

Making finance fun: the gamification of personal financial management apps

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Abstract

Purpose – This study integrates self-determination theory (SDT) and the technology acceptance model (TAM) to explore how gamification increases users' motivation and intention to use personal financial management (PFM) apps, and how it facilitates their adoption.

Design/methodology/approach – Data from 208 users of the Mint app were analyzed using partial least squares structural equation modeling.

Findings – The results showed that gamifying PFM apps satisfies users' needs for competence and autonomy and enhances their autonomous motivation to use them. Users' motivation increases their perceptions of ease of use and usefulness of the apps and causes them to develop more favorable attitudes toward them. The findings also confirmed a relationship between users' attitudes toward PFM apps and the behavioral intention to use them.

Research limitations/implications – To investigate the generalizability of results, studies using other PFM apps would be useful. The cross-sectional nature of the research also limits its causal inference.

Practical implications – This research provides support for the use of gamification in PFM apps and offers suggestions that may help fintech companies and banks to persuade users to engage with their apps.

Originality/value – Although gamification is a trending topic, few studies have explored its use in the finance industry. Drawing on SDT and the TAM, this study extends previous research and adds new insights into the effects of gamification in this context.

Keywords Personal financial management apps, Gamification, Self-determination theory, TAM

Paper type Research paper

1. Introduction

The financial industry has been one of the first to adopt mobile technologies (Jun and Palacios, 2016). In this context, finance apps have gained great popularity among consumers. In 2019, finance apps accounted for 5% of app downloads (AppsFlyer, 2020) and were accessed over one trillion times (App Annie, 2020). Along with mobile banking and payment apps (Karjaluo *et al.*, 2019), personal financial management (PFM) apps are among the fastest growing categories of finance apps. The global PFM-tool market size was \$1,449.9 million in 2018 and is expected to reach \$3,338.8 million in 2025, with a compound annual growth rate of 12.65% from 2018 to 2025 (QYResearch, 2019).

Developed by banks and fintech companies, PFM apps have changed the way consumers manage their finances. PFM apps seek to improve consumers' financial health by helping them to manage and take control of their finances. PFM apps usually consolidate users' accounts in one place, which allows them to monitor how much they earn, where and on what, they spend their money and plan their spending, saving and investing. The apps also help users by creating budgets, setting goals, finding ways to save, sending notifications and alerts and simplifying the investing process. Examples of PFM apps include Mint, Personal Capital, You Need a Budget, Mvelopes and Robinhood, among many others.



Mobile apps in the banking sector seek to improve their users' experiences (Komulainen and Saraniemi, 2019) and enhance their motivation and engagement (Garzaro *et al.*, 2021). In common with apps in sectors such as health, sports, tourism, hospitality and education (e.g. Hofacker *et al.*, 2016; Liu *et al.*, 2019; Tu *et al.*, 2019; Wang and Tahir, 2020), one way to achieve this is through gamification, that is, the implementation of game features and other game-like designs (Deterding *et al.*, 2011). For instance, numerous PFM apps enable users to set savings goals and seek to motivate them to achieve these through challenges. The apps use progress bars and other performance graphs to provide financial information. In addition, some of these apps enable users to compare and/or share their financial situation and goals with their peers.

Defined from the service marketing perspective as a "process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation" (Huotari and Hamari, 2017, p. 25), gamification has gained the attention of both scholars and practitioners in recent years (Koivisto and Hamari, 2019; Wunderlich *et al.*, 2020). By creating scenarios similar to those experienced in games, gamification seeks to promote positive psychological outcomes among individuals and shape their behaviors (Koivisto and Hamari, 2019). As such, in the finance context, gamification has the potential to make financial management fun and increase consumers' financial literacy (Rodrigues *et al.*, 2016b), that is, their understanding and use of personal finance-related information (Huston, 2010). It can also improve financial well-being and motivate their users to undertake specific behaviors, such as saving (Bayuk and Altobello, 2019).

Many studies have recognized that gamification research is largely concentrated in the domains of education and learning (Seaborn and Fels, 2015; Kasurinen and Knutas, 2018; Koivisto and Hamari, 2019). By contrast, other fields, such as finance, have received little attention, despite gamification becoming a common practice in the sector (Baptista and Oliveira, 2017). Indeed, as recently noted by Bayuk and Altobello (2019, p. 953), "academic research has only begun to explore what characteristics of the new technologies, including game features or incentives, are most effective in motivating individuals to save, and whether use of these financial gaming apps improves financial well-being".

Table 1 summarizes the relatively few studies that have explored the use of gamification in the finance industry. While these works have provided important insights into the use of gamification in the finance sector, more studies are needed to enhance this understanding. Specifically, research is mainly focused on the e-banking field (e.g. Rodrigues *et al.*, 2016a, b, c; Baptista and Oliveira, 2017). Some works explore gamification only as a research context (e.g. Rodrigues *et al.*, 2016b), so their findings, although relevant, do not allow conclusions to be drawn about how gamification influences consumers' behaviors. Furthermore, many studies do not analyze actual gamified app–user interactions. Instead, they assess how users rate game features in hypothetical financial gaming apps (e.g. Bayuk and Altobello, 2019), banking systems (Nasirzadeh and Fathian, 2020) and e-banking (e.g. Baptista and Oliveira, 2017; Rahi and Ghani, 2018, 2019).

