Healthy Behavior Did Not Alter Fasting Insulin or Other Diabetes Risks in Children: Randomized Clinical Trial. *Games for Health Journal*, 8(4), 257–264. <https://doi.org/10.1089/g4h.2018.0097>
- Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2017). Studying student differentiation in gamified education: A long-term study. *Computers in Human Behavior*, 71, 550–585. <https://doi.org/10.1016/J.CHB.2016.08.049>
- Baumel, A., Muench, F., Edan, S., & Kane, J. M. (2019). Objective User Engagement With Mental Health Apps: Systematic Search and Panel-Based Usage Analysis. *Journal of Medical Internet Research*, 21(9). <https://doi.org/10.2196/14567>
- Benjumea, J., Roperio, J., Rivera-Romero, O., Dorrnoro-Zubiete, E., & Carrasco, A. (2020). Privacy Assessment in Mobile Health Apps: Scoping Review. *JMIR Mhealth Uhealth* 2020;8(7):E18868 <https://Mhealth.Jmir.Org/2020/7/E18868>, 8(7), e18868. <https://doi.org/10.2196/18868>
- Bhavnani, S. P., Narula, J., & Sengupta, P. P. (2016). Mobile technology and the digitization of healthcare. *European Heart Journal*, 37(18), 1428–1438. <https://doi.org/10.1093/EURHEARTJ/EHV770>
- Bitrián, P., Buil, I., & Catalán, S. (2021). Enhancing user engagement: The role of gamification in mobile apps. *Journal of Business Research*, 132, 170–185. <https://doi.org/10.1016/j.jbusres.2021.04.028>
- Bormann, D., & Greitemeyer, T. (2015). Immersed in Virtual Worlds and Minds. [Http://Dx.Doi.Org/10.1177/1948550615578177](http://Dx.Doi.Org/10.1177/1948550615578177), 6(6), 646–652. <https://doi.org/10.1177/1948550615578177>
- Buunk, A. P., Groothof, H. A. K., & Siero, F. W. (2016). Social comparison and satisfaction with one's social life. [Http://Dx.Doi.Org/10.1177/0265407507075410](http://Dx.Doi.Org/10.1177/0265407507075410), 24(2), 197–205. <https://doi.org/10.1177/0265407507075410>
- Chen, Y., & Pu, P. (2014). HealthyTogether: exploring social incentives for mobile fitness applications. *ACM International Conference Proceeding Series*, 25–34. <https://doi.org/10.1145/2592235.2592240>
- Cheng, V. W. S., Davenport, T., Johnson, D., Vella, K., & Hickie, I. B. (2019). Gamification in Apps and Technologies for Improving Mental Health and Well-Being: Systematic Review.

