

# 게임화 및 개인정보 염려가 피트니스 앱 사용의도에 미치는 영향

## Exploring the Effect of Gamification and Privacy Concerns upon Behavioural Intention to Use Fitness Apps

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### 요 약

본 연구는 기술수용모델을 기반으로 게임화 요소와 프라이버시 염려가 피트니스 앱 사용 의도에 미치는 영향을 실증적으로 탐색하였다. 피트니스 앱 사용 시 민감할 수 있는 개인정보가 수집된다는 점을 반영하여 게임화와 프라이버시 염려를 함께 고려하여 연구를 진행하였다.

게임화의 요인으로 성취, 소셜, 몰입을 선정하고 온라인 설문지를 통해 운동 앱 사용자 187명의 데이터를 수집하여 분석하였다. 그 결과 인지된 사용 용이성, 유용성 그리고 게임화 요인 중 성취 요인이 사용의도에 유의한 영향을 미친다는 것을 확인하였으며 프라이버시 염려와 게임화 요인 중 소셜과 몰입 요인은 앱 사용 의도에 유의한 영향을 미치지 않는 것으로 분석되었다. 본 연구는 개발자 및 경영자들이 피트니스 앱을 디자인하고 관리할 때 고려해야 할 시사점을 제공하고 있다.

**키워드** : 게이미피케이션, 개인정보보호, 앱 사용의도, TAM, 피트니스 앱

## I. Introduction

Smartphones became one of the most important tools used in people's daily lives over the past decade. This is due to the development of mobile software applications (apps) which fulfill a wide range of purposes such as searching for information online, social networking, shopping or playing online mobile games (Byun *et al.*, 2018). The proliferation of smartphones has led to various changes in individuals' lives, and even more significant changes have oc-

curred in society as a whole due to their ubiquitous availability, irrespective of time and place (Park *et al.*, 2014).

Fitness and health related apps emerged as one of the fastest growing segments of mobile apps. Especially among smartwatch users, fitness and health related apps show increased popularity. Yuan *et al.* (2015) reported that about one in five smartphone users had at least one health related app on their mobile device, while Krebs and Duncan (2015) found in their research that 58% of smartphone users had

downloaded health or fitness apps onto their mobile devices, mainly for the purpose of tracking their activity or diet. To combat the discontinuance behaviour of fitness app users, as well as to improve brand image and increase brand engagement many fitness app providers and sports brands have adopted gamification strategies (Lu and Ho, 2020; Ritchie, 2018; Wolf *et al.*, 2018).

Gamification is frequently seen as a potential solution for the low adoption rates, as it may positively influence user attitudes and behaviours, create immersive and social environments for users of sports and physical activity apps (Al-Rayes *et al.*, 2022; Thomson *et al.*, 2016). We conduct our research by selecting (1) achievement elements, (2) socially relevant elements, and (3) immersion elements classified in the literature (Britrian *et al.*, 2020; Koivisto and Hamari, 2019). However, despite the rapid growth of the mobile fitness app industry, it has been observed that many mobile fitness app users discontinue using apps they downloaded, and adoption rates for fitness apps were lower than other mobile apps such as social networking or mobile game apps. Among the reasons for discontinuance, loss of interest, hidden costs, as well as privacy and trust concerns are noted to play a significant role (Krebs and Duncan, 2015).

Privacy issues and data security are inherently significant to and widely discussed in information systems research, and Internet users' information privacy concerns have been identified as a hindrance to technology adoption by Malhotra *et al.* (2004). A significant amount of sensitive personal information collected by fitness app providers is a relevant aspect that warrants consideration of data privacy. Therefore, this study investigates the need to address privacy concerns and examines whether it also influences the user's intention to continue using them.

In this study, we explore (1) whether the gamification factor increases the intention to use the app, (2) the necessity of solving the privacy problem, and whether it affects the intention to use it. The findings of our study may help practitioners and developers establish strategies for design and development of related applications.

## II. Theoretical Background

### 2.1 Technology Acceptance Model

The Technology Acceptance Model (TAM) originally proposed by Davis (1989) gained significant popularity in MIS research and has been applied to a wide range of technologies in different contexts (Byun *et al.*, 2018). It has also been utilized to understand technology adoption in various service domains, including fitness (Kim *et al.*, 2022). The TAM primarily revolves around two key belief perceptions: perceived ease of use and perceived usefulness. These perceptions play a crucial role in shaping users' attitudes and intentions towards technology adoption. Over the years, numerous researchers extended the original TAM and recently applied TAM to mobile devices, including mobile banking, payment systems, mobile marketing, and mobile healthcare (Cha, 2012). Therefore, TAM should be a suitable choice for our theoretical background.

However, it is also worth noting that the TAM is also criticized by some scholars who believe that the model may not be accurate in specific situations. They suggest a stronger need for extensions and modifications of the existing construct to better understand people's behaviour (Ajzen, 1991). We extended TAM by integrating gamification and privacy concerns which are both relevant variables with regards to mobile fitness applications.