In addition to the narrow scope of domains that have been investigated, a further limitation identified by the gamification literature is its lack of theoretical foundations and its use of a limited number of theories (Seaborn and Fels, 2015; Koivisto and Hamari, 2019). Rapp *et al.* (2019, p. 5) noted that the human condition is, however, complex, and to ground gamification designs, "it is often necessary to draw from a variety of theoretical approaches." Without a doubt, self-determination theory (SDT; Deci, 1975) is the theoretical framework most used in gamification research (Rapp *et al.*, 2019). Nevertheless, in the finance context, conceptual models based on the technology acceptance model (TAM; Davis, 1989) have been proposed to examine the adoption of banking services in general (e.g. Santini *et al.*, 2019; Souiden *et al.*, 2021) and gamified e-banking in particular (e.g. Rodrigues *et al.*, 2016b, c; Baptista and Oliveira, 2017). While both theories, SDT and TAM, are useful for explaining users' responses to gamified finance apps and PFM apps, in particular to the best of the authors' knowledge, no previous research has combined them in this context.

Reference	Aim	Type/research design	Context	Variables studied	Key findings
Rodrigues <i>et al.</i> (2016a)	To develop a framework for software gamified in e-banking	Empirical/Qualitative (discussion groups)	e-banking	Users' perceptions about the software features, functionalities and characteristics, in five gamification cases	Based on users' designs preferences, ten dimensions organized into two categories are identified: characteristics (design, appearance, functionality, rules and objectives) and elements (game, product, security, process and information)
Rodrigues <i>et al.</i> (2016b)	To investigate how ease-of-use and enjoyment influence customers' use of e-banking with a gamified business software	Empirical/Quantitative (survey)	e-banking	Socialness, ease-of-use, enjoyment, usefulness and intention to use	Ease-of-use and enjoyment are interrelated, and both have influence in e-banking usage; socialness influences the user perceptions of enjoyment and usefulness
Rodrigues <i>et al.</i> (2016c)	To identify the main variables that influence bank customers' use of gamified e-banking applications	Empirical/Quantitative (survey)	e-banking	Gamification, socialness, ease-of-use, enjoyment, usefulness, intention to use and business impact	Gamification improves customers' perceptions of social interaction, which, in turn, influence customers' intention to use the gamified application
Rodrigues <i>et al.</i> (2017)	To investigate how game design integrated in a banking website influences customers' intention to use e-banking	Empirical/Quantitative (survey)	e-banking	Gamification, ease-of-use, information, web design, web characteristics and intention to use	Gamification has a significant influence on the perceptions of ease of use, the web design, information, webpage characteristics and the intention to use e-banking

Table 1.
Summary of empirical studies exploring gamification in the finance sector

(continued)

Reference	Aim	Type/research design	Context	Variables studied	Key findings
Baptista and Oliveira (2017)	To identify the impact of game mechanics and game design techniques in the acceptance of mobile banking services	Empirical/ Quantitative (survey)	Mobile banking	Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, gamification, behavioral intention and use behavior Age and gender (moderators)	Gamification positively relates to intention to use mobile banking services Performance expectation, effort expectancy, social influence, hedonic motivation, price value and habit have a positive influence on behavioral intention. Facilitating conditions, habit and behavioral intention have a positive influence on use behavior
Rahi and Ghani (2018)	To examine factors influencing the adoption of Internet banking	Empirical/ Quantitative (survey)	Internet banking	Performance expectancy, effort expectancy, innovativeness, compatibility, intention to adopt Internet banking and intention to recommend in social networks Gamification (moderator)	Innovativeness and perceived technology security are the most important factors influencing users' intention to adopt Internet banking. Gamification moderates the relationship between customer's intention to adopt Internet banking and customer's intention to recommend Internet banking in social networks

*(continued)***Table 1.**

Reference	Aim	Type/research design	Context	Variables studied	Key findings
Bayuk and Altobello (2019)	To explore the potential benefits of gamification for financial well-being and motivation to save	Empirical/ Quantitative (survey and experiment)	Financial apps	Subjective knowledge, expertise with financial topics, game features (social vs economic), motivation to use the app, efficacy of the app and perceived usefulness	Users with experience with finance and money-savings apps are motivated by both social and economic features of financial applications, whereas those with no experience prefer economic features
Rahi and Ghani (2019)	To investigate factors influencing the adoption of Internet banking	Empirical/ Quantitative (survey)	Internet banking	Performance expectancy, effort expectancy, website design, website characteristics, general self-confidence, intention to adopt Internet banking and intention to recommend Gamification (moderator)	Performance expectancy, effort expectancy, website design, website characteristics and general self-confidence positively influence the intention to adopt Internet banking. Gamification moderates the relationship between customer's intention to adopt and customer's intention to recommend Internet banking
Nasirzadeh and Fathian (2020)	To investigate the relationship between demographic and personality traits of individuals and their preferences for gamification elements and expected benefits	Empirical/ Quantitative (survey)	Banking	Age, education, gender, personality traits, game elements (point, level, badge, reward, leaderboard, etc.) and expected benefits	Preferences toward gamification elements and perceived expected benefits depend on the demographic characteristics and personality traits

Table 1.

To address these gaps, this study focuses on the financial domain and integrates SDT and the TAM to explore how gamification increases users' motivation and intention to use PFM apps and how it facilitates their adoption. In particular, as shown in Figure 1, the study analyzes the effects of motivational affordances, that is, game elements, on motivational factors such as perceived competence, perceived autonomy and autonomous motivation, and their

subsequent effects on technology acceptance variables such as perceived ease of use and perceived usefulness. An exploration is then made of users' attitudes toward gamified PFM apps and their intention to use them.

The contribution of this study is threefold. First, although gamification research has grown over the last years, there is an underrepresentation of studies in the finance domain. In addition, given that contextual factors influence the consequences of gamification (Koivisto and Hamari, 2019), results from some fields, such as education and health, might not be relevant in others. Consequently, recent calls have highlighted the need to broaden the scope of the domains under study (Koivisto and Hamari, 2019). This research contributes to the gamification literature by adding new insights into the adoption and use of PFM apps. Second, drawing on two theories, SDT and the TAM, this research provides new insights into consumers' use of PFM apps by exploring how game features influence users' motivations and beliefs about the technologies used. Finally, the research offers practical implications for fintech companies and banks seeking to attract consumers to their gamified finance apps.