- JMIR Ment Health* 2019;6(6):E13717 <https://Mental.Jmir.Org/2019/6/E13717>, 6(6), e13717.
<https://doi.org/10.2196/13717>
- Cho, I., Kaplanidou, K., & Sato, S. (2021). Gamified Wearable Fitness Tracker for Physical Activity: A Comprehensive Literature Review. *Sustainability* 2021, Vol. 13, Page 7017, 13(13), 7017. <https://doi.org/10.3390/SU13137017>
- Chow, C. Y., Riantiningtyas, R. R., Kanstrup, M. B., Papavasileiou, M., Liem, G. D., & Olsen, A. (2020). Can games change children's eating behaviour? A review of gamification and serious games. *Food Quality and Preference*, 80.
<https://doi.org/10.1016/J.FOODQUAL.2019.103823>
- Clark, O., Grogan, S., Cole, J. M., & Ray, N. (2019). A Systematic Review on the influence of avatar appearance on health-related outcomes. *The Persuasive Power of Video Game Avatars in Health Behaviour Change*.
https://www.researchgate.net/publication/333487237_A_Systematic_Review_on_the_influence_of_avatar_appearance_on_health-related_outcomes
- Cotton, V., & Patel, M. S. (2019). Gamification Use and Design in Popular Health and Fitness Mobile Applications. *American Journal of Health Promotion*, 33(3), 448–451.
<https://doi.org/10.1177/0890117118790394>
- de Croon, R., Wildemeersch, D., Wille, J., Verbert, K., & vanden Abeele, V. (2018). Gamification and serious games in a healthcare informatics context. *Proceedings - 2018 IEEE International Conference on Healthcare Informatics, ICHI 2018*, 53–63.
<https://doi.org/10.1109/ICHI.2018.00014>
- de Souza Gaspar, J., Lage, E. M., da Silva, F. J., Mineiro, É., Ramos De Oliveira, I. J., Oliveira, I., de Souza, R. G., Oliveira Gusmão, J. R., de Souza, C. F. D., & Nogueira Reis, Z. S. (2020). A Mobile Serious Game About the Pandemic (COVID-19 - Did You Know?): Design and Evaluation Study. *JMIR Serious Games* 2020;8(4):E25226
<https://Games.Jmir.Org/2020/4/E25226>, 8(4), e25226. <https://doi.org/10.2196/25226>
- Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating Internalization: The Self-Determination Theory Perspective. *Journal of Personality*, 62(1), 119–142.
<https://doi.org/10.1111/J.1467-6494.1994.TB00797.X>
- Deci, E. L., & Vansteenkiste, M. (2004). Self-determination theory and basic need satisfaction: Understanding human development in positive psychology. *Ricerche Di Psicologia*, 27(1), 23–40. <https://psycnet.apa.org/record/2004-19493-002>
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining “gamification.” *Proceedings of the 15th International Academic*

- MindTrek Conference: Envisioning Future Media Environments, MindTrek 2011*, 9–15.
<https://doi.org/10.1145/2181037.2181040>
- Ehrenhard, M., Wijnhoven, F., van den Broek, T., & Zinck Stagno, M. (2017). Unlocking how start-ups create business value with mobile applications: Development of an App-enabled Business Innovation Cycle. *Technological Forecasting and Social Change*, 115, 26–36.
<https://doi.org/10.1016/J.TECHFORE.2016.09.011>
- Festinger, L. (1954). A Theory of Social Comparison Processes. *Human Relations*, 7(2), 117–140.
<https://doi.org/10.1177/001872675400700202>
- Galetsis, P., Katsaliaki, K., & Kumar, S. (2022). Exploring benefits and ethical challenges in the rise of mHealth (mobile healthcare) technology for the common good: An analysis of mobile applications for health specialists. *Technovation*, 102598.
<https://doi.org/10.1016/J.TECHNOVATION.2022.102598>
- Gentry, S. V., Gauthier, A., L'Estrade Ehrstrom, B., Wortley, D., Lilienthal, A., Tudor Car, L., Dauwels-Okutsu, S., Nikolaou, C. K., Zary, N., Campbell, J., & Car, J. (2019). Serious Gaming and Gamification Education in Health Professions: Systematic Review. *Journal of Medical Internet Research*, 21(3), e12994. <https://doi.org/10.2196/12994>
- Gilbert, P., Price, J., & Allan, S. (1995). Social comparison, social attractiveness and evolution: How might they be related? *New Ideas in Psychology*, 13(2), 149–165.
[https://doi.org/https://doi.org/10.1016/0732-118X\(95\)00002-X](https://doi.org/https://doi.org/10.1016/0732-118X(95)00002-X)
- Hamari, J., & Koivisto, J. (2013). *Social Motivations To Use Gamification: An Empirical Study Of Gamifying Exercise*.
- Hamari, J., & Koivisto, J. (2015). “Working out for likes”: An empirical study on social influence in exercise gamification. *Computers in Human Behavior*, 50, 333–347.
<https://doi.org/10.1016/J.CHB.2015.04.018>
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does Gamification Work?-A Literature Review of Empirical Studies on Gamification*.
- Hammedi, W., Leclercq, T., & van Riel, A. C. R. (2017). The use of gamification mechanics to increase employee and user engagement in participative healthcare services: A study of two cases. *Journal of Service Management*, 28(4), 640–661. <https://doi.org/10.1108/JOSM-04-2016-0116/FULL/XML>
- Hassan, L., Dias, A., & Hamari, J. (2019). How motivational feedback increases user’s benefits and continued use: A study on gamification, quantified-self and social networking. *International Journal of Information Management*, 46, 151–162.
<https://doi.org/10.1016/j.ijinfomgt.2018.12.004>