## 2.2 Mobile Fitness App Adoption

Various research explored users' behavioural intention to adopt and use mobile fitness and health related applications. Byun *et al.* (2018) investigated the adoption of sports brand apps by Nike, Adidas or Asics with a modified TAM and included perceived enjoyment to capture the hedonic components of the apps provided by these brands. They found out that all proposed variables were significant for the intention to use, with stronger effects among younger users. Their concept of perceived enjoyment is based on Venkatesh *et al.*'s (2012) definition of hedonic motivation as "fun or pleasure derived from using a technology". Similarly, Kamboj *et al.* (2020) also investigated enjoyment as a gamification mechanism for mobile apps and found that it positively affected the behavioural intention to use through increased customer engagement.

While perceived enjoyment is often associated with gamification, which describes incorporating game-like elements into non-game situations, it may not be the most suitable indicator for gamification in the context of fitness apps. Recently there has been a surge on the topic of gamification in fitness and health since gamification has gained prominence in this sector. Bitrián *et al.* (2022) published several research papers on the topics of gamification based on the self-determination theory and the TAM and defined gamification based on Koivisto and Hamari's (2019) classification of game elements. They found that gamification had a positive influence on the satisfaction of needs and autonomous motivation to use sports apps. This aligns with Xi and Hamari (2019) who suggest that gamification should enhance the system's ability to fulfil intrinsic needs and induce change in behaviour. Kim *et al.* (2022) defined gamification as four mechanisms: (1) self-monitoring, (2) goalsetting, (3) social facili-

tation and (4) rewards, which were constructed with a modification of the TAM. Their findings showed that these game mechanisms in fitness apps encouraged users to engage in more physical activity.

Regarding privacy concerns Dhagarra *et al.* (2020) examined the influence of several types of privacy concerns on the behavioural intention to use and concluded that privacy concerns should have a significant impact on the intention to use, as well as the perceived ease of use and perceived usefulness for technology acceptance in healthcare. Xu and Gupta (2009) as well as Zhou (2011) investigated the impact of privacy concerns on users' adoption intention of location-based services and found that users' concerns regarding the collection, errors and secondary use of data determined their intention to adopt the service or negatively influences the performance expectancy for the application. Privacy concerns are a common theme in MIS research; however there is still a lack of literature that combines privacy concerns with gamification (Trang and Weiger, 2021). Given that gamification is a common feature in fitness apps and considering the high amount of person-related and sensitive data collected by these apps, addressing this gap in research seems significant to us.

## 2.3 Privacy Concerns

Research divides privacy into 4 different types of privacy. These include (1) physical privacy which describes being free from surveillance and intrusions to one's physical space, (2) interactional privacy which states that one should be able to control with whom they would like to have social encounters, (3) psychological privacy which is the ability to protect one's thoughts, feelings and values from being intruded and lastly (4) informational privacy which is the kind of privacy that is mostly referred to as privacy in the

context of MIS research.

Informational privacy describes the ability to control the aggregation and spreading of information (Dienlin and Metzger, 2016). Malhotra *et al.* (2004) investigated internet users' privacy concerns and examined the relationship between privacy concerns and behavioural intention. Information privacy in the context of internet users refers to users' willingness to preserve and control their personal data online (De Cosmo *et al.*, 2021) and privacy concerns may pose a threat to internet users' informational privacy, their autonomy and their freedom which can be impacted by companies' data collection and analysis practices (Cabinakova *et al.*, 2016).

Since 2001, privacy concerns have risen significantly due to the rapid development of information and communication technologies which are often associated with doubtful information collection and usage practices. Specifically, older generations are less willing to share their personal information online (Mini, 2017). Privacy concerns are considered direct determinants of behavioural intention, as previous studies have found a significantly negative impact between privacy concerns and the intention to use a technology. When users have high security concerns about their personal data, they may decide not to adopt or discontinue using a technology, especially in sensitive areas such as health and fitness (Dhagarra *et al.*, 2020; Zhou, 2011).

## 2.4 Gamification

Gamification refers to the idea of enhancing services and systems by incorporating game mechanisms or elements in non-game situations (Koivisto and Hamari, 2019) with the purpose of creating similar positive and motivating experiences as one can feel when playing an actual game. Gamification aims at increasing users' motivation to behave in certain ways and is

an intentional way of using technology to achieve that goal (Alexandros, 2024). Many app providers are using gamification to create more enjoyable and game-like experiences for their users in order to make them reuse their services (Ritchie, 2018). Chen and Pu (2014), as well as Goodwin *et al.* (2017), claimed that gamification should be an essential part of fitness apps due to the increased fun and motivation of physical activity. However, there is no consistent definition of gamification across literature (Wolf *et al.*, 2018). This lack of consistency might also stem from the fact that gamification research is still in its infancy despite its rapid growth in various research directions. As one example, in their study Högberg *et al.* (2019) state that the effect of gamification on a change in behaviour or intention, stems from the gameful experience evoked by the gamification. They mention playfulness, affect, enjoyment, flow, immersion, challenge, skill, social experience, presence, and sensory experience as the dimensions of gameful experience.

