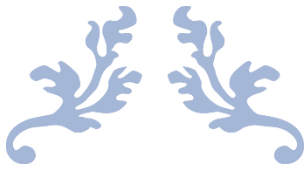

Investigating the effect of gamification on the adoption of fitness apps on mobile devices in South Africa

DECEMBER 1, 2018

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Abstract

Despite the large number of downloads of mobile apps and the growth of the fitness mobile app industry, research shows that fitness mobile apps are faced with the issue of having a low adoption rate. This thesis focusses on fitness mobile apps and attempts to understand this issue of adoption or continuous fitness mobile app usage in a South African context and specifically looks at the role of gamification in fitness mobile app adoption. The research is conducted to better understand how gamification affects and can improve fitness mobile app adoption. Gamification can be defined as the addition of points, badges, leaderboards and other elements found in games to other non-game related areas such as fitness apps.

A survey was administered to three cohorts of students at the University of Cape Town in South Africa to assess this. The cohorts focused on MyFitnessPal, Nike+ or Strava gamified fitness mobile apps, respectively, in order to allow for comparisons of survey responses across the three fitness mobile apps. The survey design used an extension of the Technology Acceptance Model (TAM) to quantitatively measure the relationship between gamification in fitness mobile apps and the behavioural intention to adopt the fitness mobile app. User perspectives on how gamification affects adoption of fitness mobile apps was also gathered in the survey.

Perceived usefulness (PU), perceived ease of use (PEU) and perceived enjoyment (PE) were found to have a positive relationship to the behavioural intention (BI) to adopt a fitness mobile app in the sample. Across the cohort's subjective norm didn't significantly contribute to the BI to adopt a fitness mobile app. Interestingly it was found to correlate negatively with the variable BI when analyzing the responses from the Nike+ cohort. In the cohorts for MyFitnessPal and Strava this was not the case as these two variables were found to be positively correlated.

The progress bar was perceived to be the most useful gamification element in a fitness mobile app in all three cohorts when compared with leaderboards, badges, levels and points. When looking at how gamification improves adoption motivations the following popular reasons were provided by participants: progress tracking and achievement (encourage improvement). This was followed by the common themes PEU, PE, award/incentive, competitive aspect and goal setting assistance. The

findings from this study contribute to better understanding how gamification improves fitness app adoption in a South African context.

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1. Introduction

1.1. Background and problem statement

Annual downloads of mobile apps worldwide were reported to reach 268.69 billion in 2018, illustrating the relevance of studying the field of mobile applications (apps) (Byun, Chiu, & Bae, 2018). However, according to Wolf, Weiger and Hammerschmidt (2018), 63% of mobile app users have been shown to use a newly installed app no more than ten times, illustrating the need to understand factors affecting mobile app adoption.

Fitness mobile apps are listed as one of the fastest growing industries (Byun, Chiu, & Bae, 2018; Yuan et al., 2015). According to Hermann and Kim (2017), thousands of free and paid smartphone apps exist, which are related to fitness. 58% of users of smartphones have been reported to have downloaded a minimum of one fitness related mobile app (Byun, Chiu, & Bae, 2018). In a bid to retain dominance in the market, sports related brands have taken advantage of this demand for fitness mobile apps by buying out popular fitness app companies as well as developing their own (Byun, Chiu, & Bae, 2018). For example, the fitness app MyFitnessPal was bought out by the sportswear company Under Armour (Byun, Chiu, & Bae, 2018). Moreover, Nike launched their own sports fitness app Nike+ (Nike News, 2016).

Thomson, Nash, and Maeder (2016) mention self-monitoring features are characteristic of physical activity (fitness) type apps and include tracking physical activity progress, performance and goal setting and achievement. They argue that enhanced adoptive patterns and usage are associated with such features. A fitness app recording the number of steps a person walks in a day is an example of tracking physical activity progress and performance. A fitness app could also, for example, award a badge to a person for reaching a goal of cycling 21km. This illustrates the mentioned goal setting and achievement a fitness app could incorporate. Hermann and Kim (2017) further stated that automatic tracking of progress and a user-friendly interface are desirable attributes of fitness apps.

Unpredictable technology usage and whether fitness related apps assist with maintaining personal fitness are concerns mentioned by Hermann and Kim (2017). According to Thomson, Nash and Maeder (2016), the ability to sustain user motivation and engagement over time is an issue for most smartphone fitness health type apps.

Fitness apps have a relatively low adoption rate of 19% according to Yuan et al. (2015), in comparison to social networking or gaming category apps, which have adoption rates of 47% and 60%, respectively. Furthermore, according to Byun, Chiu and Bae (2018), there is a lack of studies on sport brand app adoption and consumer perception.

In such a competitive climate where adoption rates are concerning, gamification may be the solution to increasing the adoption rate for a particular fitness mobile app (Thomson, Nash, & Maeder, 2016; Wolf, Weiger, & Hammerschmidt, 2018). According to Thomson, Nash and Maeder (2016) the increased popularity of utilising gamification in designing persuasive physical activity (fitness) apps is an attempt to resolve the low adoption and engagement of the fitness apps, among other issues. Furthermore, gamification is one of the principles mentioned in literature to positively influence user attitudes or behaviours related to adoption of physical activity (fitness) apps (Thomson, Nash, & Maeder, 2016).

Games create immersive, interactive and engaging environments when implemented in physical activity apps (Thomson, Nash, & Maeder, 2016). According to Garett and Young (2018), games can also offer the benefit of ongoing feedback and progress tracking against benchmarks. Gamification entails applying elements in games like points, badges, performance feedback and leaderboards to other areas such as fitness apps and other non-game contexts (Feyisetan et al., 2015).

Gamification acts to motivate continuous mobile app use and certain desirable behaviours such as increasing speed and distance of running through the use of the app (Wolf, Weiger, & Hammerschmidt, 2018). To illustrate with a hypothetical example, a boy named Rob may feel more motivated to run an extra 5km to earn 500 points in his fitness app on his cellphone. The points that are awarded characterise the gamification built into the fitness app. According to Tinati et al. (2016), the mechanisms underlying this motivation could be intrinsic, whereby one does a task because it is pleasurable or fun. The authors also argue that the mechanism could also be extrinsic motivation, whereby one is motivated by external incentives or achievements, for example, money (Tinati et al., 2016). According to Bowser et al. (2013), the motivation drivers behind using gamified apps include the following: social aspect or community membership, fun, linked to personal interest, opportunity to compete against others, discover new things and achieve a personal best.

Examples of applications using gamification are detailed below. The app “Zombies run!” entails the user picking a mission in the app and listening to a narrative during a run (Thomson, Nash, & Maeder, 2016). The user must rescue survivors and fetch supplies in the “zombie territory” as they run. The user hears sound effects that aid in their immersion into the “zombie world” created by the app. Another example is the “Fish’n’Step” app, whereby physical activity participation is associated with the growth of virtual pets (Thomson, Nash, & Maeder, 2016). Pokémon Go is an example of an app using the power of games; its quick adoption and immense popularity demonstrate the value game elements could offer in different contexts (Garett & Young, 2018).

Another example is the Nike running app, which was gamified in 2014, and had a userbase of 28 million (Wolf, Weiger, & Hammerschmidt, 2018). Two years later, the result of removing some gamification aspects led to severe dissatisfaction with the app and a drop-off in active users. This shows that gamification can positively affect mobile app usage adoption. It also illustrates that companies need to understand how gamification impacts adoption as Nike lost users by not being aware of how gamification of their app was experienced by users (Wolf, Weiger, & Hammerschmidt, 2018).

As previously mentioned fitness apps suffer from relatively low adoption rates (Yuan et al., 2015). Additionally, it is unclear how gamification affects continuous use of fitness mobile apps (Wolf, Weiger, & Hammerschmidt, 2018).

This thesis attempts to address two problems that exist:

1. It is unclear how gamification impacts adoption of fitness mobile apps, and
2. Poor adoption rates for fitness mobile apps.

Thus, the purpose of the study is to fill this gap by attempting to understand how gamification influences fitness mobile app adoption.

1.2. Research purpose

The aim of this thesis is to use quantitative and qualitative means to gain insights into users’ perceptions of gamification in a fitness mobile app and understand the way gamification may impact adoption of the fitness mobile app. The focus is specifically on understanding user perceptions in a South African context. The insights will be

used to address the two previously mentioned problems and to inform the design of gamification in fitness mobile apps when the intention of the gamification is to improve the adoption of a fitness mobile app.

1.3. Research questions

a. Does gamification improve the adoption of fitness apps on mobile devices in South Africa?

b. How does gamification improve adoption of fitness apps on mobile devices in South Africa?

1.4. Technology Acceptance Model Approach

The Technology Acceptance Model (TAM) is cited as the most influential information systems theory and for over two decades one of the most widely followed models explaining the adoption of technology (Rese, Baier, Geyer-Schulz, & Schreiber, 2017). It assists in explaining usage intentions and offers value in understanding adoption, which is the issue of interest in this thesis (Aslam, Ham, & Arif, 2017). According to Wingo, Ivankova and Moss (2017), the TAM is a powerful predictive model when it comes to understanding user's acceptance of technology. This is based off a meta-analysis of 88 studies.

Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are important key components making up the TAM and for determining behavioural intention to use a specific technology (Shima & Mohamadali, 2017; Wingo, Ivankova, & Moss, 2017). PU is described as the belief a person has that using a given technology will enhance their performance (e.g. improved work efficiency) (Joia & Altieri, 2017; Shima & Mohamadali, 2017; Wingo, Ivankova, & Moss, 2017) PEU is described as the degree of effort a person expects to put in when using and mastering a given technology (Joia & Altieri, 2017; Shima & Mohamadali, 2017; Wingo, Ivankova, & Moss, 2017).

Perceived enjoyment (PE) extends from TAM and refers to the enjoyment of a technology when using it (Rese, Baier, Geyer-Schulz, & Schreiber, 2017). Another extension of the TAM is the component subjective norm (social influence process) (Ho, Ocasio-Velazquez, & Booth, 2017; Shroff & Keyes, 2017). The definition of subjective norm is someone's subjective belief that their family and friends, who they regard as important, think the person should act in a certain way (Ho, Ocasio-Velazquez, &

Booth, 2017). In the context of the TAM, subjective norm refers to a person perceiving that the people who are important to them believe the person should use the technology (Ho, Ocasio-Velazquez, & Booth, 2017; Wingo, Ivankova, & Moss, 2017). It is argued to be a predictor of a person's intention and actions of adopting technology (Ho, Ocasio-Velazquez, & Booth, 2017). According to Hermann and Kim (2017), subjective norm was not found to influence fitness related apps incorporating exercise.

The mentioned PU, PEU and subjective norms may influence technology adoption behaviours differently across males and females. To illustrate, according to Ho, Ocasio-Velazquez and Booth (2017), there is a tendency for PU to influence the technology adoption behaviours of men while subjective norm and PEU are stronger influencers of technology adoption behaviours of females. Furthermore, there are other factors influencing technology adoption differences across gender besides the components of TAM (Riquelme & Rios, The moderating effect of gender in the adoption of mobile banking, 2010).

Although a widely accepted model of information technology acceptance, TAM has shortcomings. According to Shroff and Keyes (2017), the model's shortcomings are the lack of external influence and motivational factors. Furthermore, they mention a gap in research regarding the internal motivator role of the social environment. To address these shortcomings an extension of the model including the variable subjective norm will be used and the limitations of the model fully explaining adoption intentions will be acknowledged when analysing the results in this study.

TAM will be used to answer the first research question in this thesis. This will entail creating a survey measuring the individual TAM components and looking at the relationship between the components and the behavioural intention to adopt a gamified fitness mobile app. Statistical analysis including correlations and multiple regression analysis will be used to determine the relationships between the TAM components and the behavioural intention to adopt fitness mobile apps which include gamification. In addition, students will be asked survey questions relating to how gamification impacted the adoption of gamified fitness mobile apps. The qualitative user insights gathered will be used to answer the second research question.

1.5. Thesis overview

The structure of the rest of this thesis is outlined as follows. Chapter 2 is the literature review, where previous research related to gamification, fitness mobile apps and the mechanisms at work with gamification will be elaborated on. Chapter 3 follows and outlines the research methodology for the study. Chapter 4 is the results and a discussion of the data collected which will be elaborated on next. Chapter 5 is the conclusion which will be followed by chapter 6 which outlines future research and chapter 7 which states the limitations of the study.

2. Literature review

Existing research on fitness mobile apps and gamification will be presented in this chapter. The first part of the literature review will give an overview of the adoption of fitness applications. Next, the literature review will elaborate on gamification and gamification elements. This will be followed by fitness mobile app gamification. The literature review will end with research on the gamification mechanisms involved in the adoption of fitness mobile apps.

2.1. Adoption of Fitness Applications

Mobile use is fast expanding across the globe and various companies are using apps (e.g. Nike+) to engage customers with their offerings and brand (Goodwin & Ramjaun, 2017). However, getting users to continuously use fitness applications is not easy. As soon as a new fitness apps comes out, the current fitness app is abandoned (Wylie, 2010). Consequently, adoption or use continuance is an issue faced by the large diversity of fitness applications available to the public (Hamari & Koivisto, 2015). Adoption of fitness applications has been studied using TAM, as discussed below.

In research using TAM, people demonstrated a willingness to adopt health related wearables incorporating gamification (Spil, Sunyaev, Thiebes, & Van Baalen, 2017). People seemed to show a positive view of the need for gamification for health improvement. Users communicated confidence in ease of use and perceived usefulness pertaining to the gamification. This may be attributed to the user-friendliness and added functionality (Spil, Sunyaev, Thiebes, & Van Baalen, 2017) .

Beldad and Hegner (2017) reinforced these findings with research originating from Germany, which is cited as a popular fitness app location. According to the authors, besides the mentioned perceived use and ease of use, social norm also appeared to predict this intention to continue using a given fitness app (Beldad & Hegner, 2017). Social influence, or social norm, is divided into two categories: injunctive social norm (a similar concept to subjective norm), and descriptive social norms (Beldad & Hegner, 2017) . According to Beldad and Hegner (2017), injunctive social norm is defined as what the majority of people disapprove or approve of typically. They describe descriptive social norm as what most people normally do. Beldad and Hegner (2017) mention that based on past studies, injunctive social norm or subjective norm significantly affect technology (e.g. mobile payment services) adoption intentions.

Although the TAM components perceived usefulness and perceived ease of use have been cited as playing a role, Byun, Chiu, and Bae (2018) state that perceived enjoyment in sport brand apps is the biggest player in terms of intention to use the app. Gamification is argued to be linked to the intention of a user to use an app due to the fun and enjoyment derived from the gamification (Byun, Chiu, & Bae, 2018).

Adoption of fitness applications is important to those in the fitness applications industry. From the TAM-related research mentioned, gamification is argued to potentially play a positive role in adoption of fitness applications. Furthermore, there has been rapid growth of gamified health and fitness apps (Spil, Sunyaev, Thiebes, & Van Baalen, 2017). Gamification will be elaborated on in the next section.

2.2. Gamification elements in fitness mobile apps

As games have gained momentum in terms of uptake and ubiquity, the application of game characteristics (e.g. leaderboard, badges) to different contexts (e.g. award badges in a mobile app for completing a task) has become a research focus and this phenomenon has been called "gamification" (Cheong, Filippou, & Cheong, 2013). Games motivate and offer engagement to gamers, which may be recreated with gamification (Cheong, Filippou, & Cheong, 2013). This is supported by Wylie (2010), who argues that aspects of gamification come from popular computer games, such as World of Warcraft, which entertain users and engage them to the point that they keep on coming back to play. Gamification has the purpose of enhancing human motivations to behave in a certain way (Goodwin & Ramjaun, 2017).

Gamification in fitness mobile apps is growing in popularity, adding a fun element to motivate physical exercise (Chen & Pu, 2014; Goodwin & Ramjaun, 2017). It is argued to be an essential part in fitness mobile apps (Chen & Pu, 2014). Gamification mechanisms fitness mobile apps may employ include leaderboards, rewards, tracking progress, and profile development (Barratt, 2017; Wolf, Weiger, & Hammerschmidt, 2018). Three examples of mobile apps incorporating an active (fitness) aspect and game attributes are Nike+, Fitocracy and Pokemon Go.

According to Larsson (2013), the two popular fitness mobile apps, Nike+ and Fitocracy, contain gamification elements and have accumulated large userbases. Nike+ has been shown to be successful with about 7 million members. The app's gamification aspects include users earning points, tracking running activities and

challenging other users through the app. Fitocracy, another popular fitness mobile app, with 1 million users in 2013, motivates users with points and achievements (Stålnacke Larsson, 2013).

Although not specifically a fitness mobile app, Pokémon Go (one of the most popular mobile apps of 2016), an augmented reality mobile app game that used GPS to track user movement, was found to encourage physical activity (Cheng, 2017). This illustrates game like applications encouraging activeness (fitness). According to the findings of Cheng (2017), players were twice as likely to walk 10,000 steps daily compared to non-users of Pokémon Go. Furthermore, the fun aspect of using the app led to some previously inactive individuals having a sharp spike in physical activity (Cheng, 2017).

Including achievement systems in an app alongside other gamification components has been shown in preliminary studies to have greater user retention rates compared to apps without it. This may be due to the fun and value added to the experience from achievement systems, as stated by 96% of users in the study by Wylie (2010).

Common gamification elements will be elaborated on in the following sections.

2.2.1. Leaderboards

Leaderboards entail comparability of individual rankings on a scoreboard and competition for rankings positioned higher up on the board (Hung, 2017; Tan & Hew, 2016). Rankings could, for example, be based on points for calories burnt or distance cycled (Navarro et al., 2013). According to Wong and Kwok (2016), to create a mutually beneficial situation for all, nicknames can be used on leaderboards to allow those who wish to not show their performance to remain anonymous.

Competition needs can be seen as a motivator mechanism at play in leaderboards as users compare themselves to others based on leaderboard rankings (Hung, 2017). The Strava app incorporates competition as part of its gamification using leaderboards, which also act on satisfying achievement and status needs. The app has a leaderboard ranking best cycling times that people using the app have logged. To further add to the fun aspect of gamification, people who rank at the top on the leaderboard are crowned “queen” or “king of the mountain”. According to Barratt (2017), users of the app enjoyed it when they outcompeted friends or saw their name high on the leaderboard.