- Ioannou, A. (2019). A model of gameful design for learning using interactive tabletops: enactment and evaluation in the socio-emotional education classroom. *Educational Technology Research and Development*, 67(2), 277–302. <https://doi.org/10.1007/S11423-018-9610-1/FIGURES/9>
- Jamshidifarsani, H., Tamayo-Serrano, P., Garbaya, S., Lim, T., & Blazevic, P. (2019). Integrating self-determination and self-efficacy in game design. *Games and Learning Alliance*, 11385 LNCS, 178–190. https://doi.org/10.1007/978-3-030-11548-7_17/FIGURES/2
- Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. *Internet Interventions*, 6, 89–106. <https://doi.org/10.1016/J.INVENT.2016.10.002>
- Kang, H., & Kim, H. K. (2020). My avatar and the affirmed self: Psychological and persuasive implications of avatar customization. *Computers in Human Behavior*, 112. <https://doi.org/10.1016/J.CHB.2020.106446>
- Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-based Methods and Strategies*. John Wiley & Sons, Inc. <https://books.google.de/books?hl=en&lr=&id=M2Rb9ZtFxccC&oi=fnd&pg=PR12&dq=Kapp+2012&ots=JyOh027F3K&sig=RJ0kbZM-ZNsgikJP6Xqm7qmDKMc#v=onepage&q=Kapp%202012&f=false>
- Kim, K., Schmierbach, M. G., Bellur, S., Chung, M. Y., Fraustino, J. D., Dardis, F., & Ahern, L. (2015). Is it a sense of autonomy, control, or attachment? Exploring the effects of in-game customization on game enjoyment. *Computers in Human Behavior*, 48, 695–705. <https://doi.org/10.1016/J.CHB.2015.02.011>
- Klock, A. C. T., Gasparini, I., Pimenta, M. S., & Hamari, J. (2020). Tailored gamification: A review of literature. *International Journal of Human-Computer Studies*, 144, 102495. <https://doi.org/10.1016/J.IJHCS.2020.102495>
- Koivisto, J., & Hamari, J. (2019a). Gamification of physical activity: A systematic literature review of comparison studies. *GamiFIN Conference*. https://www.researchgate.net/publication/332371183_Gamification_of_physical_activity_A_systematic_literature_review_of_comparison_studies
- Koivisto, J., & Hamari, J. (2019b). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, 45, 191–210. <https://doi.org/10.1016/J.IJINFOMGT.2018.10.013>
- Krath, J., Schürmann, L., & von Korfflesch, H. F. O. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious