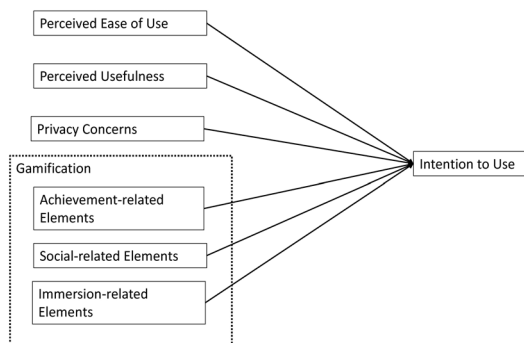
We find this representation of gamification too comprehensive for our study and instead adopted the concept used by Bitrián *et al.* (2020) and Koivisto and Hamari (2019). According to them, gamification elements can be divided into three categories: (1) achievement-related elements, (2) social-related elements, and (3) immersion-related elements. The application of this gamification element not only provides fun to users and leads to immersion, which can not only lead to active behaviour, but also motivate the desire for achievement, showing the intention to continue the experience, which can lead to continuous behaviour (Zichermann and Cunningham, 2011).

In addition, in order to solve the sustainability and motivation problems in the mobile healthcare app field, it is very important to encourage app users to continue to participate by having fun in the process of interacting with the system (Kang, 2023).

### III. Research Model and Hypotheses

#### 3.1 Research Model

Our research model (<Figure 1>) consists of a total of 6 independent variables, namely perceived ease of use and perceived usefulness which are both part of the TAM, privacy concerns which has been added to the TAM by previous scholars such as Dhagarra *et al.* (2020), and finally we integrate the three elements of gamification according to Koivisto and Hamari (2019) into the TAM. The dependent variable is the intention to use fitness apps. In addition, demographic variables (gender, age, area of residence, etc.) were used as control variables.



<Figure 1> Research Model

#### 3.2 Hypotheses Development

Perceived ease of use describes the belief that using a certain technology reduces required efforts for performing a task. This belief is then compared to the user's perception of the effort required to learn and use the technology or information system (Byun *et al.*, 2018). One of the main features of perceived ease of use described in previous studies is simplicity which describes how easy and simple the app is to comprehend,

interact with, access or operate (Yang *et al.*, 2017). Previous studies confirmed that users' perception of ease of use should positively influence their attitudes and intentions to adopt a technology (Kim *et al.*, 2022). Further, previous research using the TAM demonstrated that when technology is perceived as easy to use, it is also perceived as effective and beneficial. As a results studies have found that perceived ease of use significantly influences users' perceived usefulness of the technology (Bitrián *et al.*, 2021). In the context of mobile fitness apps, we also expect the ease of use to be a significant indicator for the intention to use the fitness apps. Furthermore, we agree with previous research that an easy user interface will lead to the fitness app being perceived as more useful. Thus, we would like to propose two hypotheses regarding perceived ease of use which align with previous research.

H1: Perceived ease of use positively influences users' intention to use gamified fitness/health apps.

H2: Perceived ease of use positively influences perceived usefulness.

Perceived usefulness refers to the belief that using a particular technology can facilitate the accomplishment of specific tasks (Byun *et al.*, 2018). Alongside perceived ease of use, perceived usefulness is a key construct in the TAM explaining technology adoption. In the context of mobile health, continuous health reports and data visualization, as it often can be found in fitness apps as well, can help users track their physical activity which is an example for a useful feature of a fitness app. Usefulness is a key factor for determining the attractiveness to use a technology (Gharakhani and Pourhashemi, 2020; Kim *et al.*, 2022; Liu *et al.*, 2022).

H3: Perceived usefulness positively influences users' intention to use gamified fitness/health apps.

We identified in the literature that when users have high security concerns, they may decide not to adopt or discontinue using a technology, especially in sensitive areas such as health and fitness (Dhagarra *et al.*, 2020; Zhou, 2011). There are different types of measures for privacy concerns related to the usage of mobile health and fitness apps. In this study, we adopted privacy concerns following Dhagarra *et al.* (2020), and the measurement items include concerns about data collection, storage, and third-party usage. Other research works often divide privacy concerns into four categories, each with several associated items: collection, unauthorized access, error, and secondary use (Smith *et al.*, 1996; Xu and Gupta, 2009).

Overall, previous literature highlights the negative influence of privacy concerns on the willingness to disclose information on the internet as well as the negative impact on the intention to use mobile applications (Dhagarra *et al.*, 2020).

H4: Privacy concerns negatively influence users' intention to use gamified fitness/health apps.

