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The Impact of Gamification Design on the Success of Health and Fitness Apps

Research-in-Progress

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Abstract

Gamification has been increasingly employed in health-related apps in recent years. However, the effect of gamification design on the success of health and fitness apps remains unknown and has not been investigated before. This study attempts to identify what gamification elements are frequently used in the design of health and fitness apps and to empirically quantify their effects on app downloads and user ratings of these apps. We construct a rich dataset that includes information about the daily downloads, ratings and gamification design elements of 2,462 health and fitness apps on the Apple App Store. Our sample contains 924 paid apps and 1,538 free apps. This study contributes to both the gamification and mobile app literatures and provides important implications for app developers who intend to adopt gamification in mobile app design.

Keywords: Gamification, health and fitness apps, app design, popularity, customer reviews

Introduction

Gamification, the use of game design elements in non-game contexts, has become an increasingly popular way to engage users in various business domains (Santhanam et al. 2016). There is also a rapid development in the healthcare IT area that many health and fitness mobile apps employ gamification in app design to help users prevent and manage disease and monitor health behaviors and vitals (Hebden and Fuemmeler. 2015). Despite the widespread use of gamification elements in the design of health and fitness apps, the effect of gamification use on the success of these apps is unknown and has not been empirically examined. Previous research in the gamification area primarily focuses on the impact of gamification use on user engagement in different contexts, such as educational training (Santhanam et al. 2016), workplace (Suh et al. 2017) and physical exercises (Hamari and Koivisto. 2013). Additionally, prior studies often focus on one single gamification design component in each study. For example, Fitz-Walter et al. (2011) investigate how virtual achievements can help engage university students.

Building on the growing literature of gamification design, this study aims to empirically quantify the economic benefit of gamification use on app success at the app level. Our analyses are based on a large sample of 2,462 health and fitness apps with the language being English and having received at least one user rating on the Apple App Store at the beginning of 2017. This research contributes to the literature and sheds lights on mobile app design in the following aspects: (1) we first identify the gamification elements that are commonly employed in health and fitness apps, and (2) we assess the effects of these gamification elements on app success as measured by the number of downloads and

consumers' evaluation of an app as measured by app ratings. The findings of this study provide important implications for app developers on how to effectively adopt gamification elements in the app design.

Literature Review

Gamification

The term, gamification, initially coined by Pelling (2002), started to gain popularity in the academic community since 2010. One of the earliest and perhaps also the most popular definition of gamification is “the use of game design elements in non-game contexts” (Deterding et al. 2011). Prior research on gamification can be broadly classified into two areas, one on gamification design and the other on the effect of gamification use in specific contexts.

Gamification Design

On gamification design elements, Liu et al (2016) develop a framework for design and research of gamified information systems. In their article, they also discuss game design elements in detail. Many prior studies have examined the elements of game design and how these elements are applied in the development of a game. For instance, Mekler et al. (2013) investigate game elements such as points, leaderboards, and badges. Hunicke et al. (2004) introduce a popular taxonomy called MDA that is widely used by industry professionals. MDA stands for mechanics, dynamics, and aesthetics. Liu et al. (2016) introduce a taxonomy that covers two broad categories: gamification objects and mechanics. Reeves and Read (2009) summarize the “Ten Ingredients of Great Games”: self-representation with avatars; three-dimensional environments; narrative context; feedback; reputations, ranks, and levels; marketplaces and economies; competition under rules that are explicit and enforced; teams; parallel communication systems that can be easily configured; time pressure. Lister et al. (2014) propose six gamification components after reviewing the current body of literature and identify the common themes and components of gamification used or discussed in the literature related with health behavior. The six components are leaderboards, levels of achievement or rank, digital rewards, real world prizes, competitions/challenges and social or peer pressure.

In addition to gamification design elements, Liu et al. (2016) also discuss another important part of gamification design, the design principles. They analyze six design principles, including task congruence principle, personalization principle, technology affordance principle, dynamism principle, recurrence principle and meaningful engagement: the dual-outcome principle. The general principle is “Game design elements incorporated in a target system must match the intended purpose of the system” (Liu et al., 2016, p. 1018), which can find support from prior IS research (Goodhue 1995; Goodhue and Thompson 1995).

Effect of Gamification Design

Prior studies have also investigated the effect of gamification in various contexts. The main focus of research in this stream is to identify whether gamification works and how it works. In general, prior studies show that gamification use can have a positive impact on users' motivation, self-efficacy, learning outcome and so on.