- games and game-based learning. *Computers in Human Behavior*, 125, 106963.
<https://doi.org/10.1016/J.CHB.2021.106963>
- Kuppens, P., Realo, A., & Diener, E. (2008). The role of positive and negative emotions in life satisfaction judgment across nations. *Journal of Personality and Social Psychology*, 95(1), 66–75. <https://doi.org/10.1037/0022-3514.95.1.66>
- Lampropoulos, G., Keramopoulos, E., Diamantaras, K., & Evangelidis, G. (2022). Augmented Reality and Gamification in Education: A Systematic Literature Review of Research, Applications, and Empirical Studies. *Applied Sciences* 2022, 12(13).
<https://doi.org/10.3390/APP12136809>
- Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014). Just a Fad? Gamification in Health and Fitness Apps. *JMIR Serious Games*, 2(2), e9. <https://doi.org/10.2196/games.3413>
- Liu, Y. D., Trestini, M., & Schmoll, L. (2020). A preliminary study of correlations explaining student interest in digital games-based learning. *Proceedings of the 14th International Conference on Game Based Learning, ECGBL 2020*, 354–363.
<https://doi.org/10.34190/GBL.20.060>
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, 57(9), 705–717.
<https://doi.org/10.1037/0003-066X.57.9.705>
- Marathe, S., & Sundar, S. S. (2011). What drives customization? Control or identity? *Conference on Human Factors in Computing Systems - Proceedings*, 781–790.
<https://doi.org/10.1145/1978942.1979056>
- Mazeas, A., Duclos, M., Pereira, B., & Chalabaev, A. (2022a). Evaluating the Effectiveness of Gamification on Physical Activity: Systematic Review and Meta-analysis of Randomized Controlled Trials. *J Med Internet Res* 2022;24(1):E26779
<https://www.jmir.org/2022/1/E26779>, 24(1), e26779. <https://doi.org/10.2196/26779>
- Mazeas, A., Duclos, M., Pereira, B., & Chalabaev, A. (2022b). Evaluating the Effectiveness of Gamification on Physical Activity: Systematic Review and Meta-analysis of Randomized Controlled Trials. *J Med Internet Res* 2022;24(1):E26779
<https://www.jmir.org/2022/1/E26779>, 24(1), e26779. <https://doi.org/10.2196/26779>
- Miller, A. S., Cafazzo, J. A., Seto, E., & Elliott, R. F. (2016). A game plan: Gamification design principles in mHealth applications for chronic disease management Background and significance. *Health Informatics Journal*, 22(2), 184–193.
<https://doi.org/10.1177/1460458214537511>

- Morschheuser, B., & Hamari, J. (2018). The Gamification of Work: Lessons From Crowdsourcing. *Https://Doi.Org/10.1177/1056492618790921*, 28(2), 145–148.
<https://doi.org/10.1177/1056492618790921>
- Morschheuser, B., Hamari, J., Koivisto, J., & Maedche, A. (2017). Gamified crowdsourcing: Conceptualization, literature review, and future agenda. *International Journal of Human-Computer Studies*, 106, 26–43. <https://doi.org/10.1016/J.IJHCS.2017.04.005>
- Morschheuser, B., Maedche, A., & Walter, D. (2017). Designing cooperative gamification: Conceptualization and prototypical implementation. *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW*, 2410–2421.
<https://doi.org/10.1145/2998181.2998272>
- Morschheuser, B., Riar, M., Hamari, J., & Maedche, A. (2017). How games induce cooperation? A study on the relationship between game features and we-intentions in an augmented reality game. *Computers in Human Behavior*, 77, 169–183.
<https://doi.org/10.1016/J.CHB.2017.08.026>
- Nicholson, S. (2012, June). A User-Centered Theoretical Framework for Meaningful Gamification. *Games+ Learning+ Society*. <http://becauseplaymatters.com>
- Nishihara, T., Parwak, Y., Edogun, E., Park, G., & Lee, S. (2020). The Promise of Gamification in Addressing Health Challenges of the Modern World. In *Impacts of Information Technology on Patient Care and Empowerment* (pp. 100–108). IGI Global. <https://doi.org/10.4018/978-1-7998-0047-7.CH006>
- Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive systems design: Key issues, process model, and system features. *Communications of the Association for Information Systems*, 24(1), 485–500. <https://doi.org/10.17705/1CAIS.02428>
- Passalacqua, M., Léger, P. M., Nacke, L. E., Fredette, M., Labonté-Lemoyne, É., Lin, X., Caprioli, T., & Sénécal, S. (2020). Playing in the backstore: interface gamification increases warehousing workforce engagement. *Industrial Management and Data Systems*, 120(7), 1309–1330. <https://doi.org/10.1108/IMDS-08-2019-0458/FULL/XML>
- Peng, W., Lin, J. H., Pfeiffer, K. A., & Winn, B. (2012). Need Satisfaction Supportive Game Features as Motivational Determinants: An Experimental Study of a Self-Determination Theory Guided Exergame. *Http://Dx.Doi.Org/10.1080/15213269.2012.673850*, 15(2), 175–196. <https://doi.org/10.1080/15213269.2012.673850>
- Perryer, C., Celestine, N. A., Scott-Ladd, B., & Leighton, C. (2016). Enhancing workplace motivation through gamification: Transferrable lessons from pedagogy. *The International*

Journal of Management Education, 14(3), 327–335.