2. Theoretical background and research hypotheses

Gamification applies motivational design to persuade individuals to behave in certain ways (Werbach and Hunter, 2012). Thus, understanding the individuals' motivations is key in addressing gamification effectiveness. In this regard, SDT (Deci and Ryan, 2000) has become one of the leading frameworks for gamification research (Tobon *et al.*, 2020).

SDT distinguishes between autonomous and controlled motivation, based on whether individuals behave with a full sense of choice or under pressure (Deci and Ryan, 2015). More precisely, autonomous motivation is based on individuals behaving voluntarily, seeking fun and enjoyment (Ryan and Deci, 2000), acting in certain ways because they identify themselves with the value of the behavior, and find it personally important and valuable (Deci *et al.*, 1996). On the other hand, controlled motivation relates to behaviors undertaken because individuals are controlled, irrespective of whether the control is exerted by external sources (e.g. to obtain a reward or to avoid punishment) or internal (e.g. to satisfy ego needs or to avoid shame) (Deci and Ryan, 2015). Of these two types of motivation, autonomous motivation is more valuable for the individual because it improves his/her performance (Gagné *et al.*, 2015) and psychological well-being (Deci *et al.*, 1996). SDT-based research has analyzed the factors that encourage this form of motivation, finding that autonomous motivation develops when the individual's needs for competence, that is, the feeling that (s)he has mastered his/her own actions and become skilled at an activity (White, 1959; Ryan *et al.*, 2006), and autonomy, that is, the feeling of freedom and of liberty to choose (de Charms, 1968), are satisfied (Ryan and Deci, 2000).

In general, research into gaming has suggested that games foster competence through challenges, rewards and feedback, and autonomy through flexibility to make choices about objectives and tasks (Ryan *et al.*, 2006). Gamification research has also analyzed whether

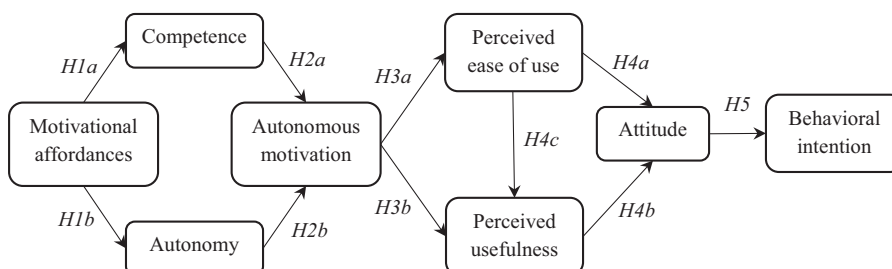


Figure 1.
Proposed model

interacting with different motivational affordances/game elements (e.g. challenges, achievements, points, leaderboards, rewards, badges, progress bars, increasing difficulty levels, cooperation, competition, avatars/profiles, narratives/ meaningful stories, customization) embedded in gamified applications satisfies their users' needs for competence and autonomy. With some exceptions (e.g. Mekler *et al.*, 2017), research has suggested that motivational affordances can help satisfy these needs. For instance, some studies have found that overcoming challenges (van Roy and Zaman, 2019; Wee and Choong, 2019), reaching increasing difficulty levels (Peng *et al.*, 2012), receiving performance feedback (Sailer *et al.*, 2017; Wee and Choong, 2019) and being rewarded (Peng *et al.*, 2012; Suh *et al.*, 2018; van Roy and Zaman, 2019) facilitate users' feelings of competence, as these game elements provide users with a sense of purpose and information on their progress (Sailer *et al.*, 2013). In the same vein, facing challenges (van Roy and Zaman, 2019) and receiving rewards (Suh *et al.*, 2018) have been shown to give users a sense of autonomy as they provide flexibility and choice over tasks. Although some studies have suggested that neither competition nor cooperation with teammates facilitates feelings of competence and autonomy (Sailer *et al.*, 2017; Bitrián *et al.*, 2020), others have argued that competition (Suh *et al.*, 2018; van Roy and Zaman, 2019; Xi and Hamari, 2019), cooperation and social networking features (Xi and Hamari, 2019) can satisfy these needs. Similarly, with some exceptions (Sailer *et al.*, 2017; Xi and Hamari, 2019), most studies have found that motivational affordances related to customization, avatars and meaningful stories are positively associated with higher levels of competence (Wee and Choong, 2019; Bitrián *et al.*, 2020) and autonomy (Peng *et al.*, 2012; Suh *et al.*, 2018; Wee and Choong, 2019; Xi and Hamari, 2019; Bitrián *et al.*, 2020), as having the possibility to personalize profiles and activities enables users to make their own decisions (Sailer *et al.*, 2013; Kim *et al.*, 2015).

As noted earlier, more and more PFM apps are using gamification to enhance their users' experiences. Some apps offer users the possibility to set financial goals and take on personal challenges related to achieving a certain level of savings and reducing expenses in one specific category. In addition, they include real-time tracking of financials, usually depicted in the form of progression charts, so users can monitor their ongoing success toward meeting their goals. They also provide feedback to users in the form of alerts and notifications regarding expenditure, account balances, upcoming bills, etc. Finally, as these apps are individually tailored to each user's needs (e.g. budgeting, planning, investing), they allow customers to personalize their experiences. Based on the arguments set out above, we expect that the motivational affordance–user interaction included within gamified PFM apps will increase their users' perceptions of competence and autonomy. Accordingly, the following hypotheses are proposed:

- H1.* Users' interactions with motivational affordances in gamified PFM apps positively influence their perceptions of (a) competence and (b) autonomy.