As previously mentioned, status (social recognition) or achievement needs may also be fulfilled by the leaderboard (Alharthi & Parrish, 2017; Tan & Hew, 2016). For example, the user may be motivated to achieve a higher status on the leaderboard, to become the top ranked player. Figure 1 below is an example of the gamification element a leaderboard.

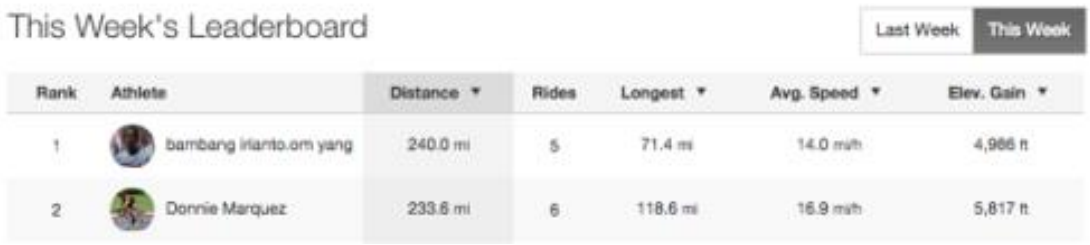


Figure 1. Leaderboard ranking users (Mani, 2016)

2.2.2. Rewards

Continuously maintaining difficult habits such as keeping up a healthy lifestyle and exercising may require some form of reward to sustain such habits (Hamari & Koivisto, 2015). People may choose to not repeatedly engage in such habits as Hamari & Koivisto (2015) state that short term rewards such as eating too much, smoking harmful substances or skipping exercise are preferred to long term rewards (e.g. improve fitness and health). Game-like and social(mobile) applications are seen as a possible way to assist people to maintain such habits such as keeping healthy and continuously following an exercise routine (Hamari & Koivisto, 2015). Gamification by, for example, rewarding a 5km run with 250 points (1000 points exchange for gift) can help motivate exercise through offering short term benefits and rewards that lead up to longer term rewards and goals (Hamari & Koivisto, 2015).

Commonly used rewards in fitness mobile apps include badges, and points.

2.2.2.1. Badges

According to Tan and Hew (2016), badges are logos, icons, and trophies awarded for achievements such as task completion. An example is a Sydneysiders 1,000 km ride badge (Navarro et al., 2013). Badges can be designed in different ways to act as an incentive for users to make contribution efforts, participate or perform a certain behaviour (Easley & Ghosh, 2016). Open Badges allows a user's badges achieved to be displayed on networks like LinkedIn, demonstrating competence to potential employers (Hung, 2017).

Badges motivate users to fulfil a need, or desire, to achieve, or receive, rewards and status (Tan & Hew, 2016). Badges as a motivator require the user to value being awarded a badge. Badges act as a positive feedback mechanism and signal achievements to others (Redondo-Duarte, Sánchez-Mena, Navarro-Asencio, & Vega, 2017).

For example, the fitness mobile app Strava makes use of badges (Figure 2) as well as virtual trophies which are awarded to the top ten rides on the app (Barratt, 2017).

Figure 2. Badges in Strava (Mani, 2016)

2.2.2.2. Points

Figure 3. NikeFuel points (Emeran, 2013)

Figure 3 above is an example of the gamification element points used in the Nike+ app. Points are numerical values given for task, goal or level achievement (Antonaci, Klemke, Stracke, & Specht, 2017). Users accumulate points that may serve the function of status signals and be used to acquire virtual goods, badges or other resources as well as position a user on a leaderboard (Tan & Hew, 2016).

Points act as a motivator as it serves as a reward (Tan & Hew, 2016). Points motivate self-efficacy by acting as a measure of performance and progress. Points earned may provide motivation as it creates a reputation or status and the user may see others as

supporting and expecting such behaviours. Thus, the user performs the action for points in order to feel recognition and social acceptance (Alharthi & Parrish, 2017).

The previously mentioned leaderboard, badges and points, catering to reward, competition and achievement desires can be classified into a category of incentive which is extrinsic incentives (Tan & Hew, 2016). Leaderboards, badges and points are also argued to satisfy competence needs which falls into the category of intrinsic incentives (Sailer, Hense, Mayr, & Mandl, 2017). Extrinsic and intrinsic incentives will be elaborated on later.

2.2.3. Progress tracking

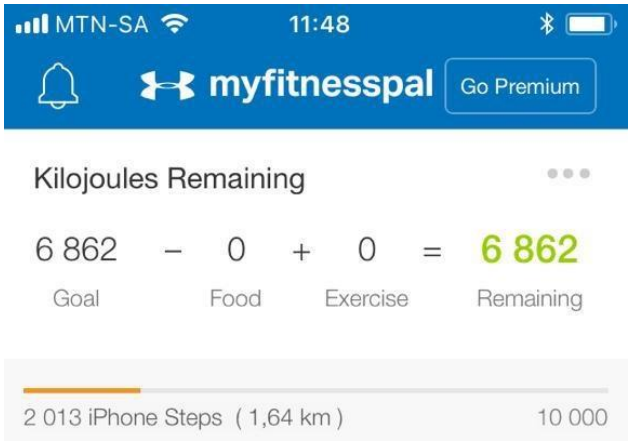


Figure 4. Progress bar recording number steps taken by a user

Progress bars as seen above show user's progress towards a goal (Hsu, Chang, & Lee, 2013). To illustrate, LinkedIn makes use of this progress bar gamification element when creating a profile (Sailer, Hense, Mayr, & Mandl, 2017). This progress bar measures the user's progress as they fill in details in the user profile section (Huotari & Hamari, 2017).

The image above (Figure 4) is a snapshot of a progress bar used in MyFitnessPal.

Figure 5. Level 5 reached in a gamified app (Mani, 2016)

Figure 5 above is an example of the gamification element levels. Levels signal status in terms of a degree of mastery of an activity (Tan & Hew, 2016). It shows the user how they are progressing and could be shown on a progress bar (Antonaci, Klemke, Stracke, & Specht, 2017). For example, people could progress from rookie to expert and then champion for frequently posting cycling pictures and giving cycling tips (Navarro et al., 2013).

Progress bars and levels act as a form of feedback of one's progress and may add to game-like user experiences (Hung, 2017).

2.2.4. Challenges

Challenges entail a user having a mission and offers a goal or purpose the user can work towards (Tan & Hew, 2016). Points, achievement badges and levels are included in gamified parts making up challenges (Wong & Kwok, 2016).

Progress bars and badges are rewarding game mechanics employed as part of Strava's challenges (Barratt, 2017). Performance graphs and profile development are enhanced through completion of the Strava app challenges (ascension, exercise time, distance). An example is Strava's 100km ride Gran Fondo Challenges as well as monthly accumulated distance and ascension leaderboard challenges. Badges are earned from the challenges and put inside the user's virtual 'trophy room' (Barratt, 2017).

2.2.5. Profile development

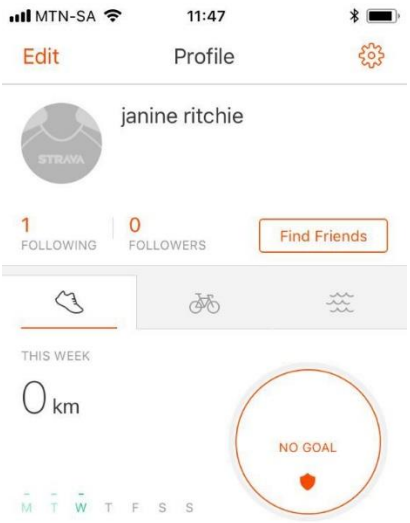


Figure 6. Strava app profile

Figure 6 above is an example of the gamification element profile development. According to Barratt (2017), a user in a gamified system may have a user profile with items such as achievements and an avatar to represent them. For example, the gamified app Strava has an 'Athlete Profile' page. The profile page includes an avatar profile picture, achievements, links to challenge pages, accumulated performance data, rider followers and photo album for rides (Barratt, 2017).

2.3. Gamification mechanisms to motivate mobile app adoption

2.3.1. Satisfaction of human needs

Different gamification elements impact motivation by acting on needs such as the need for altruism, achievement, competition, status, reward and self-expression (Tan & Hew, 2016). According to Barratt (2017), users of an app are initially motivated by competition. However, in one case, users indicated a decline in motivation due to in-app competition. Reasons included reaching a best time, seeing it as not worth the effort and declined interest in the competitive element of the app. Consequently, more than competition alone is needed to maintain user commitment to an app. To add to this, a Strava app study revealed that, according to users, competition became unpleasant as time went on using the app, despite initially being enjoyed (Barratt, 2017). Research findings show that when motivating physical activities, competition was outperformed by cooperation as well as a hybrid system (competition and cooperation) (Chen & Pu, 2014).

Other apps, namely Fitbit, miCoach and Nike+, utilize community-based competition (Chen & Pu, 2014). Research on fitbit and Nike+ apps revealed that engagement is most likely enhanced when constructive competitive elements (points, status, leaderboard) are present (Goodwin & Ramjaun, 2017).

As previously mentioned leaderboards, badges and points, catering to reward, competition and achievement desires, serve as extrinsic incentives motivating desired behaviour. However, some users may not be motivated by extrinsic incentives. They may need intrinsic incentives through meaningful gamification in order to motivate desired behaviours (Tan & Hew, 2016).

According to Tan & Hew (2016), the self-determination theory describes 3 intrinsic needs, which will be analysed to understand the motivational role of gamification. These needs are competence, social relatedness and autonomy needs, which motivate continued action by making tasks meaningful (Sailer, Hense, Mayr, & Mandl, 2017; Tan & Hew, 2016).

Leaderboards, badges and points are argued to satisfy competence needs. Points are linked to actions and accumulate to unlock badges and improve leaderboard ranking, all of which offer feedback to the user. This feedback communicates performance success of a user and thus competence level (Sailer, Hense, Mayr, & Mandl, 2017).

Autonomy as a need entails freedom to make decisions, direct one's life, as well as experience task meaningfulness. For example, gamified apps with stories give meaning, or context, to user actions. (Sailer, Hense, Mayr, & Mandl, 2017; Tong, 2015). Users make choices on how to move through challenges and paths they choose to follow to complete a challenge. Rules, goals and tools in the gamified system offer assistance and guidelines, but the user is not forced into which steps to take next (Sailer, Hense, Mayr, & Mandl, 2017; Tong, 2015).

With the social relatedness need, shared goals and gamified systems offering a feeling of belonging could satisfy this need (Sailer, Hense, Mayr, & Mandl, 2017). Gamification could be seen to motivate desired user actions by fulfilling these three mentioned needs.

Consequentially a user's motivation to adopt a gamified mobile app lies with the fulfilment of certain needs. This has implication for the design of gamified mobile apps.

2.3.2. Social needs as an incentive

In the context of social relatedness, Strava, a fitness mobile app, adds a social community element to the app experience (Barratt, 2017). In the study on Strava, cyclists using the app mentioned feeling like they belonged to a club community when logging their rides, even when other commitments inhibited riding with others (Barratt, 2017) .

This belonging 'social' need can be fulfilled through social interaction in a fitness app community through cooperation, competition or peer support. When designing pervasive fitness apps, social interaction has been found to be a key motivator to do physical activities. (Chen & Pu, 2014). According to Chen and Pu (2014), the app Fish'n'Steps introduces the element of social interaction as it entails forming teams. This team cooperation led to group enjoyment and promoted user physical activity. This enhanced individual performance (physical activity) is attributed to the team element binding user performance to team performance. In Fish'n'Steps, the fish tank conditions (e.g. tank decoration and darker water) worsen if team members underperform. This motivates each member to perform for the sake of the team (Chen & Pu, 2014).

In addition, social sharing attributes, according to Wylie (2010), are in the fitness mobile applications that are most successful. To illustrate, social sharing could take the form of a post about an app user's workout on Facebook leading to friends offering motivating feedback about the workout. Another example is using a mobile app to share point scores achieved, e.g. 100 points earned for 100 crunches (Wylie, 2010). The underlying theme is a social incentive encouraging users going back to a fitness mobile app (Chen & Pu, 2014).

Another aspect acting as a social incentive to use a gamified fitness mobile app is social influence. In gamification services, social influence (along with positive recognition) has been found to positively affect willingness to exercise and use gamification services (Hamari & Koivisto, 2015). According to Hamari & Koivisto (2015), this effect is more prominent when the user has a bigger friend circle in the service/application. Furthermore, findings show that subjective norm as well as recognition, network effects and getting reciprocal benefits adds to adoption (use continuance) (Hamari & Koivisto, 2015).

According to Wong & Kwok (2016), positive recognition and social influence are indicated via a 'like' function e.g. a like button in an app. They argue that social influence needs to be designed so that the mobile app offers support to users. Following from this, they argue that social interaction is heavily relied upon in the most successful games. In addition, research shows that it is beneficial to incorporate social features to assist engaging gamification, which will aid adoption of an app (Wong & Kwok, 2016).

2.3.3. Intrinsic vs extrinsic value

According to Glover (2013), the presence of extrinsic motivation (rewards, badges) may demotivate users who are mainly intrinsically motivated. Additionally, rewards may not motivate extrinsically if the rewards are not perceived as desirable or achievable (Glover, 2013). Thus, it is important to understand the users when designing a gamification intervention. Furthermore, not too many rewards should be awarded as it removes the motivating feeling of accomplishment and pride (Glover, 2013). The research findings of Goodwin and Ramjaun (2017) on the gamified mobile health apps fitbit and Nike+ revealed that intrinsic rewards are enjoyed by users. However, the intrinsic rewards are only valuable when they understand the reason they are given a reward (Goodwin & Ramjaun, 2017).

2.3.4. Goal-setting theory

From the goal-setting theory perspective, motivating adoption of gamified apps lies with wanting to accomplish a goal (Landers, Bauer, & Callan, 2017). According to the theory, the user engages in self-regulation. Users alter their behaviour in order to minimise the gap between the desired goal (performance level) and user performance. Applied to gamification, leaderboards offer potential motivating goals. The user may be motivated to alter their performance so as to decrease the gap between actual performance and their goal and eventually achieve that goal. The goals for the leaderboard should be worthwhile to the user and the user should see the link between goal achievement and effort. This will facilitate motivation with a leaderboard or other gamification elements (Landers, Bauer, & Callan, 2017). Another example of goal-setting theory is the gamification element badges. The user may work towards achieving the goal of receiving a badge, which signals socially valued actions and status to others (Alharthi & Parrish, 2017).

2.4. Profile of fitness mobile apps

A few fitness mobile apps incorporating gamification will be described next. Table 1 gives a summary of the gamification features found in these apps.

Table 1. Summary of gamification features found in popular fitness apps

	Leaderboards	Badges	Points	Progress bars	Levels	Challenges	Profile development
Strava	✓	✓		✓		✓	✓
MyFitnessPal	✓ (PC only)			✓			✓
Nike+	✓	✓	✓	✓	✓	✓	✓
Discovery Vitality	✓		✓	✓	✓	✓	

2.4.1. Strava

Strava is a fitness mobile app that allows users to log cycling rides, displays routes and performance e.g. heartrate, shows leaderboards ranking the best GPS tracked times and awards virtual trophies (Barratt, 2016). It also offers feedback in the form of notifying users of new best times achieved. Queen and King of the Mountain titles are awarded for placing at the top of the leaderboard. Strava also utilises gamification in the form of posing challenges (e.g. ride 100k distance) with progress bars and quests. Challenge completion results in pin badges being added to the users virtual ‘trophy room’. The user also has a profile page showing past performance data. (Barratt, 2016).

2.4.2. MyFitnessPal

MyFitnessPal is a fitness mobile app, used for counting calories taken in and used and achieving weight goals (Kagkini, 2017). The app entails recording meals and setting calories goals. Its features include tracking progress in terms of weight with activity trackers (e.g. progress bar shows number steps taken) and progress charts as well as logging food calories by using a barcode scanner attribute of the app (Kagkini, 2017).

2.4.3. Nike+

Nike+ is a fitness mobile app which monitors physical activity and awards “NikeFuel” points. Other attributes include moving up levels, unlocking achievements and competition using a leaderboard (Johnson, Deterding, Kuhn, Staneva, Stoyanov, Hides, 2016). As mentioned previously in the literature, Nike+ contains the gamification features points, progress monitoring and challenge (Larsson, 2013).

2.4.4. Discovery Vitality

Discovery, an insurance company in South Africa, launched the Vitality program which showcases the influence of rewards as an incentive to follow a healthy lifestyle. It offers clients rewards in terms of discounts on healthy food and more for accomplishing health related goals. The client is than rewarded with perks such as discounted travel and lowered annual premiums (Gore, Harmer, Pfitzer, & Jais, 2017).

2.5. Chapter summary

Gamification is utilised in various forms in popular fitness mobile apps and has various motivational mechanisms at work, which are assumed to improve adoption of a given fitness mobile app. This ranges from the mentioned human needs and social incentives to intrinsic/extrinsic value and goal-setting.

Table 2. Summary of gamification features, apps and mechanisms discussed in chapter 2

Features	App	Mechanism
leaderboard	Strava, Fitbit, Nike+	competition, competence need, social need, achievement and status needs, goal setting theory
badge	Strava	achievement, receive rewards and status, feedback, goal setting theory, competence need
points	Nike+, Fitocracy	reputation or status, recognition, social acceptance, feedback, competence need
levels		status, measure progress
profile development	Strava	
progress bar	MyFitnessPal	feedback, measure progress
challenges	Strava	autonomy

3. Research Methodology

The focus of this thesis is to investigate the relationship between gamification and fitness mobile app adoption. This entails looking at a user's perceptions of past experience with using one of three given fitness mobile apps that contain gamification. The data gathered will offer insights for designing gamification in fitness mobile apps to improve adoption of the fitness mobile app. A survey was administered to gather the data which is used to answer the two research questions outlined earlier. This chapter will cover pre-sampling, sampling, TAM, data collection approach and survey design, analysis, anticipated outcomes, ethics and pilot test.

3.1. Pre-sampling

The Division of Student Affairs at the University of Cape Town (UCT) sent out an email invitation to UCT students asking them to complete an attached questionnaire. The questionnaire asked the students to select up to three of the most used fitness mobile apps in the past from a list of gamified fitness mobile apps. The most popular three fitness mobile apps selected were used as the selection criterion for three cohorts, each cohort focusing on one of the three fitness mobile apps.