Achievement-related elements are most frequently used in literature to describe gamification, particularly in the context of health and fitness apps. Achievement-related elements include badges, points, leader boards, rankings, virtual currencies, progress bars, increasing difficulty levels and similar. Högberg *et al.* (2019) defined achievement or accomplishment as the demand or drive for successful performance, achieving goals and record progress. Considering the functionalities of many fitness apps, achievement-related elements seem suitable for capturing gamification in the

context of fitness apps. Hsu *et al.* (2013) identified two ways for goal setting. One of them is progress towards goals which includes perceived ease of use positively influences perceived usefulness. Gamification features such as progress bars, the other is explicit signs which includes mechanisms such as trophies or badges. Both types of goal setting gamification features are represented in achievement-related gamification elements. Progress tracking and levels may enhance the game-like experience of users (Ritchie, 2018). Additionally, leader boards and points further enhance the thrive for achievement and the competition among users by ranking them against each other (Hung, 2017). Similarly, points which are rewarded when obtaining a certain goal, are accumulated and can act as an intrinsic motivator for the user or have in-app rewards such as virtual goods, badges or a higher ranking on the leader board (Antonaci *et al.*, 2017; Tan and Hew, 2016). Kang (2023), who studied users of learning applications, found that achievement-related elements were positively related to playability. And this also affected the intention to use continuously. Additionally, according to Hasan *et al.* (2019), leaderboards, medals, and levels allow to receive feedback on their performance, confirming the study's findings that increase the intention to continue using the gamification system.

H5: Achievement-related gamification elements positively influences users' intention to use gamified fitness/health apps.

The second category of gamification elements according to Bitrián *et al.* (2020) is social-related elements. A social experience is defined by Högberg *et al.* (2019) as the direct or indirect presence of people, service-related social actors or the service as a social actor in the context of a gamified application. Xi and

Hamari (2019) stated that when people belong to a social environment and make meaningful social connections, it can foster stronger relationship amongst consumers and introduce more cooperation. Thus, social-related gamification elements involve competition with other users, teams, cooperation, and social networking features. Social related gamification elements are able to aid users to fulfill their psychological needs and increase the level of social relatedness experienced by individuals. Tan and Hew (2016) described challenges as a joint mission, goal or purpose users can work towards to, whereas Högberg *et al.* (2019) defined challenge as a testing of a person's abilities and the demand for great effort to be successful. Competition is defined as rivalry against oneself, other users, a group or the service to gain a desirable outcome and win a higher score, win a prize or win over others (Högberg *et al.*, 2019; Hsu *et al.*, 2013). Some studies found that social networking features can enhance the social value of mobile fitness apps. Interactions on social media and the usage of social networking features affected the usage hour, intention to continue fitness app usage and the actual physical activity of users, since it lead to changes in fitness app users' walking behaviour (Tu *et al.*, 2019). Koivisto and Hamari (2014) found that 43% would continue to use a product if an element of social connection was provided, and 57% would recommend it to others. Therefore, social elements can be seen as having a positive effect on the user's attitude and exercise performance, which can be seen as the more friends there are in the service being used, the higher the desire to exercise.

H6: Social-related gamification elements positively influences users' intention to use gamified fitness/health apps.

Lastly, the third element of gamification concerns

immersion. Immersion refers to the cognitive state of the users' attention being all consumed by another reality, in our case the mobile fitness app. This can make the users feel isolated from the outside world. The user is completely absorbed in the activity, while having a feeling of being disconnected from the real world. However, immersion can also be associated with negative experiences, such as anxiety (Högberg *et al.*, 2019). Immersion-related elements according to (Bitrián *et al.*, 2020) included avatars, stories, customization, and personalization. Animesh *et al.* (2011) found out that people who experience telepresence are less likely to make a distinction between the real world and the virtual world and thus are more satisfied with the virtual environment. The researchers further explored that users see avatars as an extension of themselves in the virtual world, which leads to a positive intention to purchase. Immersion-related elements have also been found to have a positive effect on intention to continue use in previous studies (Su *et al.*, 2016; Lee *et al.*, 2013).

H7: Immersion-related gamification elements positively influences users' intention to use gamified fitness/health app.

## IV. Research Methodology

The data collection took place in May 2023. The online survey was distributed to participants via email, Kakao Talk, or made accessible through a QR code in Korean and English language. A total of 254 individuals responded to the survey, out of which 201 (79.1%) were fitness app users. We excluded 14 questionnaires due to either incomplete or non-valid answers, resulting in a final sample size of 187 respondents.

### 4.1 Measurement Instrument

To measure the constructs of the model, we adopt items from previous literature, and utilize a five-point Likert scale as the measurement instrument, with the exception for app usage related questions and demographic questions. The main items of the TAM, including perceived ease of use, perceived usefulness, attitude, and behavioural intention, are measured on a five-point scale (1=Strongly disagree, 5=Strongly

agree) following Bitrián *et al.* (2021). The study constructs privacy concern items based on Dhagarra *et al.* (2020), who examined the impact of trust and privacy concerns on technology adoption using a modified TAM. Gamification elements are assessed in terms of the frequency of interaction (1=Never, 5=Every time) and the importance of interaction (1=Not at all important, 5=Very important). <Table 1> shows the items and survey questions for each construct.