SDT proposes that contexts that facilitate the satisfaction of competence and autonomy foster users' autonomous motivation (Deci and Ryan, 2000; Ryan and Deci, 2000). The relationship between need satisfaction and autonomous motivation has been explored in the gamification domain. For instance, research analyzing the use of gamification to promote sustainable consumption and energy conservation behaviors has found that promoting competence and autonomy among users facilitates intrinsic (Wee and Choong, 2019) and identified (Mulcahy *et al.*, 2020) forms of motivation, which are regarded as autonomous motivation (Ryan and Deci, 2000). Similarly, studies into the use of gamification to promote exercise have found that experiencing competence and autonomy increases users' motivation to continue playing the exercise game (Peng *et al.*, 2012). Similarly, autonomy has been associated with autonomous motivation to use gamified exercise apps (Bitrián *et al.*, 2020). Finally, research into work gamification has also found a positive correlation between the

satisfaction of the needs for competence and autonomy and autonomous motivation (Buil *et al.*, 2020; Mitchell *et al.*, 2020). Based on these arguments, we hypothesize that:

- H2a.* Competence positively influences users' autonomous motivation to use gamified PFM apps.
- H2b.* Autonomy positively influences users' autonomous motivation to use gamified PFM apps.

To achieve a better understanding of the effects of gamified technologies, research should focus both on the motivation derived from interacting with gameful affordances and how this motivation enhances users' perceptions of the technologies (Buil *et al.*, 2020).

The TAM (Davis, 1989) proposed that individuals' attitudes toward specific technologies are predicted by two key variables: perceived usefulness and ease of use. Perceived usefulness relates to the user's belief that a system will boost his or her performance, while perceived ease of use refers to the user's belief that using a system will not require extra effort (Davis, 1989).

Previous research has shown that perceptions of ease of use and usefulness are influenced by users' motivations to use systems (e.g. Sun and Zhang, 2006; Buil *et al.*, 2020). When users enjoy operating technology and find it entertaining and motivating, they tend to perceive it as easy to use (Venkatesh, 2000; Venkatesh *et al.*, 2002; Yi and Hwang, 2003; Fagan *et al.*, 2008; Roca and Gagné, 2008; Laumer *et al.*, 2012) and to find it useful (Yi and Hwang, 2003; Roca and Gagné, 2008; Laumer *et al.*, 2012). In the mobile banking context, previous research has reported that experiencing enjoyment promotes greater perceptions of ease of use (Koenig-Lewis *et al.*, 2015; Rodrigues *et al.*, 2016b, c; Santiniti *et al.*, 2019) and usefulness (Koenig-Lewis *et al.*, 2015; Santiniti *et al.*, 2019) of the mobile technology. On the basis of these arguments, we propose that users who are autonomously motivated to use gamified PFM apps will perceive them as easy to use and useful. Hence, we propose the following hypotheses:

- H3.* Users' autonomous motivation to use gamified PFM apps positively influences their perceptions of (a) ease of use and (b) usefulness.

As previously mentioned, users' attitudes toward specific technologies are more favorable when they perceive them as easy to use and useful (Davis, 1989; Davis *et al.*, 1989). The TAM also suggests that when users believe that technology is easy to use and requires minimum time and effort, they perceive it as effective and provides benefits. Therefore, the ease of use of a system also positively influences users' perceptions of its usefulness (e.g. Ong *et al.*, 2004; Shih, 2004; Shang *et al.*, 2005; Venkatesh, 2000).

In gamified contexts, Hamari and Koivisto (2015a) demonstrated that the usefulness of gamified apps is positively related to users' attitudes toward them. In the banking field, previous research has also found that the perceived ease of use and perceived usefulness of mobile banking apps create more favorable attitudes toward mobile banking (Lee, 2009; Akturan and Tezcan, 2012; Mohammadi, 2015; Giovanis *et al.*, 2019). Similarly, when users perceive that using a mobile banking app is easy, they tend to perceive it to be useful (Lee, 2009; Karjaluo *et al.*, 2010; Akturan and Tezcan, 2012; Mohammadi, 2015; Rodrigues *et al.*, 2016b, c).

Early finance apps were based on manual information inputs provided by users, but the newest PFM apps are linked to users' accounts and bank cards and receive transaction data automatically. Therefore, the newest apps are easier to use, more useful and efficient, as their users are not forced to perform unnecessary actions, and they do not rely on the users' memories, which saves them much time (Srivastava, 2020).

Based on these arguments we propose the following hypotheses:

H4a. Perceived ease of use positively influences users' attitudes toward gamified PFM apps.

H4b. Perceived usefulness positively influences users' attitudes toward gamified PFM apps.

H4c. Perceived ease of use positively influences perceived usefulness.

The TAM proposes that having a favorable attitude toward technology is the main determinant of behavioral intention to use the technology (Davis *et al.*, 1989). Previous research has shown that when users have a positive attitude toward mobile apps, they are willing to continue using those apps and recommend them to others (Hamari and Koivisto, 2013, 2015b). Similarly, users' attitudes have been shown to be highly important factors in predicting the use of Internet banking and mobile banking services (Lee, 2009; Akturan and Tezcan, 2012; Baptista and Oliveira, 2016; Muñoz-Leiva *et al.*, 2017; Chauhan *et al.*, 2019; Giovanis *et al.*, 2019). In addition, it has been found that positive attitudes toward mobile applications may lower barriers to adoption (Muñoz-Leiva *et al.*, 2017). Therefore, we hypothesize that:

H5. Users' attitudes toward gamified PFM apps positively influence their behavioral intention to use them.