<https://doi.org/10.1016/J.IJME.2016.07.001>

Phillips, E. G., Nabhan, C., & Feinberg, B. A. (2019). The gamification of healthcare: emergence of the digital practitioner? | Request PDF. *The American Journal of Managed Care*, 25(1), 13–15.

https://www.researchgate.net/publication/330686760_The_gamification_of_healthcare_emergence_of_the_digital_practitioner

Plant, R. W., & Ryan, R. M. (1985). Intrinsic motivation and the effects of self-consciousness, self-awareness, and ego-involvement: An investigation of internally controlling styles.

Journal of Personality, 53(3), 435–449. <https://doi.org/10.1111/J.1467-6494.1985.TB00375.X>

Possler, D., Carnol, N. N., Klimmt, C., Weber-Hoffmann, I., & Raney, A. A. (2022). A Matter of Closeness: Player-Avatar Relationships as Degree of Including Avatars in the Self. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 13477 LNCS, 171–182. https://doi.org/10.1007/978-3-031-20212-4_14

Putz, L. M., Hofbauer, F., & Treiblmaier, H. (2020). Can gamification help to improve education? Findings from a longitudinal study. *Computers in Human Behavior*, 110.

<https://doi.org/10.1016/J.CHB.2020.106392>

Reichheld, F. F. (2003). *The One Number You Need to Grow*. www.hbr.org

Rheu, M., Jang, Y., & Peng, W. (2020). Enhancing Healthy Behaviors Through Virtual Self: A Systematic Review of Health Interventions Using Avatars. *Games for Health Journal: Research, Development, and Clinical Applications*, 9(2).

<https://doi.org/10.1089/g4h.2018.0134>

Riar, M. (2020). Using Gamification to Motivate Cooperation: A Review. *ICIS 2020 Proceedings*.

https://aisel.aisnet.org/icis2020/user_behaviors/user_behaviors/12

Riar, M., Morschheuser, B., Zarnekow, R., & Hamari, J. (2022a). Gamification of cooperation: A framework, literature review and future research agenda. In *International Journal of Information Management* (Vol. 67). Elsevier Ltd.

<https://doi.org/10.1016/j.ijinfomgt.2022.102549>

Riar, M., Morschheuser, B., Zarnekow, R., & Hamari, J. (2022b). Gamification of cooperation: A framework, literature review and future research agenda. In *International Journal of Information Management* (Vol. 67). Elsevier Ltd.