<Table 1> Measurement Scales

Sources	Constructs	Items	Questions
Bitrián <i>et al.</i> (2020)	Achievement-related elements (Demand or drive for successful performance, achievement of goals and record progress)	A1	The frequency of interacting with badges/medals/trophies
		A2	The frequency of interacting with scores/points
		A3	The frequency of interacting with progress bars
		A4	The frequency of interacting with rankings/leader boards
		A5	The frequency of interacting with increasingly difficult tasks
		A6	The importance of interacting with badges/medals/trophies
		A7	The importance of interacting with scores/points
		A8	The importance of interacting with progress bars
		A9	The importance of interacting with rankings/leader boards
		A10	The importance of interacting with increasingly difficult tasks
	Social-related elements (The direct or indirect presence of people, social actions related to a service or the service itself)	S1	The frequency of interacting with competition features
		S2	The frequency of interacting with social networking features
		S3	The frequency of interacting with cooperation features
		S4	The importance of interacting with competition features
S5		The importance of interacting with social networking features	
S6		The importance of interacting with cooperation features	
Immersion-related elements (Cognitive state of the users' attention being all consumed by another reality)	I1	The frequency of interacting with profile/virtual identity/avatar	
	I2	The frequency of interacting with personalization	
	I3	The importance of interacting with profile/virtual identity/avatar	
	I4	The importance of interacting with personalization	
Bitrián <i>et al.</i> (2021)	Perceived ease of use (The belief that using a certain technology will reduces required efforts for performing a task)	PEOU1	I find this app easy to use
		PEOU2	My interaction with this app is clear and understandable
		PEOU3	I find this app easy to interact with
	Perceived usefulness (The belief that using a particular technology can facilitate the accomplishment of specific tasks)	PU1	Using this app enables me to control my health/fitness condition
		PU2	Using this app makes it easier to control my health/fitness condition
		PU3	I find this app useful to improve my health/fitness condition



<Table 1> Measurement Scales(Continued)

Sources	Constructs	Items	Questions
Dhagarra <i>et al.</i> 2020	Privacy concerns (Concern for loss of privacy and need for protection against un-called-for communication and misuse of personal information)	PC1	It bothers me when fitness apps ask me to provide personal information
		PC2	I am concerned that fitness apps will be collecting too much of my personal information
		PC3	I am concerned that unauthorized people may access my personal information
		PC4	I am concerned that fitness apps may keep my personal information in non-accurate manner
		PC5	I am concerned about giving information to fitness apps
Bitrián <i>et al.</i> 2021	Attitude (The favorable degree to which it is perceived as useful to use)	ATT1	Using this app is a good idea
		ATT2	Using this app is a wise idea
		ATT3	I like the idea of using this app
	Behavioural intention (Behaviour to use technology)	BI1	I intend to continue using this app in the future
		BI2	I will always try to use this app in my daily life
		BI3	I plan to continue to use this app frequently

### 4.2 Common Method Bias Assessment

Since this study relies on self-reported data obtained through a one-time survey, we took measures to minimize common method bias following the approach used by Bitrián *et al.* (2020). To reduce the potential for dishonest or artificial answers, participation in the survey was voluntary and the participants were informed about and ensured anonymity and data confidentiality before starting with the questionnaire. In

addition, each set of items (except for ease of use and usefulness, and attitude and behavioural intention) variables was presented on a separate page of the online survey to prevent respondents from easily inferring cause-effect relationships between the dependent and independent variables (Podsakoff *et al.*, 2003). In addition, the total variance explained by one factor with 29.955% falls well below the threshold of 50%. Hence, there is little evidence for common method bias in this study (<Table 2>).

<Table 2> Total Variance Extracted by One Factor

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.612	32.039	32.039	8.987	29.955	29.955
2	4.113	13.709	45.748			
3	3.224	10.746	56.494			
4	1.995	6.651	63.145			
5	1.574	5.246	68.391			
...	...	...	...			
30	0.079	.262	100.000			

<Table 3> Model Reliability and Validity Analyses Results

	Initial no. of Items	Final no. of Items	CR	AVE	Cronbach's Alpha
Achievement-related elements	10	8	0.885	0.493	0.890
Social-related elements	6	6	0.920	0.659	0.922
Immersion-related elements	4	2	0.856	0.750	0.853
Privacy Concerns	5	5	0.932	0.735	0.930
Perceived Usefulness	3	3	0.888	0.729	0.872
Perceived Ease of Use	3	3	0.922	0.798	0.917
Behavioural Intention	3	3	0.934	0.824	0.933

All three items (ATT1, ATT2, ATT3) for the construct Attitude have been removed from the model as a conclusion of the factor analysis. Each two items have also been reduced from the constructs achievement-related elements and immersion-related elements.