3. Methodology

3.1 Data collection

To estimate the minimum sample size, the program G*Power (version 3.1.9.7) was used (Faul *et al.*, 2007). For an alpha of 0.05, an effect size estimated of 0.15, a power of 80% and a number of predictors of 2 (the highest number of predictors of a latent variable in the model), a total sample size of 68 would be required. However, to have a more consistent model, it is suggested to double or triple this amount (Ringle *et al.*, 2014).

A sample of 208 users of the Mint app was recruited using the SurveyMonkey Audience service. The number of respondents was above the required sample size and is similar to that of previous studies that have explored the use of gamification in the finance industry (e.g. Rodriguez *et al.*, 2016b, c, 2017; Bayuk and Altobello, 2019).

The characteristics of the sample are presented in Table 2. The Mint app, owned by the Intuit company, was selected because it is one of the most popular PFM apps in the US (Business Insider, 2020). This gamified app provides its users with feedback by rating their achievements and sets up alerts in the form of reminders and notifications. In addition, the app allows users to set budgetary goals in different expense categories, track money movements, bills and expenses and personalize some of the apps' aspects. Therefore, five motivational affordances/game elements (i.e. credit score, alerts, budgets, tracking and personalization) were examined in the study.

3.2 Measurement instrument

All the variables used in the study were adapted from relevant previous literature and measured through 7-point scales (see Appendix). Users' interactions with motivational affordances and their need for competence were measured following Xi and Hamari (2019). Their need for autonomy was measured using items from Xi and Hamari (2019) and Standage *et al.* (2005). Autonomous motivation was measured following Guay *et al.* (2000). Perceived ease of use and perceived usefulness were both measured based on Davis (1989), while attitude was measured following Taylor and Todd (1995). Finally, items from Venkatesh *et al.* (2012) were used to measure behavioral intention.

Category		Percentage
Gender	Men	36.54
	Women	63.46
Age	<31 years old	10.10
	31–40 years old	14.42
	41–50 years old	15.87
	>50 years old	59.62
App experience	<3 months	1.44
	3–6 months	1.44
	6–12 months	5.77
	12–18 months	7.69
	18–24 months	8.65
	>24 months	75
Frequency of app use	Almost every day	10.10
	Once in 2–3 days	8.65
	Once in 4–5 days	3.37
	Once a week	23.08
	Once a month	37.02
	Once in three months	8.65
	Once in six months	6.25
	Once a year	2.88

Table 2.
Sample characteristics

3.3 Common method bias assessment

As the data were collected through a self-reported survey, some procedural and statistical methods were followed to ensure that common method bias was not an issue in this study (Podsakoff *et al.*, 2003). Regarding the procedural methods, the participants freely agreed to participate in the study, and their anonymity was guaranteed. In addition, in the online survey design, the dependent and independent variables were included on different pages of the survey to prevent the respondents from identifying cause–effect relationships among the constructs. As to the statistical methods, common method bias was assessed through a full collinearity test based on the variance inflation factors (VIF). The VIF values ranged from 1.000 to 1.841 (all lower than 3.3). Thus, there is no evidence in this research to suggest the presence of a common method bias (Kock, 2015).

4. Results

As the proposed model includes formative and reflective constructs, partial least squares (PLS) structural equation modeling with SmartPLS 3.0 was used to test the model (Chin, 2010; Hair *et al.*, 2011; Ringle *et al.*, 2015; Shmueli *et al.*, 2016). PLS simultaneously assesses the measurement and the structural model. These two steps are described next.

4.1 Measurement model analysis

First, the formative measurement model for the first-order dimensions was analyzed (Table 3). User interaction with the app's motivational affordances was conceptualized as a second-order formative construct with five first-order factors: credit score, alerts, budgets, tracking and personalization. Following Xi and Hamari (2019), each factor was measured formatively by two indicators, the frequency and the importance of the interactions. External validity was analyzed by assessing the indicators' weights and loadings. Although the weights of the indicators should ideally be statistically significant, Hair *et al.* (2017) argued that indicators with non-significant weights but with high loadings (>0.5) should be retained,

as they contribute to the construct. Thus, the external validity of the model was shown to be acceptable. Thereafter, collinearity was evaluated through the VIF values. The values ranged from 1.902 to 2.952, below the threshold of 5, which indicates an absence of collinearity problems (Hair *et al.*, 2011).

Then, the two-stage approach suggested by Hair *et al.* (2018) was used to assess the second-order formative construct. As Table 4 shows, the external validity was assessed through the indicators' weights and loadings. Following Hair *et al.* (2017), the item "personalization" was removed, as it had neither statistically significant weights nor high loadings. The model was then re-estimated, and the external validity of the remainder of the indicators was shown to be acceptable (Hair *et al.*, 2017). In addition, the model had no collinearity problems, as the VIF values were all below 5 (Hair *et al.*, 2011).

Second, the reflective measurement model was analyzed following Hair *et al.*'s (2017) criteria (see Table 5). The results show that the Cronbach's alpha and composite reliability (CR) of all constructs were greater than 0.7, confirming internal consistency reliability. Then, the individual item reliability for all factor loadings was confirmed, as they were all greater than 0.60 and statistically significant at 1% (Carmines and Zeller, 1979). Convergent validity was also confirmed as the average variance extracted (AVE) values were above 0.5 (Fornell and Larcker, 1981). Finally, discriminant validity was examined using three tests (Hair *et al.*, 2017): cross-loadings, the Fornell–Larcker criterion and the HTMT ratios. First, we checked that all indicators' outer loadings on the associated construct were greater than any of their cross-loadings on other constructs. Next, we confirmed that the square roots of the AVEs of each construct were greater than the inter-construct correlations (Fornell and Larcker, 1981) (see Table 6). Third, we confirmed that all HTMT values were below the threshold of 0.90 and that the bootstrap confidence interval did not contain the value 1 (see Table 7).