3.2. Sampling

Email invites were sent to the UCT students through the Division of Student Affairs. Students were selected based on criteria of having used one of three fitness mobile apps. Each student in the sample was put into one of three cohorts, depending on which of the three fitness mobile apps the student uses. As mentioned, the three cohorts are created based on the results from the pre-sampling. The study sample comprised of 399 participants.

3.3. TAM

The Unified Theory of Acceptance and Use of Technology (UTAUT) Model and TAM are models utilized in research for measuring adoption of technology (Yuan et al., 2015). The TAM will be used in this study as it is cited as one of the most widely followed models explaining the adoption of technology (Rese, Baier, Geyer-Schulz, & Schreiber, 2017). This is supported by Wingo, Ivankova and Moss (2017) who refer to the TAM as a powerful predictive model when it comes to understanding user's acceptance of technology. It assists in explaining usage intentions and offers value in

understanding adoption, which is the issue of interest in this thesis (Aslam, Ham, & Arif, 2017).

According to Shroff and Keyes (2017), the model's limitations stem from the models lack of external influence and motivational factors as well as a gap in research regarding the internal motivator role of the social environment. To address these shortcomings an extension of the model including the variable subjective norm will be used and the limitations of the model fully explaining adoption intentions will be acknowledged when analysing the results in this study.

Adoption of a fitness mobile app will be measured in this study using the TAM, which has taken various forms over the years. For this study the TAM components Perceived Usefulness (PU) and Perceived Ease of Use (PEU) and their relationship to Behavioural Intention (BI) to adopt a fitness mobile app will be measured as they have been found to directly affect BI. BI predicts the actual adoption behaviour (Lai, 2017). Perceived Enjoyment (PE) and subjective norm and their relationship to BI will also be measured. These two components are extensions of the model (Rese et al., 2017; Shroff & Keyes, 2017). TAM will form part of section 1 of the survey, which will be outlined next.

3.4. Data collection approach and survey design

A mixed method approach will be used in order to: 1. assess the TAM model using quantitative data and correlations in order to make inferences about the relationship between gamified fitness mobile apps and adoption and 2. Yield insights into the participant perspectives on gamified fitness mobile apps with questions requiring qualitative data. An online survey was used as it allows for easy gathering of numerous responses from university students as it can be sent in an email to the masses and only requires the students to click on a link to complete the survey anywhere. The sampling method of including participants in 3 cohorts based on the criterion of having used one of 3 given fitness mobile apps was used to ensure participants could give insights from past experience using the given app. An online survey was administered as it is easy to administer to a sample of university students and allows for collection of quantitative and qualitative data.

Google forms was used as a platform for an online survey sent to UCT students via a link in an email invite. The survey was used to collect quantitative and qualitative data

to answer the research questions outlined in chapter 1. A brief explanation of gamification with examples of gamification in fitness mobile apps was included at the beginning of the survey. A demographic part follows, requesting gender and age information as well as a question on the number of times a week a participant used the fitness mobile app.

The first section of the survey includes questions assessing the components of the TAM. TAM measures the behavioural intention to adopt. For the purpose of this study the TAM components PE, PU, PEU and subjective norm associated with gamification as well as behavioural intention will be measured to assess the relationship between gamification of the fitness mobile app and intention to adopt the fitness mobile app. Section 1 was a series of statements the participant rates on a 5-point numerical scale with 1 representing disagreeing with the statement and 5 representing agree with the statement. The statements are adapted from TAM questions found in other research studies (Byun, Chiu, & Bae, 2018; Choi & Chung, 2013; Chen & Pu, 2014; Chen, Rong, Ma, Qu, & Xiong, 2017; Rauniar, Rawski, Yang, & Johnson, 2014; Yang, Asaad, & Dwivedi, 2017; Zhou & Feng, 2017). The statements are presented below under each TAM component they measure.

PU was measured with the following 3 statements:

1. Using the gamification (e.g. points, levels, badges, levels, progress bar, leaderboard) in the app motivates you to exercise.
2. Using the gamification (e.g. points, levels, badges, levels, progress bar, leaderboard) in the app motivates you to have a healthier lifestyle.
3. The gamification helps you reach your exercise goals (e.g. run greater distances, exercise more frequently).

PE was measured with the following 2 statements:

1. The gamification makes the app more fun
2. The use of the gamification in the app makes you feel happy/positive emotions.

PEU was measured with the following 3 statements:

1. The gamification makes the fitness mobile app easier to become skilled in using.
2. You need help in using the gamified fitness mobile app.

3. The gamification makes the fitness mobile app easier to use (less effort to use\learn to use).

BI was measured with the following 2 statements:

1. The gamification motivates you to use the app more often.
2. You expect/intend to use the app in future.

Subjective norm was measured with the following 2 statements:

1. You use the app because friends or influencer individuals think you should use it.
2. You use the app because friends or influencer individuals use it.

The value selected on the 5 point numerical scale for each statement was averaged across the statements representing PU, PE, PEU, subjective norm and BI. To illustrate, the 3 statements representing PU were summed and divided by 3 to get a score representing PU. A score closer to 5 would show participants were closer to agreeing with the statement, indicating gamification offers PU from the participant's perspective.

The second section of the survey included open ended questions in order to gather qualitative data on adopting gamified fitness mobile apps. The entire survey is included in Appendix A.

To encourage students to participate in the survey, a prize was offered. By completing the survey participants were entered into a random draw. A random number generator was used to determine the winner of the prize, which was a fitbit charge 2.

3.5. Analysis

The data gathered from section 1 of the survey was analysed to determine the presence of the TAM components, the relationship between the individual TAM components and BI, and an overall analysis of the impact of PU, PEU, PE and subjective norm together on BI. This entailed representing the average ratings across participants in the form of histograms, descriptive statistics (mean, median, standard deviation), weighted marker scatterplots, calculating correlation coefficients and performing multiple regression analysis. Weighted marker scatterplots group clusters of answers together to make the relationship between different TAM components and BI clearer. Large clusters of markers indicate higher frequency of individuals selecting

a specific rating whereas small clusters indicate a lower frequency. The size of the circle markers scale with the value of the selected rating.

To elaborate, the data gathered was analysed by calculating correlations between the individual TAM components and BI in order to show the relationship between each TAM component in gamified app's and behavioural intention to adopt an app. Regression analysis was also performed on the data to determine the influence of the TAM components together on the behavioural intention to adopt an app. Furthermore, qualitative data was gathered from the survey to yield insights into themes that dominate for motivating users to adopt a gamified fitness mobile app.

Figure 7 below shows the TAM components and the relationships between the components which will be analysed with the mentioned statistical analysis.

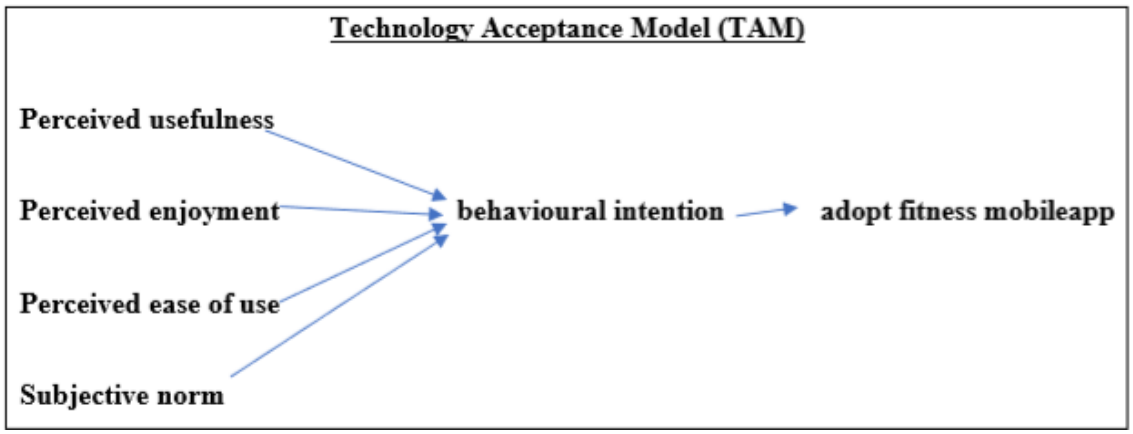


Figure 7. Extended TAM model

The data gathered from section 2 of the survey is used in discourse analysis. For the discourse analysis, the aim was to identity common themes that emerge in the qualitative data. For this purpose, open coding will be used. Open coding is a form of analysis whereby pieces of text which communicated a given concept or theme are given a code. Grouping responses by common themes assists in understanding the common themes surrounding the individual perspectives and assists in processing numerous responses. The qualitative data is analysed for common themes in order to answer the research question of “how gamification affects the adoption of fitness mobile apps”.

3.6. Anticipated outcomes

The statistical analysis of the quantitative section of the survey assessing the TAM will offer insights into the research question “Does gamification improve the adoption of

fitness apps on mobile devices in South Africa?". Adoption will be measured with statements under the theme 'behavioural intention' and the role of gamification will be measured with statements representing the four components of TAM, i.e. PU, PEU, PE and subjective norm. For section 2 of the survey, the data gathered will be analysed qualitatively by looking at emerging themes. The common themes found will be used to answer the second research question "How does gamification improve the adoption of fitness apps on mobile devices in South Africa?"

3.7. Ethics

Ethical clearance was obtained from the Faculty of Sciences Ethics Committee at the University of Cape Town prior to conducting the study and can be found in Appendix B. An informed consent form was included at the start of the online survey. Each participant had to select the yes or no options at the bottom of the informed consent form to indicate informed consent for participating in the survey. The participants were not able to continue with the survey unless they had completed the informed consent form.

3.8. Pilot test

A pilot study was carried out with 3 volunteers. The purpose of the pilot study was to ensure that participants would understand the survey questions and to identify improvements to the survey. Responses in the pilot study assisted in improving the survey design and questions.

3.9. Chapter summary

The approach for data collection in this study has been elaborated on in this chapter. The pre-sampling, sampling and survey approach to gather quantitative and qualitative data to answer the research questions was outlined. TAM was presented as a basis for the quantitative measurement side of the survey. The pilot test and ethics were also briefly discussed.

4. Results

The methodology was implemented in the study and the data collected will be analysed in this section. The chapter includes an analysis of each TAM component by itself. This is followed by an analysis of the individual relationships between BI and each TAM component, using correlations. Next, multiple regression analysis was done to observe the effect of the TAM components together on BI. This chapter is organised into the sub-sections: Pre-sampling, Sample Analysis, Demographics, Quantitative data and Qualitative data.

4.1. Pre-sampling

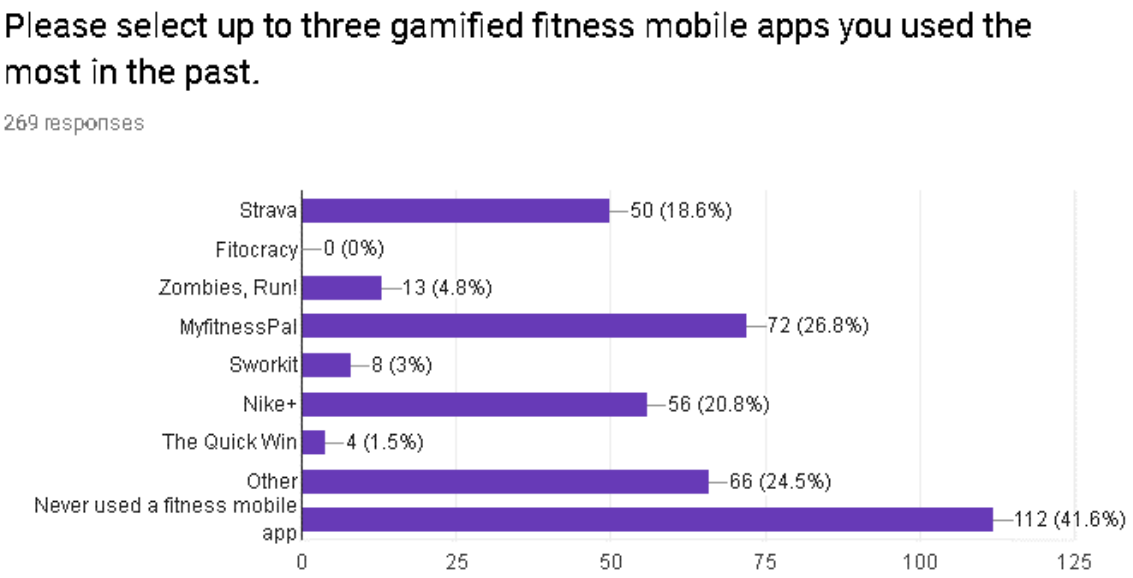


Figure 8. Summary of pre-sampling survey responses

269 responses were collected from the pre-sampling survey. The survey asked the users the question 'Please select up to three gamified fitness mobile apps you used the most in the past'. A summary of the responses from the survey are seen in Figure 8.

In Figure 8, MyFitnessPal (72 users selected), Nike+ (56 users selected) and Strava (50 users selected) were the top most selected fitness mobile apps. Based on the pre-sampling survey results, three cohorts were created for MyFitnessPal, Nike+ and Strava fitness mobile app users. As a side not, although "other" was a dominating response given by participants no app dominated among the responses given under "other" and students gave answers ranging from Samsung Health, Runtastic, Discovery app to Virgin Active app and map my ride.

4.2. Sample Analysis

UCT students were sent an email invitation to complete the survey if they had used MyFitnessPal, Nike+ or Strava in the past. 399 individuals completed the survey based on this criterion. 165 survey participants fell into the MyFitnessPal cohort. 136 survey participants fell into the Nike+ cohort. 98 survey participants fell into the Strava cohort. The cohort sizes are not equal, hence comparisons across the 3 cohorts will be done using percentages. MyFitnessPal can be seen to be the most popular fitness mobile app in our sample, followed by Nike+ and then Strava.

4.3. Demographics

Table 3 and Table 4 represent the gender ratio and frequency of fitness mobile app use across the 3 cohorts.

Table 3. Number of female and male participants in the 3 cohorts

	Female	**male**
MyFitnessPal	126 (76%)	39 (24%)
Nike+	89 (65%)	47 (35%)
Strava	32 (33%)	66 (67%)

Table 4. Number of times a week the participant used the fitness mobile app

	MyFitnessPal	**Nike+**	**Strava**
Less than once a week	12 (7%)	15 (11%)	6 (6%)
1 time a week	10 (6%)	12 (9%)	15 (15%)
2 times a week	14 (9%)	23 (2%)	13 (13%)
3 times a week	24 (15%)	**42 (31%)**	**21 (21%)**
4 times a week	19 (12%)	21 (15%)	15 (15%)
5 times a week	24 (15%)	12 (9%)	10 (10%)

6 times a week	9 (6%)	5 (4%)	6 (6%)
7 times a week	**53 (32%)**	6 (4%)	12 (12%)

When converting Table 3 values to percentages, unequal gender groups were found. 24% of participants in the MyFitnessPal cohort were male. This may show that the app is mostly targeting females. In the Nike+ cohort, 35% of participants were male. The Strava cohort differed as it had 33% female participants, thereby having more males as opposed to the other cohorts having more female participants. Hence Strava may target males more than females while Nike+ and MyFitnessPal may be more targeted towards females.

In Table 4, most survey participants used the fitness mobile app at least once a week. The greatest portion of participants in the MyFitnessPal cohort selected using the app 7 times a week, making up 32% of the MyFitnessPal cohort. The greatest portion of participants in the Nike+ cohort selected using the app 3 times a week, making up 31% of the Nike+ cohort. The greatest portion of participants in the Strava cohort selected using the app 3 times a week, making up 21% of the Strava cohort. MyFitnessPal appears to be used more frequently in the sample compared to Nike+ and Strava, when comparing the number of times a week participants indicated using the app. 80% of participants in the MyFitnessPal cohort indicated using the fitness mobile app 3 or more times a week. 63% of participants in the Nike+ cohort indicated using the fitness mobile app 3 or more times a week. 64% of participants in the Strava cohort indicated using the fitness mobile app 3 or more times a week. As most of the participants used a fitness mobile app 3 or more times a week, the responses should indicate themes relating to adoptive behaviours.

Before proceeding to discuss the findings from the survey, the limitations of using self-reporting methods will be acknowledged. The survey gathering qualitative data on participants perspectives of gamification motivation and app usage has the shortcomings of the data being inaccurate. Participants may misinterpret the survey questions leading to inappropriate responses. The questions may lead the participant to give a certain response they think the researcher wants from the survey questions. These factors need to be kept in mind when looking at the data.

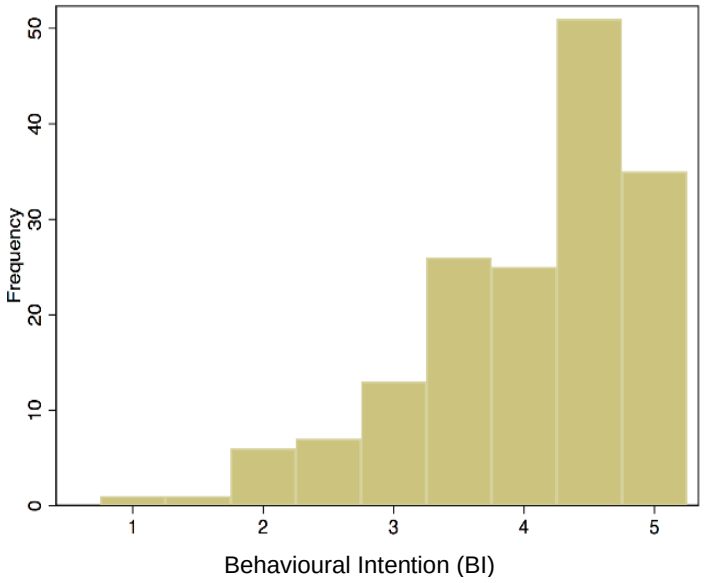
4.4. Quantitative data

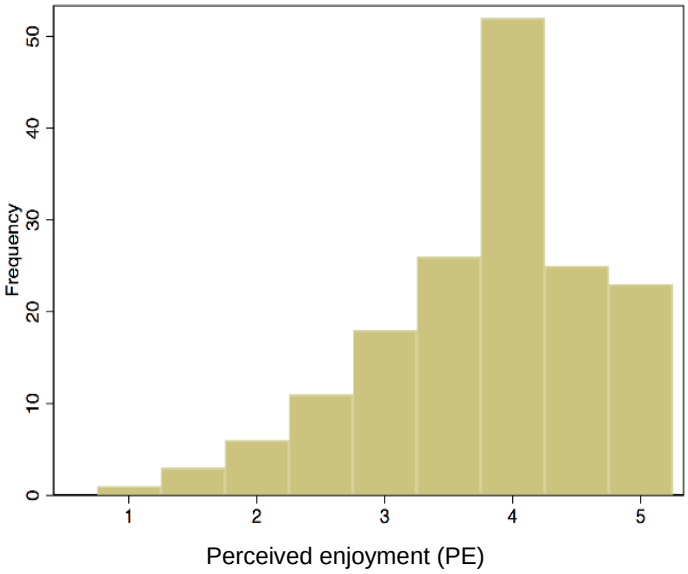
The results from the quantitative section of the survey measuring TAM will follow. The results are presented in this section with histograms and tables with descriptive statistics for the MyFitnessPal, Nike+ and Strava cohorts respectively. Refer to section 3.4 for the statements (e.g. the gamification makes the app more fun) rated by participants which are represented visually in weighted marker scatterplots and histograms in this chapter.