## V. Analysis and Results

### 5.1 Reliability and Validity Tests

A Principal Component Analysis (PCA) with Varimax rotation and Kaiser normalization is initially carried out to identify items that were not necessary for the analysis. Based on the rotated component matrix, a total of 7 items are excluded from the analysis, including all three items for Attitude (Jennex *et al.*, 2016).

Both an Exploratory Factor Analysis (EFA) and a Confirmatory Factor Analysis (CFA) within a Structural Equation Model (SEM) are performed to further assess the reliability and validity of the model. A summary of the results of the EFA and CFA is shown in <Table 3>.

The overall Cronbach's Alpha (C.Alpha) was found to be 0.913. <Table 3> presents the C.Alpha, Composite Reliabilities (CR), and Average Variance Extracted (AVE) for each construct. The CR values were all above 0.80 or 0.90, which indicates that the constructs have sufficient convergent validity. The AVE value was 0.50 or higher except for one config-

uration (Achievement-related elements). However, the C.Alpha and CR values of that element were included in the analysis because they were highly reliable values. Overall, removing previously mentioned 7 items resulted in a good model fit (Fornell and Larcker, 1981).

In <Table 4>, the Standardized Factor Loadings (SFL) are presented, and it is recommended for these values to be above 0.6. In this analysis, all items meet this criterion except for A5, which is slightly below the recommended threshold of 0.6. Hence, overall, the SFL indicate a strong correlation between the observed variables and the latent common factors.

<Table 5> depicts the discriminant validity analysis of the measurement model. The square root values of the AVE values for each construct are larger than the values of the other correlation coefficients in each column and each row (Achievement-related elements = 1, Social-related elements = 2, Immersion-related elements = 3, Privacy Concerns = 4, Perceived ease of Use = 5, Perceived Usefulness = 6, Behavioural Intention = 7). Thus, the discriminant validity report indicates very low correlation between the measures of unrelated constructs.

〈Table 4〉 Construct Factor Analysis

Construct	Item	SFL	SE	Z	p-value	Sig.
Achievement-related elements	A1	0.729	0.128	8.400	0.000	***
Achievement-related elements	A2	0.779	0.140	8.066	0.000	***
Achievement-related elements	A3	0.646	0.100	10.003	0.000	***
Achievement-related elements	A4	0.701	0.115	7.778	0.000	***
Achievement-related elements	A5	0.577	0.105	7.011	0.000	***
Achievement-related elements	A6	0.750	0.132	8.352	0.000	***
Achievement-related elements	A7	0.739	0.134	8.208	0.000	***
Achievement-related elements	A8	0.678	-	-	0.000	***
Social-related elements	S1	0.755	0.075	11.514	0.000	***
Social-related elements	S2	0.820	0.088	10.618	0.000	***
Social-related elements	S3	0.755	0.074	11.192	0.000	***
Social-related elements	S4	0.892	0.085	12.863	0.000	***
Social-related elements	S5	0.826	0.060	17.743	0.000	***
Social-related elements	S6	0.813	-	-	0.000	***
Immersion-related elements	I2	0.920	0.075	7.905	0.000	***
Immersion-related elements	I4	0.808	-	-	0.000	***
Privacy Concerns	PC1	0.748	0.055	12.840	0.000	***
Privacy Concerns	PC2	0.890	0.047	19.918	0.000	***
Privacy Concerns	PC3	0.849	0.053	17.482	0.000	***
Privacy Concerns	PC4	0.840	0.051	17.058	0.000	***
Privacy Concerns	PC5	0.947	-	-	0.000	***
Perceived Ease of Use	PEOU1	0.850	0.093	11.665	0.000	***
Perceived Ease of Use	PEOU2	0.969	0.096	12.353	0.000	***
Perceived Ease of Use	PEOU3	0.725	-	-	0.000	***
Perceived Usefulness	PU1	0.884	0.076	15.411	0.000	***
Perceived Usefulness	PU2	0.959	0.073	16.987	0.000	***
Perceived Usefulness	PU3	0.833	-	-	0.000	***
Behavioural Intention	BI1	0.894	0.045	20.125	0.000	***
Behavioural Intention	BI2	0.887	0.049	19.705	0.000	***
Behavioural Intention	BI3	0.942	-	-	0.000	***

〈Table 5〉 Discriminant Validity Analysis

	1	2	3	4	5	6	7
1	0.702*						
2	0.642	0.812*					
3	0.411	0.412	0.866*				
4	0.054	0.125	-0.002	0.857*			
5	0.397	0.222	0.299	0.043	0.854*		
6	0.322	0.253	0.310	0.003	0.503	0.893*	
7	0.521	0.385	0.306	-0.077	0.491	0.587	0.908*