Table 3.
Formative measurement model results (first-order constructs)

Construct	Indicator	Mean	SD	Loading	<i>t</i> -value	Weight	<i>t</i> -value	VIF
Credit Score	Frequency	3.99	2.13	0.657	4.197	−0.260	0.864	2.483
	Importance	4.43	2.18	0.986	21.912	1.187	5.721	2.483
Alerts	Frequency	3.77	2.06	0.743	6.330	−0.114	0.395	2.635
	Importance	4.25	2.10	0.998	40.834	1.087	4.840	2.635
Budgets	Frequency	4.09	2.03	0.884	11.397	0.232	0.760	2.952
	Importance	4.58	2.02	0.991	24.336	0.802	2.884	2.952
Tracking	Frequency	5.42	1.85	0.993	27.726	0.855	3.402	2.349
	Importance	5.74	1.69	0.830	7.213	0.181	0.617	2.349
Personalization	Frequency	3.09	1.75	0.824	6.445	0.285	0.959	1.902
	Importance	3.80	1.93	0.978	15.234	0.782	3.019	1.902

Note(s): SD: Standard deviation; VIF: Variance inflation factor

Table 4.
Formative measurement model results (second-order constructs)

Construct	Indicator	Loading	<i>t</i> -value	Weight	<i>t</i> -value	VIF
Motivational affordances	Credit Score	0.680	8.155	0.542	4.841	1.210
	Alerts	0.562	6.477	0.138	1.204	1.384
	Budgets	0.584	6.700	0.154	1.379	1.486
	Tracking	0.768	10.248	0.603	5.625	1.351

Note(s): VIF: Variance inflation factor

Construct	Indicator	Mean	SD	Factor loading	AVE	CR	Cronbach's alpha	Q ²
Competence	COM1	4.73	1.60	0.920	0.810	0.944	0.922	0.246
	COM2	4.89	1.55	0.899				
	COM3	3.94	1.67	0.860				
	COM4	4.84	1.67	0.919				
Autonomy	AUT1	5.54	1.39	0.832	0.730	0.915	0.877	0.181
	AUT2	5.89	1.35	0.895				
	AUT3	5.87	1.42	0.888				
	AUT4	6.16	1.26	0.800				
Autonomous motivation	MOT1	5.40	1.64	0.860	0.679	0.944	0.931	0.315
	MOT2	5.13	1.70	0.896				
	MOT3	5.31	1.62	0.715				
	MOT4	4.99	1.61	0.813				
	MOT5	4.61	1.67	0.826				
	MOT6	4.36	1.70	0.866				
	MOT7	3.69	1.71	0.725				
	MOT8	4.18	1.68	0.874				
Perceived ease of use	PEOU1	5.37	1.52	0.968	0.946	0.981	0.972	0.267
	PEOU2	5.40	1.48	0.975				
	PEOU3	5.32	1.60	0.975				
Perceived usefulness	PU1	5.04	1.58	0.939	0.911	0.968	0.951	0.479
	PU2	5.31	1.55	0.963				
	PU3	5.23	1.59	0.961				
Attitude	ATT1	5.71	1.46	0.957	0.908	0.967	0.949	0.493
	ATT2	5.66	1.50	0.956				
	ATT3	5.55	1.58	0.946				
Behavioral intention	BI1	5.70	1.65	0.888	0.817	0.930	0.887	0.493
	BI2	3.74	1.88	0.872				
	BI3	4.72	1.91	0.951				

Table 5. Reflective measurement model results

Note(s): SD: Standard deviation; CR: Composite reliability; AVE: Average variance extract

	1	2	3	4	5	6	7
1. Competence	<i>0.900</i>						
2. Autonomy	0.528	<i>0.855</i>					
3. Autonomous motivation	0.632	0.565	<i>0.824</i>				
4. Perceived ease of use	0.593	0.637	0.538	<i>0.973</i>			
5. Perceived usefulness	0.638	0.537	0.598	0.676	<i>0.954</i>		
6. Attitude	0.621	0.683	0.707	0.663	0.692	<i>0.953</i>	
7. Behavioral intention	0.552	0.525	0.634	0.559	0.682	0.674	<i>0.904</i>

Note(s): Diagonal elements are the root squared AVE values. Elements below the diagonal are the constructs' correlations

Table 6. Fornell-Larcker test

4.2 Structural model analysis

The next section of the analysis evaluated the statistical significance of the standardized paths through a bootstrapping process, with 5,000 subsamples. It was shown that the model explains 31.5% of the variance of competence need satisfaction, 27.3% of autonomy need satisfaction, 47.4% of the user's autonomous motivation, 28.9% of perceived ease of use, 53.4% of perceived usefulness, 54.9% of the user's attitude and 62.2% of behavioral intention.

Table 7.
Heterotrait–monotrait
(HTMT) ratios

	Competence	Autonomy	Autonomous motivation	Perceived ease of use	Perceived usefulness	Attitude
Autonomy	0.575 [0.456; 0.680]					
Autonomous motivation	0.677 [0.548; 0.778]	0.620 [0.512; 0.717]				
Perceived ease of use	0.626 [0.506; 0.726]	0.688 [0.566; 0.785]	0.566 [0.438; 0.677]			
Perceived usefulness	0.682 [0.568; 0.770]	0.578 [0.463; 0.685]	0.634 [0.512; 0.738]	0.703 [0.583; 0.794]		
Attitude	0.661 [0.542; 0.752]	0.746 [0.619; 0.841]	0.749 [0.665; 0.816]	0.609 [0.560; 0.792]	0.727 [0.610; 0.815]	
Behavioral intention	0.610 [0.480; 0.716]	0.585 [0.472; 0.681]	0.694 [0.604; 0.771]	0.598 [0.471; 0.698]	0.742 [0.641; 0.816]	0.730 [0.628; 0.809]

Note(s): The values in brackets represent the 95% bias-corrected and accelerated confidence interval of the HTMT values

In addition, as the Q^2 values for the dependent variables were positive, the model has predictive relevance (Table 5).