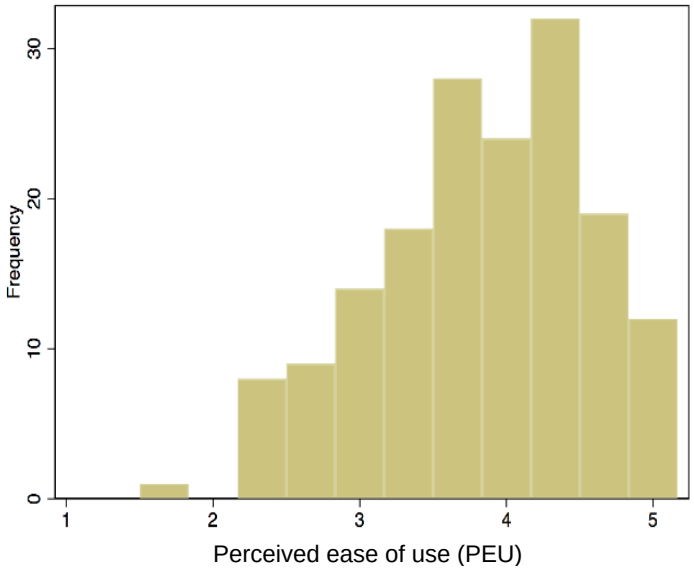
MyFitnessPal cohort:

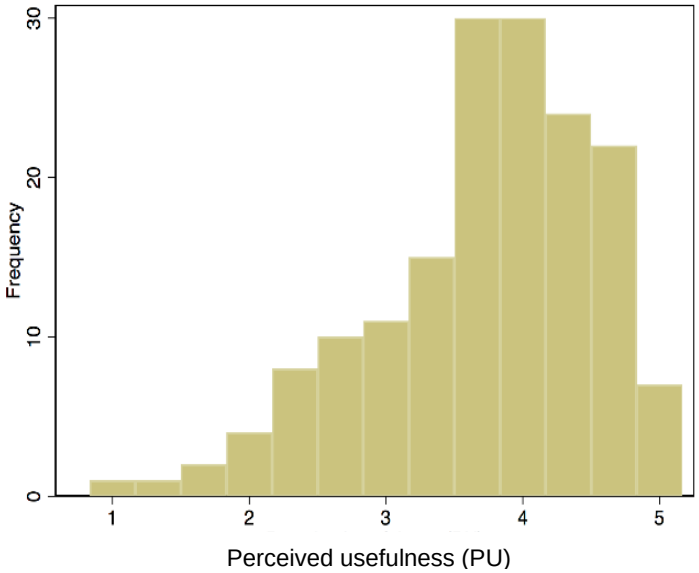
Participants in the MyFitnessPal cohort were asked to select ratings from 1 to 5 for a series of statements representing each TAM component, as previously discussed in section 3.4. The histograms in Figure 9 represent the averaged rating for each TAM component against the number of participants with the same averaged rating. The rating scale ranges from 1, for disagree, up to 5, for agree. Ratings closer to 5 indicate the presence of the TAM component based on the user's perspective.

In Figure 9, the histograms for PU, PEU, PE and BI show that most participants gave ratings closer to agree for the statements representing each individual TAM component. The histogram for subjective norm shows that most participants gave ratings closer to disagree for statements representing the subjective norm TAM component.









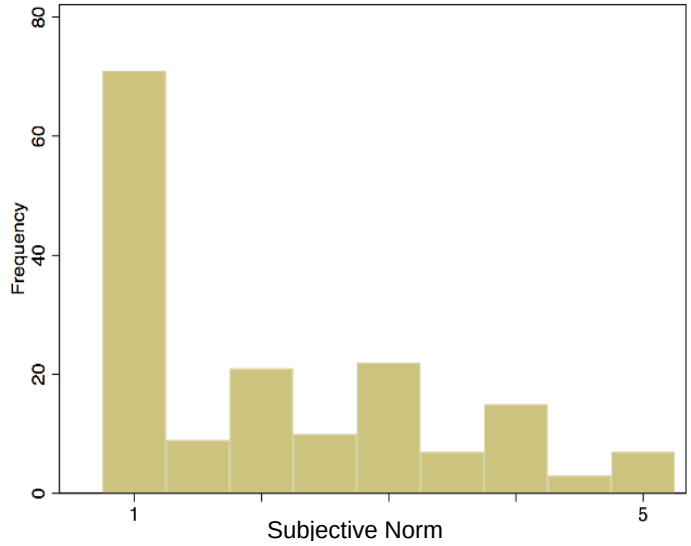


Figure 9. 5 histograms representing the distribution of average ratings from 1-5 across participant's responses for each TAM component for MyFitnessPal

Table 5 gives the descriptive statistics for the MyFitnessPal cohort.

Table 5. MyFitnessPal descriptive statistics

variable	N	min	p25	mean	p50	p75	max	sd	iqr
BI	165	1	3.5	4.039394	4.5	4.5	5	.8624764	1
PU	165	1	3.333333	3.719192	4	4.333333	5	.8205949	1
PE	165	1	3.5	3.790909	4	4.5	5	.8661534	1
PEU	165	1.666667	3.333333	3.832323	4	4.333333	5	.733097	1
SubjNorm	165	1	1	2.124242	2	3	5	1.241319	2

From Table 5, BI has a mean of 4.04, standard deviation of 0.86 and a median of 4.5 (75th percentile). PU has a mean of 3.72, standard deviation of 0.82 and median of 4.33. PE has a mean of 3.79, standard deviation of 0.87 and median of 4.5. PEU has a mean of 3.83, standard deviation of 0.73 and median of 4.33. Subjective norm has a mean of 2.12, standard deviation of 1.24 and median of 3.

In the MyFitnessPal cohort, the means of 4.04, 3.72, 3.79 and 3.83 for BI, PU, PE and PEU, respectively, show that, on average, participants selected ratings closer to agreeing as opposed to disagreeing with the statements representing these 4 TAM components. The subjective norm mean rating of 2.12 for the statements representing subjective norm lies closer to disagree. However, high variability of ratings selected across participants is also shown.

Figure 10 contains 4 weighted marker scatterplots plotting data gathered from the MyFitnessPal cohort. The frequency of average ratings for PU, PE, PEU and subjective norm was used to weight the markers. Each weighted marker scatterplot shows the relationship between an individual TAM component and BI.

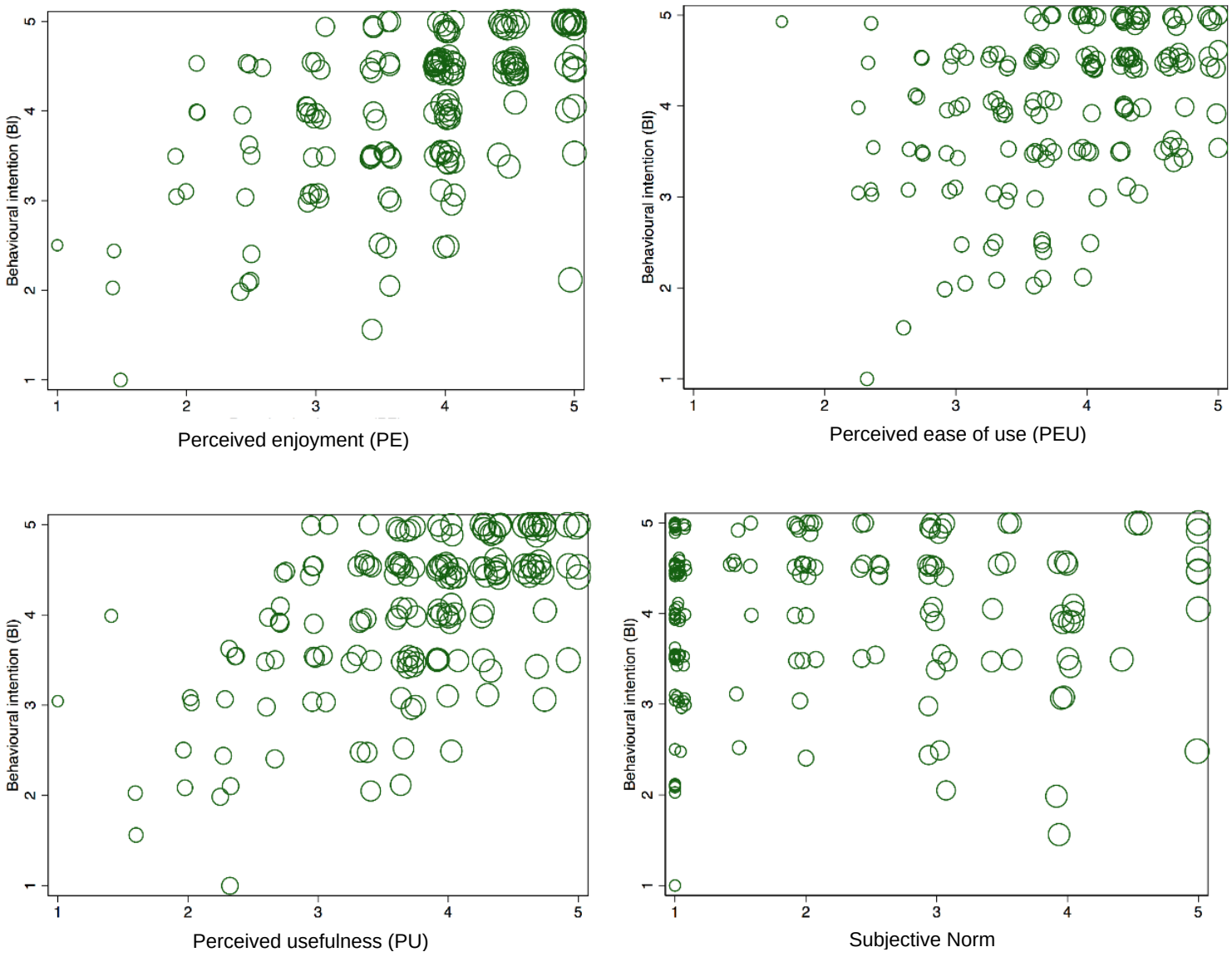


Figure 10. 4 weighted marker scatterplots representing the relationship between the individual TAM components and BI for MyFitnessPal

The relationships shown in the scatterplots are expanded on with correlation coefficients, which are presented next. Table 6 and Table 7 below represent the Pearson and Spearman correlation coefficients for the MyFitnessPal cohorst.

Table 6. Pearson correlation coefficients calculated for the measured TAM components in the MyFitnessPal cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.5786	1.0000			
PE	0.5457	0.6046	1.0000		
PEU	0.3866	0.3087	0.2405	1.0000	
SubjNorm	0.0524	-0.0084	0.0555	-0.0406	1.0000

Table 7. Spearman correlation coefficients calculated for the measured TAM components in the MyFitnessPal cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.5451	1.0000			
PE	0.5507	0.5568	1.0000		
PEU	0.4054	0.2936	0.2562	1.0000	
SubjNorm	0.0771	-0.0237	0.0234	-0.0445	1.0000

The 4 scatterplots in Figure 10 along with the correlation coefficients will be discussed here. The scatterplot plotting PU against BI shows a positive relationship between PU and BI. The Pearson correlation coefficient for this relationship is 0.58 and the Spearman correlation coefficient is 0.55, which both show that these 2 components have a positive relationship. The scatterplot plotting PE against BI shows a positive relationship between PE and BI. The Pearson correlation coefficient for this relationship is 0.55 and the Spearman correlation coefficient is 0.55, which both show that these 2 components have a positive relationship. The scatterplot plotting PEU against BI shows a positive relationship between PEU and BI. The Pearson correlation coefficient for this relationship is 0.39 and the Spearman correlation coefficient is 0.41, which both show that these 2 components have a positive relationship. The scatterplot plotting subjective norm against BI shows a positive relationship between subjective norm and BI. The Pearson correlation coefficient for this relationship is 0.05 and the Spearman correlation coefficient is 0.08, which both show that these 2 components have a weak positive relationship.

The mentioned positive relationships the scatterplots as well as the correlation coefficients and means show that when PU, PEU, PE and Subjective norm are present in a fitness mobile app containing gamification, the participant indicates intending to use the fitness mobile app in future. However, it also shows that participants indicating PU, PE and PEU not being present, tended to indicate disagreeing with the intention to use the fitness mobile app in future. This is represented in the scatterplots as a linear relationship existing between BI and the components PU, PEU and PE, which shows when these aspects are present so is the intention to use the fitness mobile app. The means reinforce this as more participants reported finding the gamification makes the app enjoyable, easier to use and more useful and wanted to use the app

compared the reverse scenario of participants not finding the app enjoyable and not intending to use the fitness mobile app.

The individual relationships in the TAM model have been analysed. The multiple regression analysis to follow entails looking at PU, PE, PEU and subjective norm together in terms of their impact on BI.

Table 8. Multiple regression analysis for MyFitnessPal

Source	SS	df	MS	Number of obs	=	165
				F(4, 160)	=	31.21
Model	53.4632779	4	13.3658195	Prob > F	=	0.0000
Residual	68.5306615	160	.428316634	R-squared	=	0.4382
				Adj R-squared	=	0.4242
Total	121.993939	164	.743865484	Root MSE	=	.65446

BI	Coef.	Std. Err.	t	P>|t|	Beta
PU	.3571475	.0800628	4.46	0.000	.3398046
PE	.2846925	.0744981	3.82	0.000	.2859063
PEU	.2528407	.0735523	3.44	0.001	.2149122
SubjNorm	.03341	.0413339	0.81	0.420	.0480853
_cons	.5919124	.3391354	1.75	0.083	.

For overall analysis of the TAM, multiple regression analysis was used. Overall, the model is significant ($f(4,160) = 31.21$, $p<001$). The R-squared value of 0.44 shows that PU, PE, PEU and subjective norm explain 44% of the variance in BI. PU, PE and PEU were found to be significant ($p<0.05$). Subjective norm was found to be insignificant as it had a p-value of 0.42. The standard correlation coefficients (beta) show that, when controlling for the other variables in the model, PU explains the most variance in BI with a standard correlation coefficient of 0.34. The standard correlation coefficient for PE is 0.29 and for PEU it is 0.21.

Nike+ cohort:

Participants in the Nike+ cohort were asked to select ratings from 1 to 5 for a series of statements representing each TAM component, as previously discussed in section 3.4. The histograms in Figure 11 represent the averaged rating for each TAM component against the number of participants with the same averaged rating. The rating scale ranges from 1, for disagree, up to 5, for agree. Ratings closer to 5 indicate the presence of the TAM component based on the user's perspective.

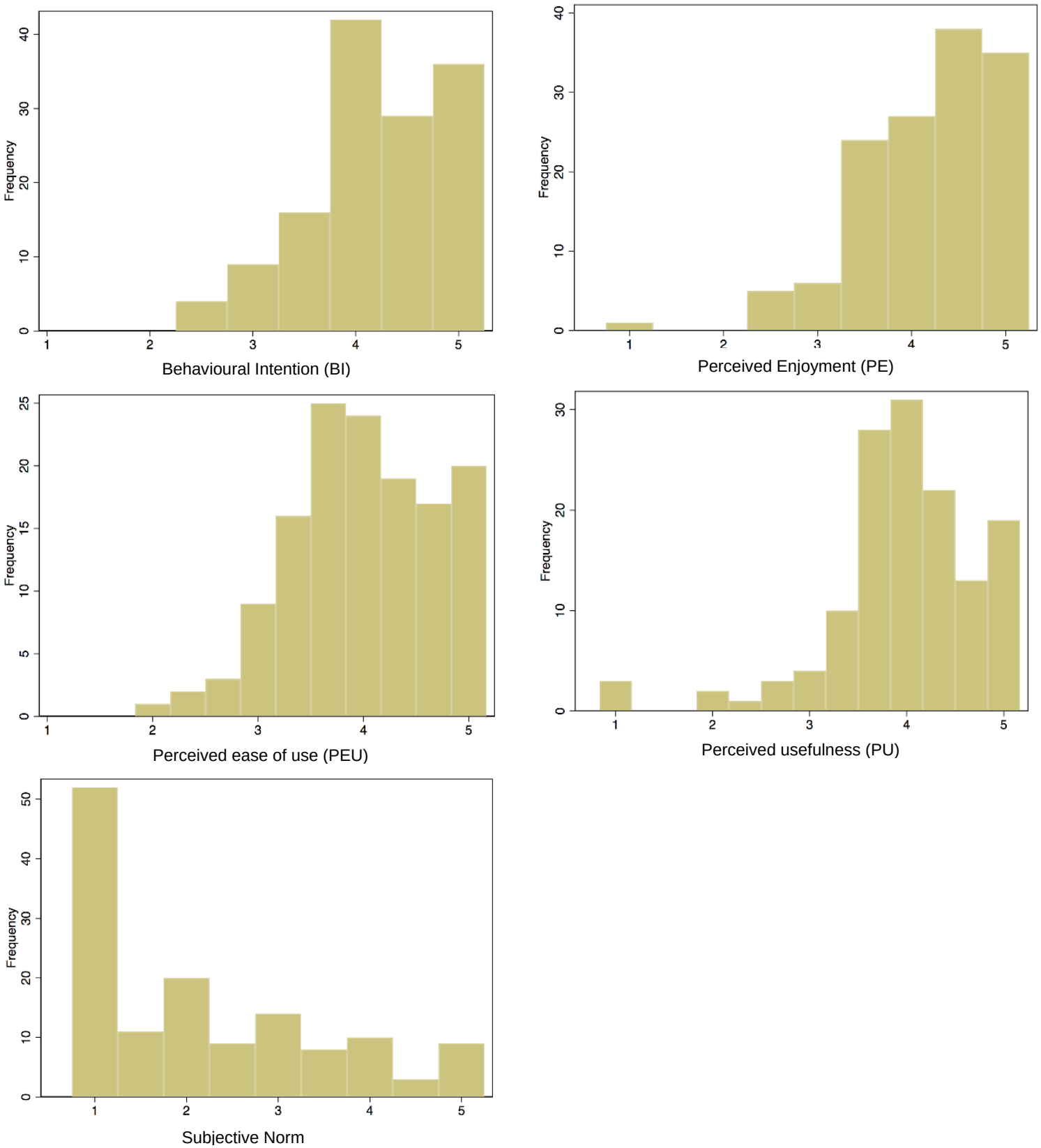


Figure 11. 5 histograms representing the distribution of average ratings from 1-5 across participant responses for each TAM component for Nike+

In Figure 11, the histograms for PU, PEU, PE and BI show that most participants gave ratings closer to agree for the statements representing each individual TAM component. The histogram for subjective norm shows that most participants gave ratings closer to disagree for statements representing the subjective norm TAM component.