<https://doi.org/10.1016/j.ijinfomgt.2022.102549>

- Richter, G., Raban, D. R., & Rafaeli, S. (2015). Studying gamification: The effect of rewards and incentives on motivation. In *Gamification in Education and Business* (pp. 21–46). Springer International Publishing. https://doi.org/10.1007/978-3-319-10208-5_2/TABLES/2
- Rigby, Scott., & Ryan, R. M. (2011). *Glued to games : how video games draw us in and hold us spellbound*. Praeger.
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, *43*(3), 450–461. <https://doi.org/10.1037/0022-3514.43.3.450>
- Ryan, R. M., & Deci, E. L. (2000a). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. <https://doi.org/10.1037/0003-066X.55.1.68>
- Ryan, R. M., & Deci, E. L. (2000b). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, *25*(1), 54–67. <https://doi.org/10.1006/CEPS.1999.1020>
- Ryan, R. M., Huta, V., & Deci, E. L. (2008). Living well: A self-determination theory perspective on eudaimonia. *Journal of Happiness Studies*, *9*(1), 139–170. <https://doi.org/10.1007/S10902-006-9023-4>
- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. <https://doi.org/10.1016/J.CHB.2016.12.033>
- Sardi, L., Idri, A., & Fernández-Alemán, J. L. (2017). A systematic review of gamification in e-Health. *Journal of Biomedical Informatics*, *71*, 31–48. <https://doi.org/10.1016/J.JBI.2017.05.011>
- Schmidt-Kraepelin, M., Warsinsky, S., Thiebes, S., & Sunyaev, A. (2020). *The Role of Gamification in Health Behavior Change: A Review of Theory-driven Studies*.
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*. <https://doi.org/10.1016/J.CEDPSYCH.2019.101832>
- Schunk, D. H., & DiBenedetto, M. K. (2021). Self-efficacy and human motivation. *Advances in Motivation Science*, *8*, 153–179. <https://doi.org/10.1016/BS.ADMS.2020.10.001>
- Schwarzer, R. (1992). Self-efficacy in the adoption and maintenance of health behaviors: Theoretical approaches and a new model. In *Self-efficacy: Thought control of action* (pp. 217–243). Hemisphere Publishing Corp. <https://psycnet.apa.org/record/1992-97719-010>

- Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*, 74, 14–31.
<https://doi.org/10.1016/J.IJHCS.2014.09.006>
- Shameli, A., Althoff, T., Saberi, A., & Leskovec, J. (2017). How Gamification Affects Physical Activity: Large-scale Analysis of Walking Challenges in a Mobile Application. *Proceedings of the ... International World-Wide Web Conference. International WWW Conference, 2017*, 455–463. <https://doi.org/10.1145/3041021.3054172>
- Statista. (2023). *Projected size of the global mHealth market from 2017 to 2025 (in billion U.S. dollars)*. <https://www-statista-com.eu1.proxy.openathens.net/statistics/1014589/worldwide-mhealth-market-size/>
- Sundar, S. S. (2008). *The MAIN Model: A Heuristic Approach to Understanding Technology Effects on Credibility*. 73–100. <https://doi.org/10.1162/dmal.9780262562324.073>
- Suppan, M., Abbas, M., Catho, G., Stuby, L., Regard, S., Achab, S., Harbarth, S., & Suppan, L. (2021). Impact of a Serious Game (Escape COVID-19) on the Intention to Change COVID-19 Control Practices Among Employees of Long-term Care Facilities: Web-Based Randomized Controlled Trial. *J Med Internet Res* 2021;23(3):E27443
<https://www.jmir.org/2021/3/E27443>, 23(3), e27443. <https://doi.org/10.2196/27443>
- Teixeira, P. J., Carraça, E. v., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 9(1), 1–30. <https://doi.org/10.1186/1479-5868-9-78/FIGURES/2>
- Vaduganathan, M., Mensah, G. A., Turco, J. V., Fuster, V., & Roth, G. A. (2022). The Global Burden of Cardiovascular Diseases and Risk: A Compass for Future Health. *Journal of the American College of Cardiology*, 80(25), 2361–2371.
<https://doi.org/10.1016/J.JACC.2022.11.005>
- Vaghefi, I., & Tulu, B. (2019). The Continued Use of Mobile Health Apps: Insights From a Longitudinal Study. *JMIR MHealth and UHealth*, 7(8). <https://doi.org/10.2196/12983>
- van Gaalen, A. E. J., Brouwer, J., Schönrock-Adema, J., Bouwkamp-Timmer, T., Jaarsma, A. D. C., & Georgiadis, J. R. (2021). Gamification of health professions education: a systematic review. *Advances in Health Sciences Education*, 26(2), 683–711.
<https://doi.org/10.1007/S10459-020-10000-3/TABLES/2>
- van Roy, R., & Zaman, B. (2019). Unravelling the ambivalent motivational power of gamification: A basic psychological needs perspective. *International Journal of Human-Computer Studies*, 127, 38–50. <https://doi.org/10.1016/J.IJHCS.2018.04.009>