The results obtained from the structural model analysis are presented in Table 8. As can be seen, all the proposed hypotheses are supported. First, interaction with motivational affordances in the gamified PFM app facilitates the satisfaction of the needs for competence ($\beta = 0.56$; $t = 10.55$) and autonomy ($\beta = 0.52$; $t = 8.96$), supporting H1a and H1b, respectively. Both the satisfaction of the need for competence ($\beta = 0.46$; $t = 5.91$) and for autonomy ($\beta = 0.32$; $t = 4.61$) promote users' autonomous motivation to use the gamified PFM app. Therefore, H2a and H2b are supported. In accordance with our predictions, autonomous motivation is positively related to the perceived ease of use ($\beta = 0.53$; $t = 9.11$) and the perceived usefulness ($\beta = 0.33$; $t = 4.16$) of the gamified PFM app, which supports H3a and H3b, respectively. In addition, perceived ease of use ($\beta = 0.36$; $t = 4.29$) and perceived usefulness ($\beta = 0.44$; $t = 5.59$) are positively associated with users' attitudes toward the gamified PFM app, supporting H4a and H4b, respectively. Similarly, perceived ease of use influences perceived usefulness ($\beta = 0.49$; $t = 6.56$), supporting H4c. Finally, users' attitudes toward the gamified PFM app positively predict their behavioral intention to use the app ($\beta = 0.60$; $t = 11.30$). Thus, H5 is supported.

Regarding the control variables, the results showed that the frequency of use of the gamified PFM app positively affected users' behavioral intention to use it ($\beta = 0.41$; $t = 7.95$).

5. Discussion

PFM apps have recently gained popularity among users. To improve users' experiences and increase their motivation to use PFM apps, most have been gamified. However, there has been little research analyzing the effect of users' interactions with gameful affordances on their motivation to use the apps and their adoption. To bridge this gap, this study combined SDT and the TAM and simultaneously analyzed the influence of the motivational factors of perceived competence, perceived autonomy, and autonomous motivation, and the technology acceptance factors perceived ease of use and perceived usefulness, on users' attitude toward gamified PFM apps and their behavioral intention to use them.

Hypotheses	β	t -value	Supported
H1a: Motivational affordances → Competence	0.562	10.553***	Yes
H1b: Motivational affordances → Autonomy	0.522	8.960***	Yes
H2a: Competence → Autonomous motivation	0.463	5.911***	Yes
H2b: Autonomy → Autonomous motivation	0.321	4.618***	Yes
H3a: Autonomous motivation → Perceived ease of use	0.538	9.117***	Yes
H3b: Autonomous motivation → Perceived usefulness	0.330	4.169***	Yes
H4a: Perceived ease of use → Attitude	0.360	4.296***	Yes
H4b: Perceived usefulness → Attitude	0.449	5.598***	Yes
H4c: Perceived ease of use → Perceived usefulness	0.498	6.569***	Yes
H5: Attitude → Behavioral intention	0.602	11.300***	Yes
<i>Control variables</i>			
Experience → Behavioral intention	-0.029	0.630	
Frequency of app use → Behavioral intention	0.416	7.954***	
Gender → Behavioral intention	0.043	0.838	
Age → Behavioral intention	0.021	0.422	
Note(s): *** $p < 0.001$			

Table 8.
Structural model results

The results of this study provide support for the use of gamification in PFM apps. In particular, this study showed that the users' interactions with the motivational affordances embedded in PFM apps (e.g. budgets, tracking, credit scores, alerts) make them feel more competent and autonomous. The impact of various motivational affordances on competence and autonomy need satisfaction has been proven in various contexts, such as exercise (Peng *et al.*, 2012), education (van Roy and Zaman, 2019), information systems (Suh *et al.*, 2018) and energy conservation (Wee and Choong, 2019). However, this issue is still under debate. Other studies in contexts such as online simulations (Sailer *et al.*, 2017), online brand communities (Xi and Hamari, 2019) and exercise apps (Bitrián *et al.*, 2020) have found that the effect of some game elements on competence, autonomy or even both is nonsignificant. Nonetheless, our findings add weight to the argument that motivational affordances have a positive influence on the satisfaction of these needs. In addition, in line with previous research drawing on SDT (Bitrián *et al.*, 2020; Buil *et al.*, 2020; Mitchell *et al.*, 2020), this study proved that when users feel competent and self-determined as a result of using gamified PFM apps, they are autonomously motivated to use them. The study also demonstrated that users' autonomous motivation to use gamified PFM apps leads them to perceive the apps as useful and easy to use. This finding contributes to the current debate about the direction of the relationship between motivation and perceived ease of use (Sun and Zhang, 2006) by showing that the motivation to use PFM apps makes users regard them as more useful and easy to use. In line with the TAM, this research demonstrates that perceiving the app as easy to use promotes the user's perception that the app is useful (e.g. Lee, 2009; Karjaluoto *et al.*, 2010; Akturan and Tezcan, 2012). Moreover, as shown in previous studies (e.g. Lee, 2009; Akturan and Tezcan, 2012; Giovanis *et al.*, 2019), this research demonstrates that users' perceptions of PFM apps' usefulness and ease of use promote favorable attitudes toward them. Similarly, it was demonstrated that a positive attitude leads to a higher behavioral intention to use the gamified PFM app.