Table 9. Nike+ descriptive statistics

variable	N	min	p25	mean	p50	p75	max	sd	iqr
BI	136	2.5	4	4.202206	4	5	5	.6649385	1
PU	136	1	3.666667	3.973039	4	4.333333	5	.778365	.6666667
PE	136	1	3.5	4.1875	4.5	5	5	.7301382	1.5
PEU	136	2	3.666667	4.002451	4	4.666667	5	.685531	1
SubjNorm	136	1	1	2.202206	2	3	5	1.285789	2

From Table 9, BI has a mean of 4.20, standard deviation of 0.67 and a median of 5 (75th percentile). PU has a mean of 3.97, standard deviation of 0.78 and median of 4.33. PE has a mean of 4.19, standard deviation of 0.73 and median of 5. PEU has a mean of 4, standard deviation of 0.69 and median of 4.67. Subjective norm has a mean of 2.20, standard deviation of 1.29 and median of 3.

For the Nike+ cohort, the means of 4.20, 3.97, 4.19 and 4 for BI, PU, PE and PEU respectively show that, on average, participants selected ratings closer to agreeing as opposed to disagreeing with the statements representing these 4 TAM components. For subjective norm, on average, participants selected a value of 2.20, which lies closer to disagreement with the statements representing subjective norm.

Figure 12 contains 4 weighted marker scatterplots plotting data gathered from the Nike+ cohort. The frequency of average ratings for PU, PE, PEU and subjective norm was used to weight the markers. Each weighted marker scatterplot shows the relationship between an individual TAM component and BI.

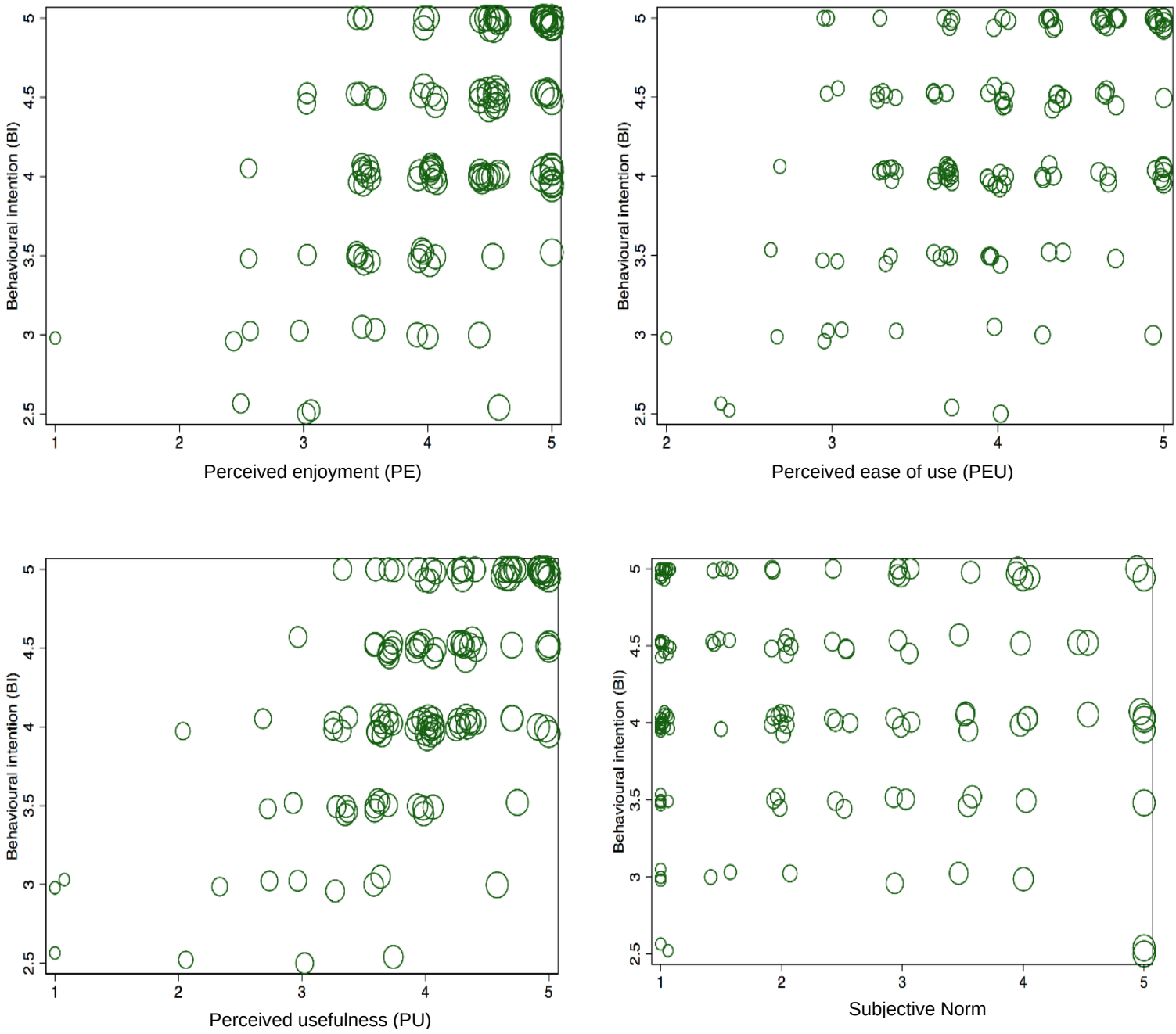


Figure 12. 4 weighted marker scatterplots representing the relationship between the individual TAM components and BI for Nike+

The relationships shown in the scatterplots are expanded on with correlation coefficients, which are presented next. Table 10 and Table 11 represent the Pearson and Spearman correlation coefficients for the Nike+ cohort.

Table 10. Pearson correlation coefficients calculated for the measured TAM components in the Nike+ cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.6284	1.0000			
PE	0.5354	0.6020	1.0000		
PEU	0.4539	0.5693	0.5540	1.0000	
SubjNorm	-0.0958	0.0376	0.0935	0.0008	1.0000

Table 11. Spearman correlation coefficients calculated for the measured TAM components in the Nike+ cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.5860	1.0000			
PE	0.4956	0.5502	1.0000		
PEU	0.4098	0.4865	0.5220	1.0000	
SubjNorm	-0.0841	-0.0036	0.1222	-0.0126	1.0000

The 4 scatterplots in Figure 12, along with the correlation coefficients, will be discussed here. The scatterplot plotting PU against BI shows a positive relationship between PU and BI. The Pearson correlation coefficient for this relationship is 0.63 and the Spearman correlation coefficient is 0.59, which both show that these 2 components have a positive relationship. The scatterplot plotting PE against BI shows a positive relationship between PE and BI. The Pearson correlation coefficient for this relationship is 0.54 and the Spearman correlation coefficient is 0.50, which both show that these 2 components have a positive relationship. The scatterplot plotting PEU against BI shows a positive relationship between PEU and BI. The Pearson correlation coefficient for this relationship is 0.45 and the Spearman correlation coefficient is 0.41, which both show that these 2 components have a positive relationship. The scatterplot plotting subjective norm against BI shows a negative relationship between subjective norm and BI. The Pearson correlation coefficient for this relationship for is -0.096 and

the Spearman correlation coefficient is -0.084, which both show that these 2 components have a negative relationship.

The mentioned positive relationships the scatterplots as well as the correlation coefficients and means show that when PU, PEU and PE are present in a fitness mobile app containing gamification, the participant indicates intending to use the fitness mobile app in future. However, it also shows that participants indicating PU, PE and PEU not being present, tended to indicate disagreeing with the intention to use the fitness mobile app in future. This is represented in the scatterplots as a linear relationship existing between BI and the components PU, PEU and PE, which shows when these aspects are present so is the intention to use the fitness mobile app. The means reinforce this as more participants reported finding the gamification makes the app enjoyable, easier to use and more useful and intended to use the app compared the reverse scenario of participants not finding the app enjoyable and not intending to use the fitness mobile app. In the case of Subjective norm, a negative relationship was found. The relevance of this is that participants indicating the presence of Subjective norm would also tend to give responses indicating disagreeing with intending to use the fitness mobile app in future. Furthermore, participants indicating Subjective norm not being present tended to indicate an intention to use the fitness mobile app in future.

Table 12. Multiple regression analysis for the Nike+ cohort

Source	SS	df	MS	Number of obs	=	136
				F(4, 131)	=	27.33
Model	27.1546033	4	6.78865082	Prob > F	=	0.0000
Residual	32.5347349	131	.248356755	R-squared	=	0.4549
				Adj R-squared	=	0.4383
Total	59.6893382	135	.442143246	Root MSE	=	.49835

BI	Coef.	Std. Err.	t	P>|t|	Beta
PU	.3868331	.0738091	5.24	0.000	.4528198
PE	.2191417	.0781153	2.81	0.006	.2406294
PEU	.0610274	.0805115	0.76	0.450	.0629173
SubjNorm	-.070009	.0335682	-2.09	0.039	-.1353762
_cons	1.657562	.2940932	5.64	0.000	.

Table 12 gives an overall analysis of the TAM model using multiple regression analysis. Overall, the model is significant ($f(4,131) = 27.33$, $p<001$). The R-squared value of 0.46 shows that PU, PE, PEU and subjective norm explain 46% of the variance in BI. PU, PE and subjective norm were found to be significant ($p<0.05$). PEU was found to be insignificant as it had a p-value of 0.45. The standard correlation coefficients (beta) show that, when controlling for the other variables in the model, PU explains the most variance in BI, with a standard correlation coefficient of 0.45. The standard correlation coefficient for PE is 0.24 and for subjective norm it is -0.14.

Strava cohort:

Participants in the Strava cohort were asked to select ratings from 1 to 5 for a series of statements representing each TAM component, as previously discussed in section 3.4. The histograms in Figure 13 represent the averaged rating for each TAM component against the number of participants with the same averaged rating. The rating scale ranges from 1, for disagree, up to 5, for agree. Ratings closer to 5 indicate the presence of the TAM component based on the user's perspective.

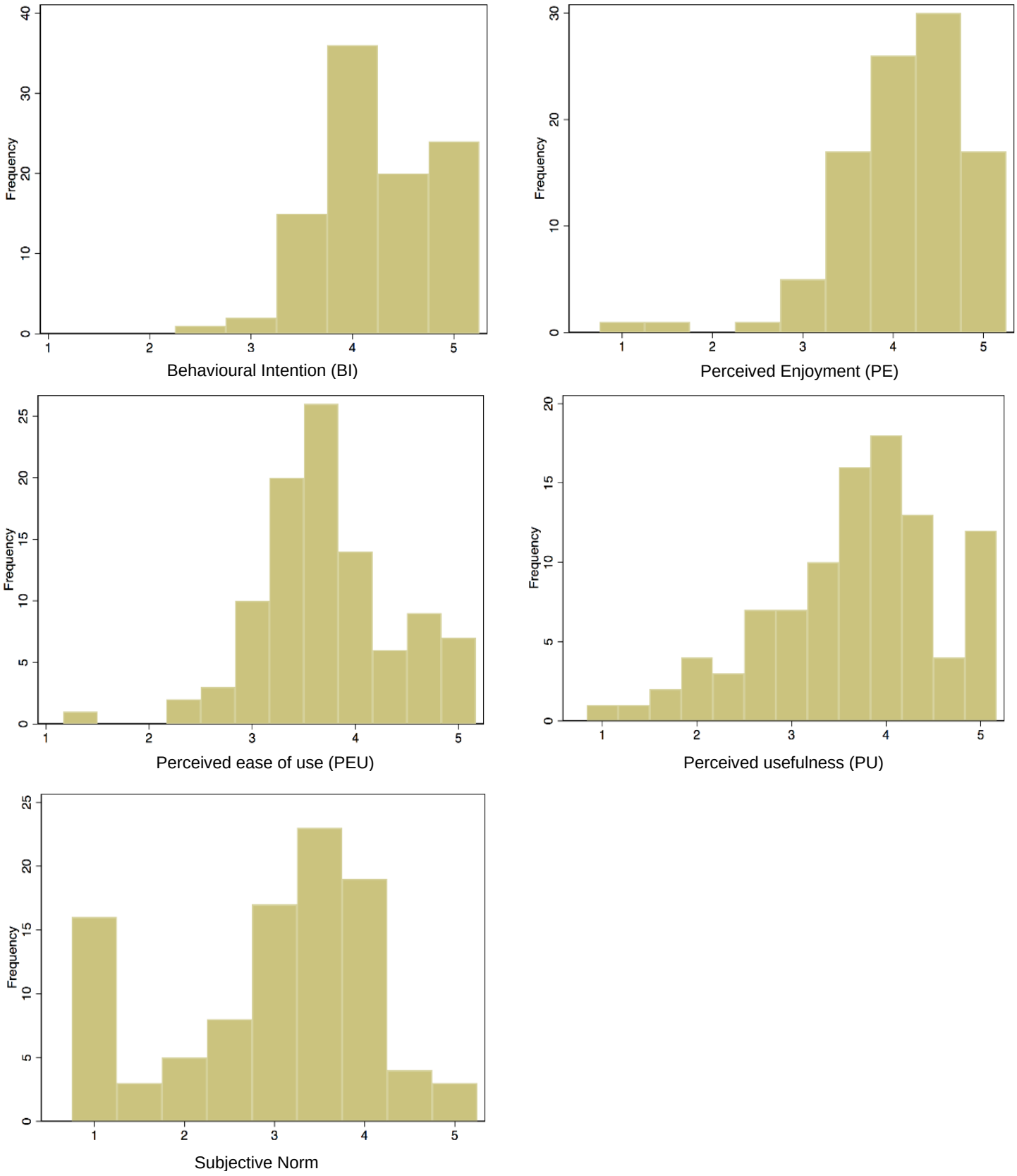


Figure 13. 5 histograms representing the distribution of average ratings from 1-5 across participant responses for each TAM component for Strava

In Figure 13, the histograms for PU, PEU, PE, subjective norm and BI show that most participants gave ratings closer to agree for the statements representing each individual TAM component.

The table below contains the descriptive statistics for the Strava cohort.

Table 13. Strava descriptive statistics

variable	N	min	p25	mean	p50	p75	max	sd	iqr
BI	98	2.5	4	4.234694	4	4.5	5	.5707839	.5
PU	98	1	3	3.666667	3.666667	4.333333	5	.9156899	1.333333
PE	98	1	3.5	4.117347	4	4.5	5	.7172435	1
PEU	98	1.333333	3.333333	3.72449	3.666667	4	5	.6735478	.6666667
SubjNorm	98	1	2.5	2.969388	3.25	4	5	1.12794	1.5

From Table 13, BI has a mean of 4.24, standard deviation of 0.57 and a median of 4.5(p75-75th percentile). PU has a mean of 3.67, standard deviation of 0.92 and median of 4.33. PE has a mean of 4.12, standard deviation of 0.72 and median of 4.5. PEU has a mean of 3.72, standard deviation of 0.67 and median of 4. Subjective norm has a mean of 2.97, standard deviation of 1.13 and median of 4.

For the Strava cohort, the means of 4.24, 3.67, 4.12 and 3.73 for BI, PU, PE and PEU respectively show that, on average, participants selected ratings closer to agreeing as opposed to disagreeing with the statements representing these 4 TAM components. For subjective norm, on average, participants selected an average rating of 2.97, which indicates the participants feel more neutral about the statements representing subjective norm. However, the median is 4, showing that although on average, participants were more neutral to the statements, the most common rating of 4 is closer to agreement for the statements representing subjective norm.

Figure 14 contains 4 weighted marker scatterplots plotting data gathered from the Strava cohort. The frequency of average ratings for PU, PE, PEU and subjective norm was used to weight the markers. Each weighted marker scatterplot shows the relationship between an individual TAM component and BI.