- Wallenburg, I., & Bal, R. (2019a). The gaming healthcare practitioner: How practices of datafication and gamification reconfigure care. *Health Informatics Journal*, 25(3), 549–557. <https://doi.org/10.1177/1460458218796608>
- Wallenburg, I., & Bal, R. (2019b). The gaming healthcare practitioner: How practices of datafication and gamification reconfigure care. *Health Informatics Journal*, 25(3), 549–557. <https://doi.org/10.1177/1460458218796608>
- Wemyss, D., Castri, R., Cellina, F., de Luca, V., Lobsiger-Kägi, E., & Carabias, V. (2018). Examining community-level collaborative vs. competitive approaches to enhance household electricity-saving behavior. *Energy Efficiency*, 11(8), 2057–2075. <https://doi.org/10.1007/S12053-018-9691-Z/TABLES/5>
- Werbach, K., & Hunter, D. (2015). *The Gamification Toolkit: Dynamics, Mechanics, and Components for the Win (English Edition) eBook* : Werbach, Kevin, Hunter, Dan: Amazon.de: Kindle Store. Wharton School Press. <https://www.amazon.de/-/en/Kevin-Werbach-ebook/dp/B079C6YJKV>
- Werbach, Kevin., & Hunter, D. (2012). *For the win : how game thinking can revolutionize your business*. Wharton Digital Press.
- World Health Organization. (2011). mHealth: new horizons for health through mobile technologies. In *mHealth: new horizons for health through mobile technologies*. World Health Organization.
- World Health Organization. (2021, June). *Cardiovascular diseases (CVDs)*. World Health Organization. [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
- World Health Organization. (2022). *Regional digital health action plan for the WHO European Region 2023–2030*. <https://apps.who.int/iris/handle/10665/343164>.
- Xi, N., & Hamari, J. (2019). Does gamification satisfy needs? A study on the relationship between gamification features and intrinsic need satisfaction. *International Journal of Information Management*, 46, 210–221. <https://doi.org/10.1016/J.IJINFOMGT.2018.12.002>
- Xu, L., Shi, H., Shen, M., Ni, Y., Zhang, X., Pang, Y., Yu, T., Lian, X., Yu, T., Yang, X., & Li, F. (2022). The Effects of mHealth-Based Gamification Interventions on Participation in Physical Activity: Systematic Review. In *JMIR mHealth and uHealth* (Vol. 10, Issue 2). JMIR Publications Inc. <https://doi.org/10.2196/27794>
- Yang, H., Du, H. S., Wang, L., & Deng, A. (2019). Engaging in Weight Loss Tasks of Mobile Health Applications: The Dual Influence of Social Support and Body Condition. *Https://Home.Liebertpub.Com/Tmj*, 25(7), 591–598. <https://doi.org/10.1089/TMJ.2018.0119>

- Yang, H., & Li, D. (2021). Health management gamification: Understanding the effects of goal difficulty, achievement incentives, and social networks on performance. *Technological Forecasting and Social Change*, 169. <https://doi.org/10.1016/j.techfore.2021.120839>
- Yee, N. (2006). Motivations for play in online games. *Cyberpsychology & Behavior : The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society*, 9(6), 772–775. <https://doi.org/10.1089/CPB.2006.9.772>
- Zainuddin, Z. (2018). Students' learning performance and perceived motivation in gamified flipped-class instruction. *Computers & Education*, 126, 75–88. <https://doi.org/10.1016/J.COMPEDU.2018.07.003>
- Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30, 100326. <https://doi.org/10.1016/J.EDUREV.2020.100326>
- Zhao, Z., Etemad, ali S., & Ali, A. (2015). Gamification of exercise and fitness using wearable activity trackers. *Proceedings of the 10th International Symposium on Computer Science in Sports (ISCSS)*, 392, 233–240. https://doi.org/10.1007/978-3-319-24560-7_30/COVER
- Zichermann, G., & Cunningham, C. (2011). *Gamification by Design : Implementing Game Mechanics in Web and Mobile Apps* (1st ed.). O'Reilly Media Inc.