Hamari et al. (2014) conduct a literature review that covers gamification implementations, measurement of effectiveness of gamification, positive and negative results of gamification, application contexts and quantitative and qualitative methods. Eck (2006) finds that gamification can make people focus on the task. Moreover, Susi et al. (2007) and Young et al. (2012) report similar findings. Santhanam et al. (2016) find that even using a gamified Technology-Mediated Training design with different competitive structures, it is still challenging to achieve both goals of higher self-efficacy beliefs and better learning outcomes. Suh et al. (2017) find that although flow experience and aesthetic experience with a gamified information system are forces that complementary with each other, the latter primarily motivates employees to contribute to and keep using a gamified information system.

In summary, while gamification use in health and fitness apps is becoming increasingly popular and researchers have studied the impact of gamification on users' health-related behavior, no prior research has conducted a systematic assessment of the effects of various gamification elements on the success of mobile apps. This will be the main focus of this study.

Health and Fitness Apps

Health and fitness apps focus on the use of mobile devices in supporting health behavior change. Nowadays, more and more health and fitness apps emerge in the mobile app market. In the area of the health and fitness apps, one stream of existing research mainly focuses on the process of developing apps and the effects of these apps. For example, Hebden et al. (2012) describe the process of developing four mobile apps aimed at modifying key lifestyle behaviors associated with weight gain during young adulthood. The other stream of studies investigates the effect of health and fitness apps on the users' behavior. McGillicuddy et al. (2013) find that the respondents in the study feel that mHealth, a mobile app, exactly offers them a chance to increase their self-efficacy and improve provider driven medical management. In addition, the research also finds that it is comfortable for the participants to being monitored with the use of mobile technology. They believe the mobile app will protect their privacy as well. Payne et al. (2015) make the conclusion that mobile apps is really a great way for people to administer their interventions.

Data

Our dataset mainly comes from App Annie, an app market data and insights company in the United States. More than 90 percent of the top 100 App publishers choose to use App Annie's products and services, and more than 600,000 apps use App Annie's Analytics tools to track downloads, revenue, rankings and user reviews/ratings. Overall, App Annie tracks more than 60 billion downloads and \$17 billion in app store revenues (Haberfeld 2018).

We focus on the health and fitness apps released on the Apple App Store in this study. In total, there were 51,804 such apps at the beginning of 2017. Our sample of health and fitness apps is determined by excluding mobile apps that are not in English and have received no user ratings at all. We only focus on English apps because we plan to employ text analytics techniques to identify the gamification elements of an app. The latter constraint is to screen out the unpopular ones, because the number of English apps under this category is still very large (31,235). Our final sample contains 2,462 health and fitness apps, and 924 of them are paid apps, while the remaining 1,538 are free apps. 621 apps provide in-app purchases, while 1,841 apps do not.

A brief descriptive summary of health and fitness apps are presented in Table 1. More than half of the apps are in the English language. Most health and fitness apps do not provide in-app purchases, as the mean of *InAppPurchase* is only 0.08. In addition, only a small portion of apps receive ratings from users.

Table 1. Descriptive Statistics of All Health and Fitness Apps as of January 2017

Variable	Obs	Mean	Std.Dev.	Min	Max
<i>Price (USD)</i>	51,804	0.66	5.78	0	699.99
<i>Size (MB)</i>	51,804	38.63	77.17	0	2,293.76
<i>InAppPurchase</i>	51,804	0.08	0.27	0	1
<i>RatingNumberCurrentVersion</i>	3,495	71.32	423.35	5	17,120
<i>RatingCurrentVersion</i>	3,495	3.59	1.19	1	5
<i>RatingNumberAllVersions</i>	6,562	708.38	8,950.83	5	497,146
<i>RatingAllVersions</i>	6,562	3.65	1.04	1	5

The main independent variable or main variable of interest is whether a specific gamification element is employed or not in a health and fitness app at a certain time point. This information will be extracted

from the version update history of each app, which is publicly available on the App Annie website. We develop a crawler program and download all the version updates of all apps in our sample. When an app releases a version update, it also provides a summary of the main changes introduced in the version update.

Following the behavioral and public health literature, we adopt the six core elements of gamification used by health professionals. They are (1) leaderboards, (2) levels, (3) digital rewards (points, badges), (4) real-world prizes, (5) competitions and (6) social or peer pressure. For an App i at Time t , we construct six dummy variables, $Leaderboard_{it}$, $Level_{it}$, $DigitalReward_{it}$, $RealPrize_{it}$, $Competition_{it}$, and $SocialPressure_{it}$, for each of these six gamification elements, respectively. If an element is used in an app, it is coded as 1. If not, it is coded as 0. Every time an app issues a version update, these variables will be updated according to the latest changes of the app.