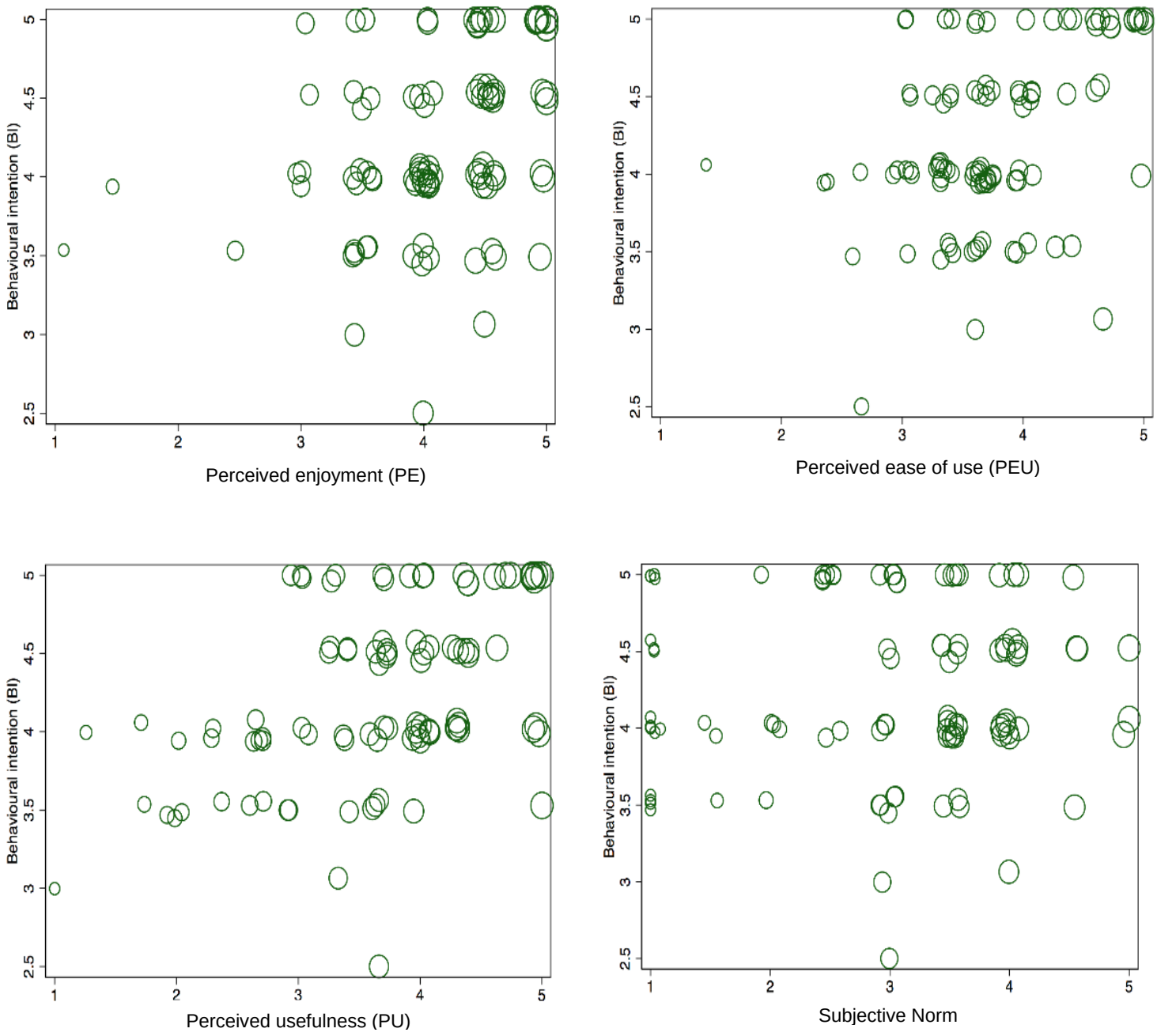


Figure 14. 4 weighted marker scatterplots representing the relationship between the individual TAM components and BI for Strava

The relationships shown in the scatterplots are expanded on with correlation coefficients, which are presented next. Table 14 and Table 15 represent the Pearson and Spearman correlation coefficients for the Strava cohort.

Table 14. Pearson correlation coefficients calculated for the measured TAM components in the Strava cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.4800	1.0000			
PE	0.3790	0.4657	1.0000		
PEU	0.3889	0.3454	0.1387	1.0000	
SubjNorm	0.0353	-0.1530	0.0332	-0.0678	1.0000

Table 15. Spearman correlation coefficients calculated for the measured TAM components in the Strava cohort

	BI	PU	PE	PEU	SubjNorm
BI	1.0000				
PU	0.4675	1.0000			
PE	0.4282	0.4818	1.0000		
PEU	0.3566	0.2462	0.1837	1.0000	
SubjNorm	0.0469	-0.0950	0.0381	-0.0408	1.0000

The 4 scatterplots in Figure 14, along with the correlation coefficients, will be discussed here. The scatterplot plotting PU against BI shows a positive relationship between PU and BI. The Pearson correlation coefficient for this relationship is 0.48 and the Spearman correlation coefficient is 0.47, which both show that these 2 components have a positive relationship. The scatterplot plotting PE against BI shows a positive relationship between PE and BI. The Pearson correlation coefficient for this relationship is 0.38 and the Spearman correlation coefficient is 0.43, which both show that these 2 components have a positive relationship. The scatterplot plotting PEU against BI shows a positive relationship between PEU and BI. The Pearson correlation coefficient for this relationship is 0.39 and the Spearman correlation coefficient is 0.36, which both show that these 2 components have a positive relationship. The scatterplot plotting subjective norm against BI shows a positive relationship between subjective norm and BI. The Pearson correlation coefficient for this relationship is 0.04 and the Spearman correlation coefficient is 0.05, which both show that these 2 components have a weak positive relationship.

The mentioned positive relationships the scatterplots as well as the correlation coefficients and means show that when PU, PEU, PE and Subjective norm are present in a fitness mobile app containing gamification, the participant indicates intending to use the fitness mobile app in future. However, it also shows that participants indicating PU, PE and PEU not being present, tended to indicate disagreeing with the intention to use the fitness mobile app in future. This is represented in the scatterplots as a linear relationship existing between BI and the components PU, PEU and PE, which shows when these aspects are present so is the intention to use the fitness mobile app. The means reinforce this as more participants reported finding the gamification makes the app enjoyable, easier to use and more useful and intended to use the fitness mobile app compared the reverse scenario of participants not finding the app enjoyable and not intending to use the fitness mobile app.

Table 16. Multiple regression analysis for the Strava cohort

Source	SS	df	MS	Number of obs	=	98
				F(4, 93)	=	11.38
Model	10.3870606	4	2.59676516	Prob > F	=	0.0000
Residual	21.2149802	93	.228118066	R-squared	=	0.3287
				Adj R-squared	=	0.2998
Total	31.6020408	97	.325794235	Root MSE	=	.47762

BI	Coef.	Std. Err.	t	P>|t|	Beta
PU	.196162	.0641876	3.06	0.003	.3146962
PE	.1538155	.0769766	2.00	0.049	.1932836
PEU	.2201646	.0767557	2.87	0.005	.259803
SubjNorm	.0478979	.0438238	1.09	0.277	.0946522
_cons	1.919893	.3905345	4.92	0.000	.

For overall analysis of the TAM model, multiple regression analysis was used. Overall, the model is significant (f(4,93) = 11.38, p<001). The R-squared value of 0.33 shows that PU, PE, PEU and subjective norm explain 33% of the variance in BI. PU, PE and PEU were found to be significant (p<0.05). Subjective norm was found to be insignificant as it had a p-value of 0.28. The standard correlation coefficients (beta) show that, when controlling for the other variables in the model, PU explains the most

variance in BI, with a standard correlation coefficient of 0.32. The standard correlation coefficient for PE is 0.19 and for PEU it is 0.26.

A summary table of the correlations between BI and the TAM components PU, PE, PEU, and subjective norm for the 3 cohorts is presented in Table 17.

Table 17. Summary of TAM correlations for 3 cohorts

	MyFitnessPal		**Nike+**		**Strava**	
	Pearson correlation	Spearman correlation	Pearson correlation	Spearman correlation	Pearson correlation	Spearman correlation
PU-BI	0.578	0.545	0.628	0.586	0.480	0.468
PE-BI	0.545	0.550	0.535	0.496	0.379	0.428
PEU-BI	0.386	0.405	*0.454*	*0.410*	0.389	0.357
Subj norm-BI	0.052	0.077	-0.096	-0.084	*0.035*	*0.047*

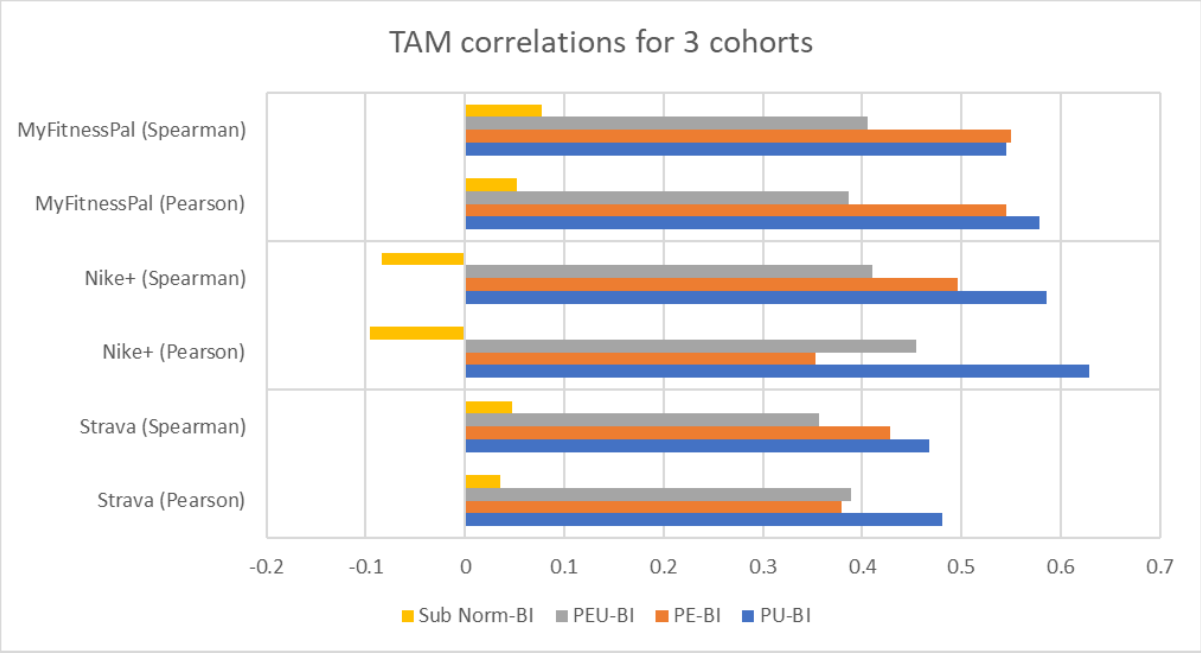


Figure 15. Spearman and Pearson correlations between BI and PU, PEU, PE and subjective norm.

As previously mentioned PEU in the Nike+ cohort and subjective norm in the Strava cohort were found to be insignificant in the multiple regression analysis. Consequently, the correlation coefficients for these two components are italicised.

4.4.1. Comparison discussion

The TAM results show that Strava and MyFitnessPal have the same pattern. However, Nike+ multiple regression analysis results differed in that greater variability in PEU ratings was observed. PEU had a positive relationship in all 3 cohorts, but in the Nike+ cohort it was found to be insignificant. This may be attributed to PU having less variability in ratings selected, hence being a stronger predictor of BI compared to PEU, where the variability of selected ratings is greater. For all 3 cohorts, subjective norm showed a weak relationship to BI, thereby not contributing much to the adoption model, namely TAM.

In the Strava cohort, the mean rating for subjective norm was 2.969 while the median was 4. This may be the result of the selected ratings being spread out across the rating scale (degree of variability in rating choices). This may imply that participants gave mixed rating responses to the statements representing subjective norm. In the histograms representing ratings, most MyFitnessPal and Nike+ cohort participants selected ratings closer to disagree for statements representing the component subjective norm. In the MyFitnessPal and Strava cohort, although subjective norm was seen to have a weak positive relationship with BI, it is insignificant in terms of explaining variance in BI when controlling for other variables and thus may not play much of a role in adopting MyFitnessPal and Strava. Interestingly, this differs from the Nike+ cohort, where a weak negative relationship exists, and subjective norm was significant when it comes to explaining unique variance in BI. The Nike+ cohort also differed from the other 2 cohorts as PEU was found to be insignificant when it comes to explaining unique variance in BI. This may be attributed to the variability in ratings selected by participants.

In descending order, the TAM components PU, PE, PEU and subjective norm together explain 44%, 46% and 33% of the variance in BI in the Nike+, MyFitnessPal and Strava cohorts, respectively. Some of the variance in BI to adopt a fitness mobile app containing gamification can be attributed to PU, PE, PEU and subjective norm. PU was observed to explain the most variance in BI in the MyFitnessPal, Nike+ and Strava cohort.

4.5. Qualitative data

Discourse analysis was used to gather insights to answer the research question ‘How does gamification improve adoption of fitness apps on mobile devices in South Africa?’. The themes that emerged from the survey responses for the MyFitnessPal, Nike+ and Strava cohort will be presented as part of the discourse analysis under the following headings: gamification motivates fitness mobile app usage; gamification influence on the opinion of using a fitness mobile app; most useful gamification element; and most enjoyed gamification element.

4.5.1. Gamification motivates fitness mobile app usage

Participant survey responses have been divided into two categories: 1. motivated by gamification; and 2. not motivated by gamification.

4.5.1.1. Motivated by gamification

143 (87%) participants in the MyFitnessPal cohort indicated that the gamification motivated the participants to use MyFitnessPal. 124 (91%) participants in the Nike+ cohort indicated that the gamification motivated the participants to use Nike+. 88 (90%) participants in the Strava cohort indicated that the gamification motivated participants to use Strava.

Using open coding, participants’ reasons given for gamification motivating the use of the fitness mobile app were categorised into the themes seen in Table 18. The number of responses under each theme are grouped by each cohort they originated from, namely the MyFitnessPal, Nike+ and Strava cohorts.

Table 18. The number of responses falling into the identified common themes for the survey question pertaining to how gamification motivated the use of the fitness mobile app

Theme	**MyFitnessPal**	**Nike+**	**Strava**
Progress tracking	45	22	13
Achievement/encourage improvement	24	45	24
PEU	19	11	2
PE	18	28	8
Award/incentive	16	15	11
Competitive aspect	10	12	25
Goal setting assistance	7	11	6
Interactivity	6	3	0
Feedback	6	3	0
Visual appeal	4	0	3
Richer experience/more attractive	2	3	1
Attainable	2	1	2
Interesting	1	5	2
Social aspect (social recognition/community)	0	3	5

The identified themes from the discourse analysis shown in Table 18 are described in Table 19.

Table 19. Descriptions for themes identified in the discourse analysis

Theme	**Description**
Progress tracking	Gamification being used to measure a person's progression (e.g. number steps in a day).
Achievement/encourage improvement	The person being motivated to perform better with the gamification and achieve (e.g. beating a previous cycle time).
PEU	Gamification making the tracking of one's progress with the app easier to do and requiring less effort.
PE	Gamification making the fitness mobile app enjoyable.
Award/incentive	Being awarded rewards, trophies, incentives.
Competitive aspect	Gamification allowing the user to compete with and compare their performance to others. This is illustrated with users desiring to beat other users rankings on a leaderboard.
Goal setting assistance	Aiding the setting of targets to reach.
Interactivity	The fitness mobile app gamification being interactive.
Feedback	The person being given notifications encouraging the use of the app.
Visual appeal	Being visually able to see one's effort and progress in the app (e.g. see steps increase position visually on progress bar).
Richer experience/more attractive	Gamification improving the experience of the app and giving the app more appeal/attractiveness.
Attainable	Targets being made easy to achieve.
Interesting	Gamification making the app interesting
Social aspect	A sense of belonging from friends and the community using the app.

Examples of participant responses categorised into some of the themes in Table 18 that stood out will be expanded on next.

4.5.1.1.1. PEU

Examples of participant responses are “less effort to track exercise and progress”, ‘it made tracking and growing my progress much easier”’, “gamification simplifies and presents the data in a motivating way” and “easy to track progress”.

4.5.1.1.2. PE

Examples of participant responses are “it makes it fun”, “it makes the app more fun” and “was fun to track my own progress and see what others were up to”.

4.5.1.1.3. Award/incentive

Examples of participant responses are “made me want to achieve my goals because of the rewards I would get on the app”, “it provides incentive”, “the reward basis motivates you more”, “The progression and rewards system helps motivate me because it allows me to feel rewarded if I accomplish my goals”, “particularly enjoyed the personal best trophies /awards” and “receiving awards for reaching goals makes me feel good”.

4.5.1.1.4. Goal setting assistance

Examples of participant responses are “helped set my targets for me”, “it set goals I had to reach but without pressure” and “sets you goals so you can strive to achieve the next level”.

4.5.1.1.5. Achievement/encourage improvement

Examples of participant responses are “makes me want to improve”, “you are encouraged to ‘better’ your score”, “challenges us to beat previous records”, “feel like I had to complete a level and get to the next”, “motivation to beat personal records” and “excited to see your results after you've run and what you've achieved based on your previous attempts and against others”.

4.5.1.1.6. Progress tracking

Examples of participant responses are “It was nice to be able to see proof of progress and effort”, “it helps to measure my progress”, “knowing how well I’m doing motivates me”, “It helps me keep track of my progress”, “My motivation is not necessarily for the badges directly but more for the benefit of tracking my progress” and “It allows me to track my progress”.

4.5.1.1.7. Competitive aspect

Examples of participant responses are “allowed for comparison with others”, “the leaderboard in particular added a sense of competitiveness with friends to the app, which motivated a greater use of the app”, “competition between friends was fun” and “it just allowed me to compete with my friends”.

4.5.1.1.8. Social aspect

Examples of participant responses are “feel more like you are a part of a community” and “positive affirmation of achievement from friends”. No participants gave comments tagged under this theme in the MyFitnessPal cohort.

4.5.1.2. Not motivated by gamification

22 participants in the MyFitnessPal cohort indicated that the gamification in the app did not motivate the use of the app. Examples of participant responses included “difficult to use”; “not value achievement stats”; “not much gamification”; and “used app for calorie counting only”. 12 participants in the Nike+ cohort indicated that the gamification did not motivate the use of the fitness mobile app. Examples of participant responses included “gamification isn’t tangible”, “I didn't understand how it worked so it was meaningless for me” and “doesn't affect my usage of it”. One participant felt demotivated by the gamification, saying “it demotivated me if anything when I was slacking in my goals’’. 10 participants in the Strava cohort indicated that the gamification did not motivate users to use the Strava fitness mobile app. Examples of participant responses included “I like to see how my exercise has compared to previous sessions on the same route, but that isn't the motivation to exercise.”, “I use it mostly to record runs/races that I do and not to achieve badges etc”, “I sometimes look at the achievements but it doesn’t make much difference. I just run until I no longer have any time” and “it became too much about the game rather than the love for the sport”.