\* Square Root of the AVE

## 5.2 Structural Model Analysis & Hypotheses Testing

The proposed model of this study was tested using IBM's SPSS 26 and SPSS Amos 26 Graphics software. Identifying fitness app users' intention to use the applications with a focus on the influence of gamification and privacy concerns, we conducted a multiple linear regression to test the structural model and hypotheses. The model's overall validity is assessed using several indicators. The model fit indices indicate a good fit. The Standardized Root Mean Square Residual (SRMR) valued at 0.0604 is below the acceptable threshold of 0.08, indicating a favorable fit. The Root Mean Square Error of Approximation (RMSEA) value of 0.056 is lower than the recommended threshold of 0.07, suggesting a favorable fit. Furthermore, the Comparative Fit Index (CFI) value of 0.952 exceeds the desirable threshold of 0.9, indicating a satisfactory fit. However, the Normed Fit Index (NFI) value of 0.880 fell below the desired threshold of 0.9 (Kim *et al.*, 2022). The model's adjusted coefficient of determination (adjusted R<sup>2</sup>) which measures the model's explanatory power, accounted for 44.4% of the variance, indicating a good level of explanatory capability.

The results for hypothesis testing are presented in <Table 6>. We have used a multiple linear regression in SPSS.

Firstly, the study confirms the positive influence of perceived ease of use on both, the behavioural intention to use and perceived usefulness, at a significance level of  $p < 0.01$ . Therefore, H1 (Beta = 0.194,  $t = 2.905$ ) and H2 (Beta = 0.505,  $t = 7.968$ ) are strongly supported. We used a Sobel test to examine the mediating relationship between perceived ease of use and perceived usefulness, which returned highly significant results (Sobel = 4.329,  $p < 0.01$ ). Moreover, perceived usefulness demonstrated a significant positive impact (Beta = 0.386,  $t = 5.930$ ,  $p < 0.01$ ) on behavioural intention to use, supporting hypothesis H3.

Although privacy concerns are rejected at a 5% significance level, we found some significant influence of privacy concerns on the behavioural intention to use. Hence hypothesis H4, testing the negative influence of privacy concerns on the intention to use, would still be supported at a significance level of  $p < 0.1$  (Beta = -0.094,  $t = -1.716$ ).

Regarding the influence of gamification, the hypotheses can be summarized as follows: H5 (achievement-related elements) was found to have the highest level of influence on the intention to use (Beta = 0.212,

<Table 6> Multiple Linear Regression Results

Distinction	Beta (Std. Coefficients)	t	Sig.	VIF
(Constant)	.831	2.591	.010	
Ease Of Use	.194	2.905	.004	1.492
PEOU on PU	.505	7.968	.000	1.000
Usefulness	.386	5.930	.000	1.418
Privacy Concerns	-.094	-1.716	.088	1.011
Achievement	.212	2.942	.004	1.733
Social	.134	1.918	.057	1.639
Immersion	-.044	-.701	.484	1.298

Adjusted R<sup>2</sup> = 0.444, df = 6, F = 25.771

$t = 2.942$ ,  $p < 0.01$ ), while H6 (social-related elements) was rejected at a significance level of 5% but could be accepted by a significance level of 10%. (Beta = 0.134,  $t = 1.918$ ,  $p < 0.1$ ). However, H7 (immersion-related elements) was rejected (Beta = -0.044,  $t = -0.701$ ) since no significant impact was observed. Demographic variables, except for the weekly usage time of the app ( $p < 0.003$ ), showed no significant influence on behavioural intention.

The tolerance and VIF values are all within the required thresholds which implicates that multicollinearity cannot be found.

### 5.3 Discussion

This study investigated the impact of gamification and privacy concerns on the intention of Korean users to adopt mobile fitness applications.

This research based its theoretical background on TAM which is a widely used model in MIS research. Perceived ease of use and perceived usefulness are the key constructs of the TAM, describing the behavioural intention of people to adopt or use a technology. Our findings support the importance of perceived ease of use and perceived usefulness, as identified by Bitrián *et al.* (2021), in influencing the behavioural intention to use fitness applications. Users who perceive fitness apps as easy to use for achieving their health and fitness goals, are more likely to be inclined to use these apps. The ease of use also positively influenced the perceived usefulness, meaning that the easier the apps is to use, the more it is perceived to be effective and useful as well.

Fitness apps incorporate gamification elements to make the user experience more enjoyable and engaging (Bitrián *et al.*, 2020). Consistent with the findings of Bitrián *et al.* (2020) and Kim *et al.* (2022), our study confirms that achievement-related game elements

(e.g., badges, medals, trackers, leaderboards, rankings, etc.) significantly enhance the intention to use fitness apps by providing the feeling of accomplishment and intrinsic motivation.

Additionally, we find that social elements (e.g., challenges and social networking) also play a somewhat significant role in users' decision to utilize fitness apps. Social-related gamification elements can create meaningful social connections, increase the social relatedness and the fulfilment of psychological needs.