To identify whether a gamification element is employed in an app or not, we plan to adopt two different approaches. The first approach is to define a list of distinct keywords for each gamification element and then perform a keyword searching and matching on all version update histories. This approach is fast and easy to implement, but the disadvantage is that the accuracy may not be perfect. The second approach is to involve human coders to read the version update histories and manually identify the gamification elements introduced in each version update. This approach is more accurate, but is likely to take more time and effort given the large sample size.

The dependent variables are daily downloads and the average ratings associated with different versions of an app. The daily downloads data is not free and will be purchased from App Annie for the year of 2017. Ratings and reviews data are publicly available on the App Annie website.

Hypotheses

The main research question we try to answer is whether the use of specific gamification elements has a positive effect on the success of health and fitness apps. We measure app success in two ways, number of app downloads and average rating of the app. We propose the following two hypotheses for empirical testing.

H1: The use of gamification elements in a health and fitness app is positively associated with its number of app downloads.

We argue that when a health and fitness app adds certain gamification elements, it would potentially make the app more popular among mobile users. To examine and quantify the specific effects of the six core gamification elements introduced in the Data section, H1 can be tested as six sub-hypotheses for each of the six core gamification elements.

H2: The use of gamification elements in a health and fitness app is positively associated with the average rating it receives from mobile users.

We argue that the use of gamification elements in health and fitness apps will be positively perceived by mobile users. If a health and fitness app employs more gamification elements, users would be more likely to give higher ratings for this app. Similarly as H1, this hypothesis will also be tested for each of the six core gamification elements.

Empirical Analysis

For the first hypothesis, we estimate the following panel regression model to test it:

$$\text{Log}(\text{Downloads}_{it}) = \alpha + \text{Gamification}_{it}'\beta + \gamma_1 \text{Day}_t + \gamma_2 \text{App}_i + \gamma_3 \text{Update}_{it} + \varepsilon_{it}$$

- Downloads_{it} is the daily number of downloads for a health and fitness app.
- Gamification_{it} is a vector that describes the use of gamification elements by App i on Day t . Each element of the vector is a dummy variable. If a gamification element is used in the app, the corresponding element's value is 1. If not, the value equals to 0.

- Day_t and App_i are vectors of day and app dummies (i.e., app and time fixed effects). All time-invariant app characteristics such as free vs. paid app, app price, and whether in-app purchase is offered or not, are accounted for by the app fixed effects.
- $Update_{it}$ is a dummy variable to control for the effect of new updates on downloads. If App_i issues a version update on Day_t , it equals to 1. If not, it equals to 0.
- ε_{it} is a stochastic disturbance term.

For the second hypothesis, we estimate the following panel regression model to test it. Because user ratings are not received on every day and can be sporadically posted for most apps (except the most popular ones), we focus on an app-version panel data instead of an app-day panel data. We consider all versions released for each app in 2017.

$$Rating_{iv} = \alpha + Gamification_{iv}'\beta + \gamma_1 Month_v + \gamma_2 App_i + \gamma_3 RatingNumber_{iv} + \varepsilon_{iv}$$

- $Rating_{it}$ is the average rating of all reviews associated with $Version v$ of $App i$.
- $Gamification_{iv}$ is a vector that describes the use of gamification elements by $App i$ in its $Version v$. Each element of the vector is a dummy variable. If a gamification element is used in the app, the corresponding element's value is 1. If not, the value equals to 0.
- $Month_v$ is the vector of month dummies indicating the calendar month in which $App i$ releases its $Version v$. This is to control for the common time shocks that affect all the app updates in each specific month.
- App_i is the vector of app dummies to control for all time-invariant app characteristics.
- $RatingNumber_{iv}$ is the number of ratings received by $Version v$ of $App i$.

Expected results

For the H1, the use of gamification elements in a health and fitness app is expected to make the app more popular. If the coefficient of a gamification element is significantly positive, it suggests that this gamification element has a positive effect on the number of downloads for the app. If the coefficient is significantly negative, it suggests that the specific gamification element has a negative effect on the number of downloads. Otherwise, it suggests gamification elements are not correlated with app downloads.

In addition, from our empirical results we can also identify what elements are most effective for making a health and fitness app more successful in terms of downloads, which would provide important guidance to app developers on how to create successful apps.

Similarly, for the H2, the use of gamification elements is expected to have a positive effect on mobile users' ratings of a health and fitness app. If the coefficient of a gamification element is significantly positive, it suggests adding this element to a health and fitness app can generate more positive online word of mouth (WOM). If the coefficient is significantly negative, it suggests using this specific gamification element would lead to more negative online WOM. Otherwise, it suggests that gamification design does not significantly affect online WOM.

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