4.5.1.3. Comparison discussion

A discussion of the data and themes will follow. Most of the participants viewed the gamification as motivating the use of the fitness mobile app across all three cohorts (87%, 91% and 90% responses for the MyFitnessPal, Nike+ and Strava cohorts respectively).

Interestingly, more participants in the Nike+ cohort, compared to the other 2 cohorts, mentioned perceived enjoyment as the reason for motivating the use of the fitness mobile app (11% (MyFitnessPal), 21% (Nike+), 8% (Strava)). Progress tracking and achievement/encourage improvement were prominent themes across all the three cohorts, which both fall into intrinsic motivation. Awards or incentives like badges also came up as a theme but to a lesser degree of popularity.

With the competitive aspect theme, participant comments about having friends to compare and compete with was mentioned. The Strava cohort had more participant responses falling under the competitive aspect theme compared to the other 2 cohorts. The community and friend network utilizing Strava aids this creation of competition through gamification.

The social aspect theme was seen in responses in the Nike+ (2.2%) and Strava (5.1%) cohorts and not in the MyFitnessPal (0%) cohort. Thus, MyFitnessPal could be argued to be more focused on the individual and their progress as opposed to the community environment. However, the number of responses is very small in each cohort and there may not actually be any difference across the three cohorts.

The attainable theme shows that, when designing gamification in fitness mobile apps, the gamification elements should be easy enough for the user to progress and achieve e.g. realistic goals for getting some badges or not too hard challenges to move up levels and challenges that don't take too long. Furthermore, some participant responses touched on the notion that a variety of users of different fitness levels use a fitness mobile app. Competing on the leaderboard against others who are of different fitness levels was an interesting point mentioned in some participant comments.

The themes for the 3 cohorts in Table 18 are represented as a bar chart in Figure 16.

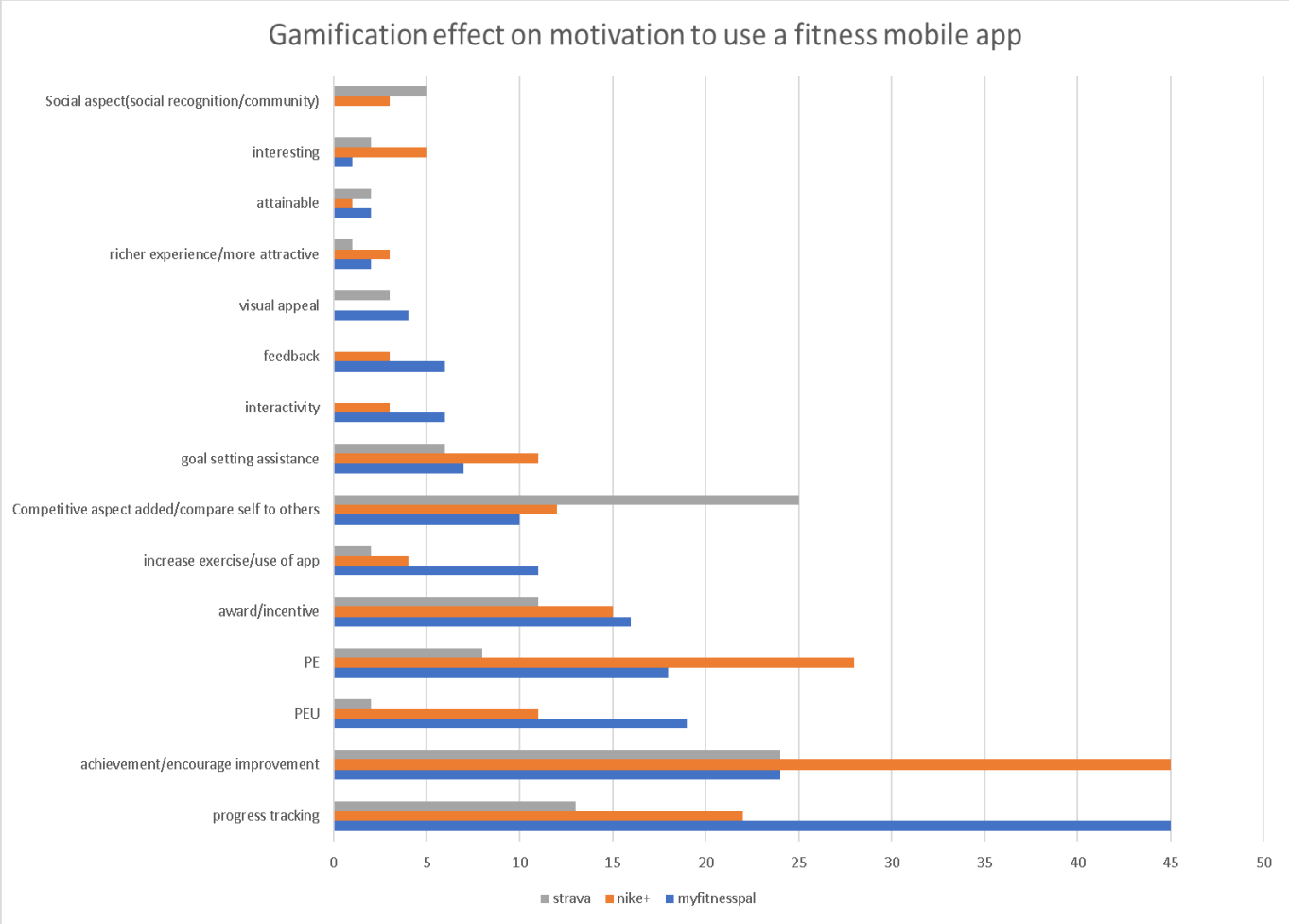


Figure 16. Common themes for the MyFitnessPal, Nike+ and Strava cohorts that emerged when participants were asked how gamification motivates the use of a fitness mobile app

As mentioned previously, the participants' responses when asked how gamification motivated the use of the fitness mobile app were categorised into common themes. A discussion on these common themes presented in Figure 16 will follow.

In the Nike+ cohort, the dominating themes identified fall into the category of intrinsic motivation. This is because most common reasons given by participants fall into the common themes achievement\encourage improvement, PE and progress tracking, which are all internal elements for an individual.

In the MyFitnessPal cohort, intrinsic motivation also had a prominent role. This is attributed to the most common reasons given by participants falling into the common themes progress tracking and achievement\encourage improvement. Progress tracking and achievement/encourage improvement are both internal elements for an individual. PEU and PE both follow behind in terms of being dominating themes. PEU

and PE only differ by one participant response. According to literature, PEU and PE are part of the TAM adoption model (Rese, Baier, Geyer-Schulz, & Schreiber, 2017).

For the Strava cohort in Figure 16, the most prominent reason given by participants regarding gamification motivating the use of the fitness mobile app falls into the common themes competitive aspect/compare self to others, achievement/encourage improvement, progress tracking, award/incentive, PE and goal setting assistance.

In the Strava cohort the competitive aspect/comparison to others theme was one of the most prominent themes. This differs from the MyFitnessPal and Nike+ app cohorts where intrinsic motivation was more prominent with the themes that dominated. This may be due to the Strava community that exists. For the Strava cohort, the achievement/encourage improvement and progress tracking themes followed behind the competitive aspect/comparison to others theme and are also in the top three most prominent themes in the MyFitnessPal and Nike+ cohorts.

Achievement is cited by literature to be fostered by gamification (Neyman, 2017). Furthermore, according to Chou (2015), a core drive operating in gamification is development and accomplishment. The mentioned achievement/encourage improvement theme found in this study forms part of this drive. The description of the core drive development and accomplishment is as follows: an internal drive to achieve mastery(achievement), make progress (encourage improvement) and succeed at challenges (Chou, 2015). The competitive aspect/comparison to others theme that emerged in the study forms part of the social influence and relatedness core drive in literature as it entails social acceptance, competition and social feedback.

Progress tracking and goal setting assistance themes that emerged in the study relate to literature where it is mentioned that some fitness applications utilize gamification for goal setting and tracking assistance (Garett & Young, 2018). The useful (PU) and enjoyment (PE) themes that emerged from survey responses mirror research that communicates that gamification offers this fun and usefulness aspect (Bildl, 2014).

4.5.2. Gamification influence opinion of using fitness mobile app

Figure 17 represents the findings from the survey related to the participants' perspective on the influence gamification has on one's opinion to use a fitness mobile app.

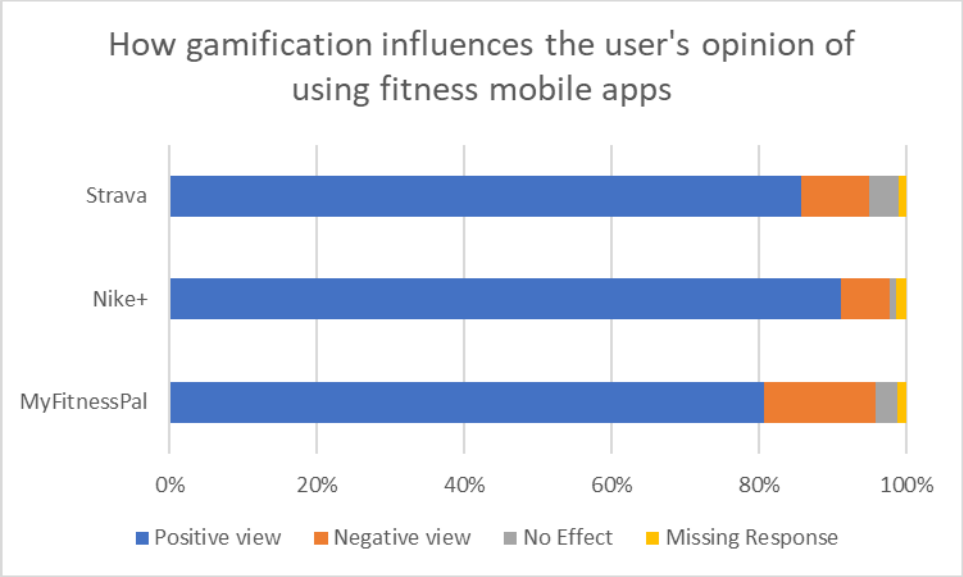


Figure 17. Participant responses when asked how gamification influences the participant's opinion of using fitness mobile apps, categorised by positive, no effect and negative view theme categories

In Figure 17, the MyFitnessPal, Nike+ and Strava cohorts mostly had responses categorised into the theme of having a positive view of the fitness mobile app. This theme aligns with most of the participants in the 3 cohorts viewing gamification as improving the user's opinion of using a fitness mobile app.

The number of participant responses that fall into the theme gamification had no effect or created a negative view of fitness mobile apps was substantially less than the number of participant responses for gamification creating a positive view of the fitness mobile app.

4.5.3. Most useful gamification element

Participants were asked to select the most useful gamification element from the following options: leaderboard, badges, progress bar, levels and points. The results are plotted in Figure 18.

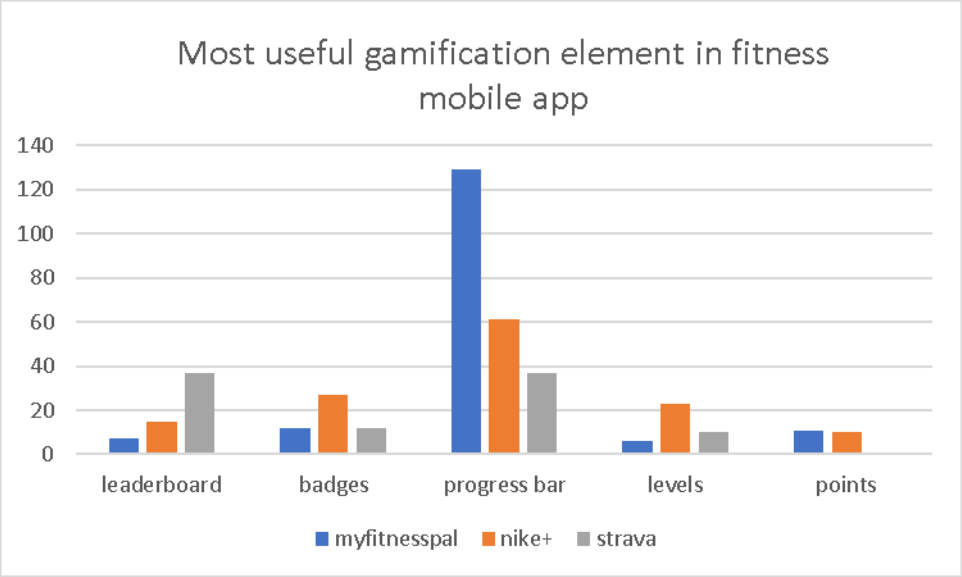


Figure 18. Most useful app gamification element across MyFitnessPal, Nike+ and Strava cohorts

Perceived usefulness (PU) is a component of the adoption measuring model (TAM). Therefore, there is relevance in analysing the participant responses regarding the most useful gamification element in the fitness mobile app. In Figure 18 the progress bar dominated as the most useful gamification element in the MyFitnessPal, Nike+ and Strava cohorts. In the Strava cohort, the leaderboard and progress bar were selected by the same number of participants as the most useful gamification element. The Strava cohort does not have a points column in Figure 18 as it does not use points.

The progress bar dominating as the most useful gamification element in this study replicates the observations in another study on game elements where progress bars were said to appear as one of the most useful (useful in terms of making it more fun to use a system) (Cheong, Filippou, & Cheong, 2013).

The Strava cohort had similar results to the other cohorts as the progress bar was also the most popular. However, the cohort differed in that the leaderboard was also the most popular choice as the most useful gamification element.

The dominating progress bar across the 3 cohorts could indicate that it means a lot more in fitness to beat your goal than compete with friends. There is an inherent motivation to reach your own goals, which maps better to the progress bar than the leaderboard.

4.5.4. Most enjoyed gamification element

Participants were asked to select the most enjoyed gamification element from the following options: leaderboard, badges, progress bar, levels and points. The results are plotted in Figure 19.

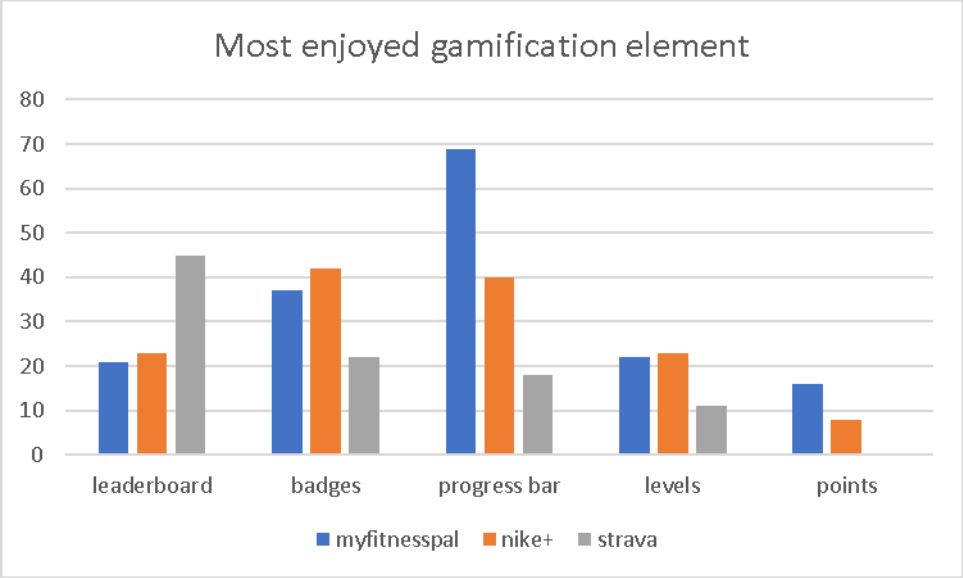


Figure 19. Most enjoyed app gamification element in MyFitnessPal, Nike+ and Strava cohort

Perceived enjoyment (PE) is a component of the adoption measuring model (TAM). Therefore, there is relevance in analysing the participant responses regarding the most enjoyed gamification element in the fitness mobile app. In Figure 19, the progress bar dominated as the most enjoyed gamification element in the MyFitnessPal cohort. The badges, closely followed by the progress bar, dominated as the most enjoyed gamification element in the Nike+ cohort. The leaderboard dominated as the most enjoyed gamification element in the Strava cohort. In Figure 19, Strava does not have a points column as it does not use points.

Most participants selecting the leaderboard as the most enjoyed gamification element in the Strava cohort could be related back to the findings that Strava had a dominating theme of ‘competitive aspect’ for reasons that the gamification motivated the use of the fitness mobile app. The leaderboard offers this competition whereby users can compare themselves to others and compete for higher rankings (Hung, 2017).

The survey results from the most enjoyed gamification element selection shows a similar pattern to the results from the most useful gamification element selection. Furthermore, levels were not as popular a choice as badges in terms of being the most enjoyed.

4.6. Results and discussion chapter summary

The quantitative data measuring TAM and statistical analysis as well as the qualitative data collection and discourse analysis were presented in this chapter. As part of the discourse analysis, the following topics were expanded on: motivation to adopt, the influence of gamification on the opinion of fitness mobile apps and the most useful and most enjoyed gamification elements. Findings showed that PU, PE, PEU and, to a much lesser degree, subjective norm is perceived by participants to be offered by gamification in the fitness mobile app. Furthermore, most participants had average ratings closer to agree for statements representing the behavioural intention to adopt a fitness mobile app. This was reinforced by the discourse analysis, where most participants indicated that the gamification motivated the use of the fitness mobile app. Popular themes as to why the gamification was thought to motivate adoption included progress tracking, achievement/encourage improvement, competitive aspect, PE and PEU. Additionally, most participants indicated that the gamification influenced the opinion of using fitness mobile apps by presenting a positive view of the fitness mobile app. The chapter also touched on the most useful gamification element according to participant responses, which was the progress bar. The chapter ended with the most enjoyed gamification element. The progress bar, badges and leaderboard were the most popular choices as the most enjoyed gamification element in the study.