However, although previous literature suggest that immersion-related gamification elements influence the intention to use, our study did not observe a significant relationship between immersion-related game elements and the intention to use fitness apps. This may be due to the nature of fitness app usage, which often prioritizes actual physical activity rather than creating a sense of immersion within the app itself.

Moreover, privacy concerns are rejected by a 5% significance level but are still accepted at 10% significance level. Thus, we suggest some significance of privacy concerns in our study.

Overall, our study contributes to the growing body of literature on the factors influencing the intention to use fitness apps, specifically focusing on the role of gamification and privacy concerns. The results accentuate the significance of achievement-related (leaderboards, progress bars, points and badges) and social elements (social networking, challenges, and competition) in motivating the intention to use fitness apps, whereas immersion-related gamification elements (personalization, avatars) have little significant impact on the intention to use fitness apps. These findings have implications for developers and researchers aiming to enhance the design and effectiveness of fitness apps in promoting users' engagement and long-term usage which will be elaborated on in further detail in the following section.

## VI. Conclusion

This study provides several insights for both researchers and practitioners in the field of health and fitness. The results confirm a significant positive impact of achievement-related game elements such as leader boards, badges, points and progress bars and a positive influence of social-related game elements including social networking and challenges on users' intention to use fitness apps, whereas immersion-related gamification element such as avatars or personalization did not show a significant impact.

We suggest that practitioners should take advantage of these findings to enhance user motivation by implementing game elements that foster a feeling of achievement and facilitate social interaction. Moreover, the study verifies the importance of perceived ease of use and perceived usefulness, which are the two main perceptions of TAM, for users' intention to use fitness apps.

Our findings should encourage developers to focus on creating user-friendly interfaces and emphasizing the practical benefits of the app. Furthermore, this study highlights the need to address users' privacy concerns. Having robust privacy measures and transparent data handling practices can help build trust.

The findings of this study have several implications for the design and implementation of fitness apps. Firstly, the incorporation of achievement-related game elements, such as badges, medals, and leader boards, can significantly enhance users' intention to use fitness apps. App developers should prioritize the implementation of such kinds of elements to provide users with a sense of accomplishment and competition, which will motivate them to use the app more often and for longer sessions. Additionally, integrating social-related game features, such as challenges and social

networking, can foster a sense of belonging and social interaction, further enhancing the intention to use the app. These findings stress the importance of gamification strategies in creating enjoyable experiences for fitness app users.

Moreover, our results highlight the significance of perceived ease of use and perceived usefulness in determining users' intention to use fitness applications, contributing to the body of literature on the TAM. We suggest app developers should focus on designing user-friendly interfaces to minimize the usage barriers and improve the overall user experience. Furthermore, emphasizing the practical benefits of the app, such as its effectiveness in aiding users to achieve fitness goals and providing personalized recommendations, can strengthen users' perception of usefulness and drive their intention to continue using the app.

Despite several insights provided by this study, there are limitations that should be acknowledged. This research was conducted with a sample of Korean fitness app users only, which may limit the generalizability of the findings to other countries. Furthermore, this work was limited by the time it was conducted at. Fitness apps are still in the take-off stage and when fitness and health apps have reached maturity, the future investigation might deliver differing findings. We expect that forthcoming research works should aim at overcoming the limitations and providing a better understanding of the user behaviour of fitness apps.

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# Exploring the Effect of Gamification and Privacy Concerns upon Behavioural Intention to Use Fitness Apps

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## Abstract

This study empirically explores the influence of gamification elements and privacy concerns on users' intention to use fitness apps, based on the technology acceptance model (TAM). This research classifies gamification in fitness apps into three categories: achievement-related elements, social-related elements, and immersion-related elements. Although previous research investigated the gamification of fitness apps, few studies combined the impact of gamification with privacy concerns. Considering the significant amount of sensitive personal data collected by fitness apps, we recognize the importance of data privacy and aim to address this gap in research. To achieve this goal, we collected and analyzed data from 187 Korean fitness app users through an online questionnaire. The results confirm the highly significant influence of perceived ease of use, perceived usefulness, and achievement-related gamification elements. Social-related gamification elements, immersion-related gamification elements, and privacy concerns however show insignificant results for the intention to use fitness apps in the Korean market. Location and time limit the generalizability of this study; however, the findings of this study nonetheless offer valuable insights for practitioners and developers to enhance the design and development of their applications.

**Keywords:** *Fitness Apps, Gamification, Intention to Use, Privacy Concerns, TAM Model*

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서울대학교에서 경영학사와 석사를 졸업하고 University of Arizona에서 MIS 박사 학위를 취득하였다. 미국 버지니아의 George Mason University 조교수, 현재는 중앙대학교 경영경제대학 교수로 재직 중이다. 주요 연구 관심분야는 정보기술 투자의 평가, 실감미디어 기술의 확산 등이다.

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