5.1 Theoretical implications

This study makes several theoretical contributions to the gamification literature in general and to research into PFM apps in particular. First, compared to other contexts, relatively few studies have focused on the use of gamification in the finance domain. Thus, this study responds to the recent call for academic research into the effects of gamified PFM apps (Bayuk and Altobello, 2019). In addition, as most previous research into app gamification in the finance/banking sector has not focused on the user's interactions with motivational affordances, this study contributes to the literature by providing new insights into the use of PFM apps and how these user–game element interactions affect their users' motivation and their use of the apps. Second, taking into account the lack of theoretical foundations in the gamification literature reported by previous research (Seaborn and Fels, 2015; Koivisto and Hamari, 2019), this study contributes to the existing body of research by proposing and testing a model combining SDT, one of the major theories explaining human motivation, and the TAM, which focuses on the factors that affect new technology acceptance, and which has been used successfully to analyze finance apps (Tam and Oliveira, 2016). In fact, to the best of the authors' knowledge, the present study is the first attempt to combine both theories in this context, providing a better explanation of the antecedents of users' attitude toward gamified PFM apps. Finally, by conducting an empirical study in a real gamified context using previously validated measures, this work overcomes some of the methodological shortcomings reported in previous studies, such as the use of small samples and non-validated measures, and the use of overly descriptive approaches (Hamari *et al.*, 2014; Koivisto and Hamari, 2019; Rapp *et al.*, 2019), and responds to the call for more empirical

5.2 Managerial implications

This study also provides a number of practical implications for PFM app managers and designers, especially for fintech companies and banks seeking to enhance the user experience. First, the design of apps should help their users experience autonomous motivation and, thus, their integrated gamified elements should allow them to feel competent and self-determined. In addition to merely storing financial information about users' cards and accounts, it would be interesting if PFM apps could offer their users the possibility to set personal goals regarding their finances, such as fixing saving objectives for the family's summer holidays, or to buy a new car. This would offer users a feeling of self-determination, as they would perceive a sense of autonomy through being able to customize their app experience. Similarly, this would help to promote feelings of competence, as setting and accomplishing these financial goals would give users a sense of purpose. In addition, providing functionality that will allow users to create specific budgets for the categories that are more important to them personally (e.g. household bills, food, leisure), and let them fix maximum limits for those categories they want to cut (e.g. fashion, technology items), will help them feel more autonomous, and permit them to flexibly customize their experiences. Moreover, to motivate users to achieve their financial goals, PFM apps should offer real-time money tracking and provide visual information in the form of performance graphs/progress bars, so they can see how successful they are in meeting their goals. This will help them feel more competent in the use of the app and to feel purposeful. Similarly, keeping users informed about specific events (e.g. expenditure, account balances, upcoming bills) with in-app alerts and notifications, and rewarding them with scores/virtual badges for their achievements, will also promote feelings of competence and autonomy, and make them more motivated to use the app. In addition, to promote favorable attitudes toward PFM apps they should be designed such that users find them easy to use and useful. Unlike mobile banking apps designed to manage the money users have in one specific branch, PFM apps compile information from different financial sources. Thus, users should be able to link all their accounts and bank cards within the app, so that it automatically receives all the necessary information. The alerts and notifications provided by the app might also enhance perceptions of usefulness.

5.3 Limitations and future research

Despite its substantial contributions, this study has some limitations that offer avenues for future research. First, only one specific PFM app was analyzed. Thus, it would be interesting to replicate this study using other PFM apps. Second, while this study has shown how gamification can increase behavioral intention to use PFM apps, variables related to positive financial behaviors were not considered. Hence, future research might analyze if applying gamification to PFM apps increases their users' financial well-being and financial literacy. In addition, the data was collected at one specific time. Therefore, it would be interesting to analyze the effectiveness of gamification within a longitudinal framework, as this might provide insights into probable causation and long-term effects.

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Constructs, items and sources

Interaction with motivational affordances (adapted from Xi and Hamari (2019))

AFF1	The frequency of interacting with credit score in Mint
AFF2	The frequency of interacting with bill reminder alerts in Mint
AFF3	The frequency of interacting with budgets in Mint
AFF4	The frequency of interacting with tracking in Mint
AFF5	The frequency of interacting with personalization in Mint
AFF6	The importance of interacting with credit score in Mint
AFF7	The importance of interacting with bill reminder alerts in Mint
AFF8	The importance of interacting with budgets in Mint
AFF9	The importance of interacting with tracking in Mint
AFF10	The importance of interacting with personalization in Mint

Competence (adapted from Xi and Hamari (2019))

COM1	I think that I am pretty good when I use this app
COM2	I am satisfied with my performance when I use this app
COM3	I feel like an expert using this app
COM4	I feel like a competent person when I use this app

Autonomy (adapted from Xi and Hamari (2019) and Standage et al. (2005))

AUT1	In this app I have different options
AUT2	I feel free to use this app
AUT3	I feel free to decide what activities to do in this app
AUT4	When I use this app, it is because I want to use it

Autonomous motivation (adapted from Guay et al. (2000))

MOT1	I use Mint because I think that this app is interesting
MOT2	I use Mint because I think that this app is pleasant
MOT3	I use Mint because this app is fun
MOT4	I use Mint because I feel good when using this app
MOT5	I use Mint because I am doing it for my own good
MOT6	I use Mint because I think that this app is good for me
MOT7	I use Mint because of personal decision
MOT8	I use Mint because I believe that this app is important for me

Perceived ease of use (adapted from Davis (1989))

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 (adapted from Davis (1989))

PU1	Using this app enables me to control my finances/expenses
PU2	Using this app makes easier to control my finances/expenses
PU3	I find this app useful to control my finances/expenses

Attitude (adapted from Taylor and Todd (1995))

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

Behavioral intention (adapted from Venkatesh et al. (2012))

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

About the authors

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