5. Conclusion

The aim of this thesis was to investigate the effect of gamification on the adoption of fitness apps on mobile devices in South Africa. Adoption of fitness mobile apps was identified as a problem in chapter 0. Literature on the mechanisms underlying how gamification works was researched to understand what is currently known about gamification. A study was conducted to understand how gamification affects the adoption of fitness mobile apps and to determine if it improves adoption. The thesis focused on 2 research questions, the first question looking at the relationship between gamification and fitness mobile app adoption and the second question looking at the mechanisms behind gamification improving fitness mobile app adoption. To answer these 2 research questions, an online survey was sent to students at the University of Cape Town in South Africa. The selection criterion to participate in the survey was to have used the fitness mobile app MyFitnessPal, Nike+ or Strava in the past. Participants were divided into 3 cohorts, each cohort corresponding to having used MyFitnessPal, Nike+ or Strava in the past.

The TAM was used as a basis for measuring and determining the relationship between gamification and the adoption of a fitness mobile app. The first part of the survey measured the TAM components PU, PEU, BI to adopt as well as the added model extensions PE and subjective norm. The gathered data was statistically analysed, and the calculated correlations showed a positive relationship between the individual TAM components and BI to adopt a gamified fitness mobile app. This answers the first research question “does gamification improve the adoption of fitness apps on mobile devices in South Africa?” as the PU, PE and PEU related to gamification in the fitness mobile app were found to have a positive relationship to the BI to adopt a fitness mobile app. An unexplained finding was that PEU was found to be insignificant in the multiple regression analysis for the Nike+ cohort and forms part of the TAM used in this study to measure adoption.

Subjective norm was found to have a weak relationship with BI in each cohort. Although suggested as an extension of TAM, subjective norm was found in the study to not contribute much to the BI to adopt a fitness mobile app. It was an unexpected outcome that the relationship between subjective norm and the behavioural intention to adopt a fitness mobile app differed across the MyFitnessPal, Nike+ and Strava cohorts. Particularly noteworthy is the finding of negative Pearson and Spearman

correlation coefficients of -0.096 and -0.084, respectively, for the relationship between subjective norm and behavioural intention in the Nike+ cohort. This was an unexpected result as it contrasted to the observed positive relationship between these 2 variables in the MyFitnessPal and Strava cohort. Furthermore, subjective norm was found to not be statistically significant in terms of explaining unique variance in BI when controlling for other variables for MyFitnessPal and Strava cohorts but was significant in the Nike+ cohort. Another interesting finding is that PU explained the most variance in BI for the 3 cohorts in the study. The results from the TAM measurements showed that gamification to an extent explains behavioural intention to adopt a fitness mobile app.

It was interesting to observe from participant responses in the study that the progress bar dominated in all 3 cohorts in terms of being perceived as the most useful gamification element in a fitness mobile app compared to the leaderboard, badges, levels and points. Additionally, the leaderboard was observed to dominate in the Strava cohort as the most enjoyed gamification element. This differed to the Nike+ and MyFitnessPal cohort as the progress bar dominated in the MyFitnessPal cohort and the badges (closely followed by the progress bar) dominated in the Nike+ cohort.

The second research question was answered using the data gathered from the second part of the survey. Discourse analysis was performed on the data and yielded the following insights to the research question “how does gamification improve adoption of fitness apps on mobile devices in South Africa?”. This was answered by identifying the following dominant reasons users gave for gamification motivating the use or adoption of a fitness mobile app. Progress tracking and achievement/encourage improvement were popular reasons indicated by participants for motivating the use of the app (i.e. adoption). PEU, PE, award/incentive, competitive aspect and goal setting assistance were also common themes in the study. Intrinsic motivators were more frequently observed from participant responses compared to the number of responses mentioning extrinsic motivators as a reason for gamification motivating fitness mobile adoption in the study.

In reflection, common themes related to the mechanisms underlying how gamification motivates adoption emerged across all 3 cohorts, with intrinsic motivations dominating more than extrinsic motivations. Thus, gamification motivates adoption for similar reasons. However, some unique themes specific to the individual cohorts emerged, showing in the cohorts that other variables (e.g. app design, community using the app)

specific to a fitness mobile app affect how gamification affects the adoption of fitness mobile apps.

Overall, the insights from this study contribute to the current body of research on gamification and fitness mobile app adoption and provide user perspectives in a South African context.

6. Future research

Additional research using the TAM with other fitness mobile apps is suggested to further explore the gamification mechanisms at play. Personalisation, interaction and attainable themes related to gamification can be researched further to better understand their role in gamification design.

Research using other extensions of TAM besides subjective norm could be carried out by others when studying fitness mobile app adoption. Furthermore, this study focused on individuals who had used MyFitnessPal, Nike+ or Strava in the past. Studies observing participants using a fitness mobile app over a certain period and comparing short vs. long term studies could yield new insights.

Several participants in the pre-sampling data collection phase mentioned they had not used fitness mobile apps. Future research could investigate the reasons for never using fitness mobile apps. As fitness applications are sometimes incorporated into wearable devices, findings in this study relating to intrinsic and extrinsic motivators can be further researched in relation to these wearable devices for fitness purposes.

The social aspect of Strava and other fitness mobile apps could be looked at in depth to better understand how the community using the fitness mobile app affects the implementation of gamification and its effectiveness in improving adoption of the fitness mobile app. This study focused on the gamification elements: leaderboards, badges, progress bars, levels and points. Other gamification elements (e.g. challenges) could be focused on when doing future research.

This study offered insights from a South African context. Future research could investigate individuals from other African countries or other locations in South Africa and compare them with international studies on user adoption of gamified fitness mobile apps.

The findings in this thesis only mentioned the themes found in the participant responses; these themes should be explored further in future studies. Furthermore, this study focused only on fitness mobile apps. Therefore, similar studies could be conducted with other gamified applications to see how the user experience differs.

Other models for measuring adoption of technology, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) Model, could be investigated in future

studies to yield new insights into user adoption (Yuan et al., 2015). Future research could also entail looking into how to fit the results into a theoretical model to better understand, and even predict, user behaviour in the adoption of gamified fitness mobile apps.

7. Limitations

A limitation of the study was the use of an incentive as it encouraged people to complete the survey, as they may not have answered the survey properly as they may have only filled it out to stand a chance to win the prize. Another limitation may be the unequal number of males and females in each cohort, resulting in bias. This may however be because the apps in each cohort target a specific gender more than another gender. Missing or irrelevant responses to certain survey questions may have been another limitation in the study as the data presented may not represent the entire sample. Although most of the participants in the study were aged 18-28 years, some older outliers were present in the study. Another limitation is that comparisons were made across 3 apps that were designed differently hence generalisations across the 3 apps may be problematic as different external factors may not be accounted for when discussing the observed user responses in the study.

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Appendix A

Fitness Mobile App Adoption Survey

Welcome to the survey.

The focus of the survey is the adoption of fitness mobile apps (specifically Strava, Nike+ and myFitnessPal) which have incorporated gamification. Gamification means taking features in games that motivate you to play the game and using similar techniques in other applications. Examples of gamification include adding elements like points, leaderboards, progress bars/measurement and badges to a fitness app.

Please carefully look at the examples of gamification below found in fitness mobile apps before proceeding to the informed consent page and survey questions.

Your participation is greatly appreciated.

Fitness Mobile App Adoption Survey

* Required

Informed Voluntary Consent to Participate in Research Study

Project Title: Investigating the effect of gamification on the adoption of fitness apps on mobile devices in South Africa

Invitation to participate, and benefits:

You are invited to participate in a research study conducted with UCT students. The study aim is to develop insights into how gamification effects adoption of fitness mobile apps. I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures:

During this study, you will be asked to answer survey questions. The survey should take about 20 minutes to complete.

Risks:

There are no potentially harmful risks related to your participation in this study.

Disclaimer/Withdrawal:

Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the

information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

Confidentiality:

All information collected in this study will be kept private in that you will not be identified by name or by affiliation to an institution. Confidentiality and anonymity will be maintained as pseudonyms will be used.

What ticking the yes checkbox on this form means:

By ticking the yes checkbox in this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, to ask questions or request further information, at any time during this research.

I agree to participate in this research: *

- (●) yes
- ( ) no

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Demographics

Which gender do you identify with? *

- ( ) female
- ( ) male
- ( ) Other: _____

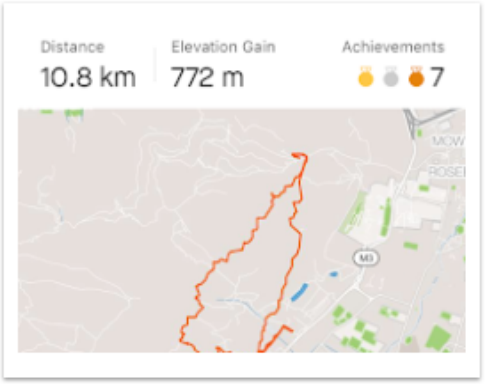
How old are you in years? *

Your answer

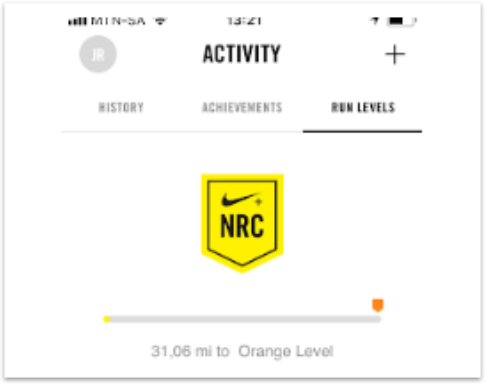
How many times a week did you use the fitness mobile app? *

- ◯ once a week
- ◯ twice a week
- ◯ three times a week
- ◯ four times a week
- ◯ five times a week
- ◯ six times a week
- ◯ seven times a week
- ◯ less than once a week

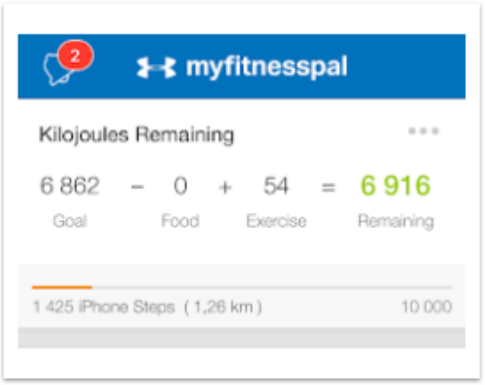
Which fitness mobile app have you used the most in the past? (all questions to follow must be answered based on the app selected here) *



○ Strava



○ Nike+



○ myFitnessPal

The following questions relate to the fitness mobile app (Strava, Nike+, myFitnessPal) selected in the previous question. The gamification in these three apps is the focus of the questions. Gamification elements that could be found in these three mobile apps include points (e.g. 50 points awarded for completing a 10km cycle), badges, levels (e.g. level 1 rookie, level 4 expert), leaderboards (e.g. rank users from high to low running times), progress bars/measurement (e.g. 30% of distance covered and 70% remaining to be completed) and challenges (e.g. run 99km in 30 days).

A series of statements are listed below. For each statement below please select a number in the range 1-5, 1 indicating you disagree and 5 indicating you agree with a statement.

1. Using the gamification (e.g. points, levels, badges, levels, progress bar/measurement, leaderboard) in the app motivates you to exercise. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

2. Using the gamification (e.g. points, levels, badges, levels, progress bar/measurement, leaderboard) in the app motivates you to have a healthier lifestyle. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

3. The gamification helps you reach your exercise goals (e.g. run greater distances, exercise more frequently). *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

4.The gamification make the app more fun. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

5.The use of the gamification in the app makes you feel happy/positive emotions. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

6.The gamification makes the fitness mobile app easier to become skilled in using. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

7. You need help in using the gamified fitness mobile app. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

8. The gamification makes the fitness mobile app easier to use (less effort to use\learn to use) *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

---

9. The gamification motivates you to use the app more often. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

10.You expect/intend to use the app in the future. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

11. You use the app because friends or influencer individuals think you should use it. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

12. You use the app because friends or influencer individuals use it. *

	1	2	3	4	5	
disagree	○	○	○	○	○	agree

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13. Did the gamification add value to the fitness mobile app and motivate you to use it more? Why? *

Your answer

14. Which gamification element (e.g. points, leaderboard) in the mobile app was the most useful? *

- ○ points
- ○ leaderboard
- ○ levels
- ○ progress bar
- ○ badges

15. Which gamification element (e.g. points, leaderboard) in the mobile app was the least useful? *

- ○ points
- ○ leaderboard
- ○ levels
- ○ progress bar\measurement
- ○ badges

16. Provide a reason for your answer to the previous question 14 and 15 (Why most and least useful?) *

Your answer

17. Which gamification element (e.g. points, leaderboard) in the mobile app was the most enjoyed? *

- ○ points
- ○ leaderboard
- ○ levels
- ○ badges
- ○ progress bar

18. Which gamification element (e.g. points, leaderboard) in the mobile app was the least enjoyed? *

- ○ points
- ○ leaderboard
- ○ levels
- ○ badges
- ○ progress bar

19. Provide a reason for your answer to the previous question 17 and 18 (Why most and least enjoyed?): *

Your answer

20. How did the gamification influence your opinion of using fitness mobile apps? *

Your answer

21. What would you suggest to improve the gamification in the fitness mobile app? *

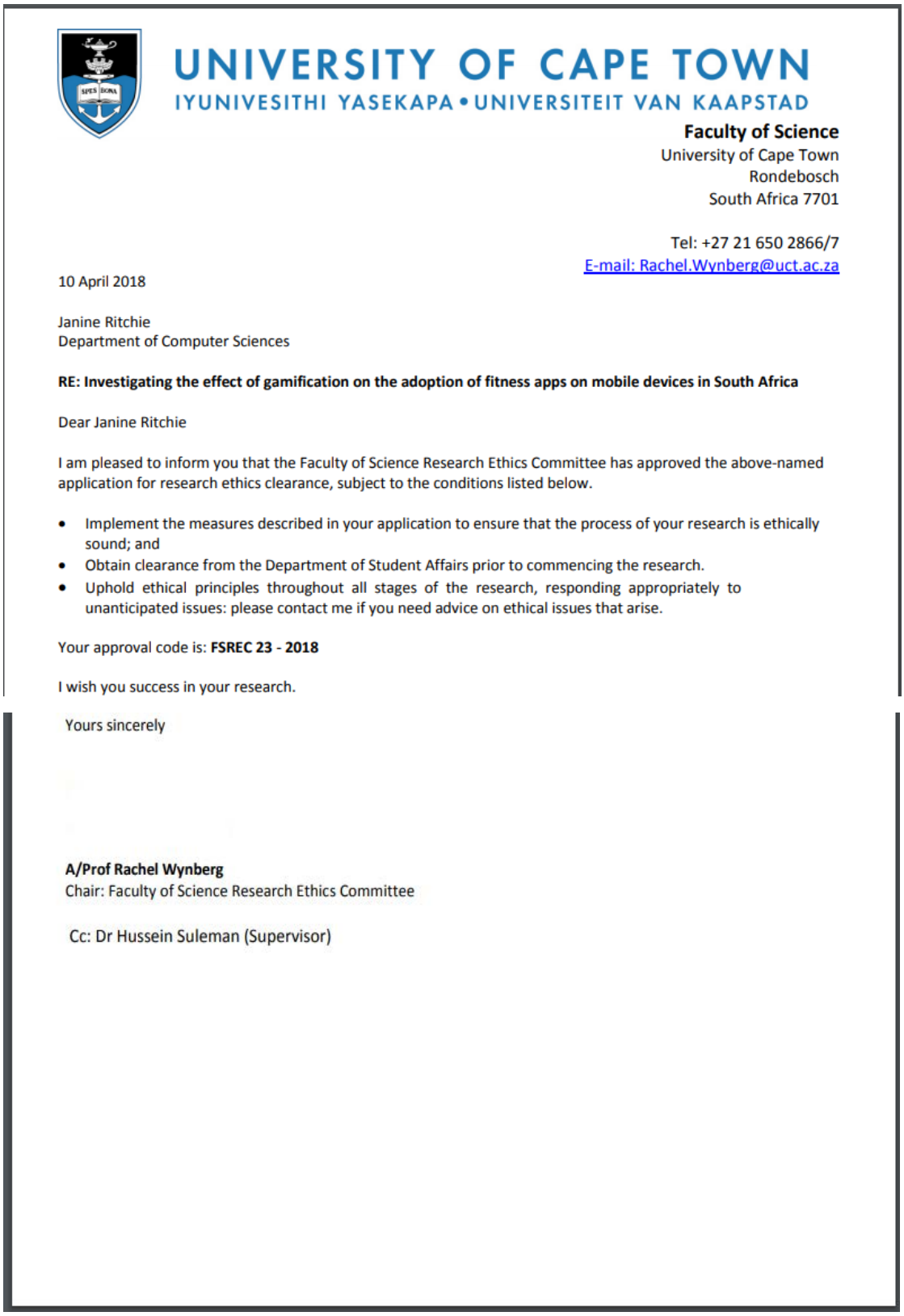
Your answer

22. What do you think of the gamification challenges (easy or difficult) in the app? (e.g. run 10km 5 times a week to level up and earn badges) *

Your answer

Appendix B

Ethics Approval documentation:



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E-mail: Rachel.Wynberg@uct.ac.za

10 April 2018

Janine Ritchie
Department of Computer Sciences

RE: Investigating the effect of gamification on the adoption of fitness apps on mobile devices in South Africa

Dear Janine Ritchie

I am pleased to inform you that the Faculty of Science Research Ethics Committee has approved the above-named application for research ethics clearance, subject to the conditions listed below.

- Implement the measures described in your application to ensure that the process of your research is ethically sound; and
- Obtain clearance from the Department of Student Affairs prior to commencing the research.
- Uphold ethical principles throughout all stages of the research, responding appropriately to unanticipated issues: please contact me if you need advice on ethical issues that arise.

Your approval code is: **FSREC 23 - 2018**

I wish you success in your research.

Yours sincerely

A/Prof Rachel Wynberg
Chair: Faculty of Science Research Ethics Committee

Cc: Dr Hussein Suleman (Supervisor)