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Updating APP to Improve Users' Satisfaction: Insights from users' Review

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Full Research Paper

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Abstract: Users' satisfaction is an important indicator of App quality, and version updating is an important means for developers to respond user requirements. Incorporating user reviews into iterative delivery of new App versions would improve the quality and ratings of Apps. Most of existing research analyzed App attributes' influences on customers' satisfaction from the application level, but the influences on users from the perspective of the version level has more practical implications and may has the underlying relationship with customers' satisfaction. According to the dimensions of managerial response, this paper explores the impacts of response consistency and response timeliness on users' satisfaction. Empirical analysis was conducted based on 4797 versions and 463176 comments from 241 shopping apps in Apple App Store on "qimai" website. The results show that response consistency and response timeliness both have a significant positive impact on users' satisfaction.

Keywords: App version; user review; users' satisfaction; managerial response

1. INTRODUCTION

The popularity of mobile terminals has promoted the rapid rise of the Software Application for Mobiles (App) market. According to the China Internet Network Information Center (CNNIC) data, as of June 2021, the number of mobile Internet users in China was 1.007 billion, each of which installs 63 apps and is used 6.7 hours averagely. Not only is the number of apps for individual users soaring, but many enterprise-oriented apps are also transferring to mobile. The mobile application market has become a hyper fast-growing market with huge demand, which is regarded as the future of the software industry.

Mobile App stores provide a unique platform for developers to quickly deploy software delivery and update. Moreover, it can provide a dialogue channel between developers and users: users indirectly participate in App update design through comments and ratings on App versions, and developers can receive outside voices and respond to them. A user's rating represents how satisfied they are with the App, which in turn is closely related to the developer's interests. A survey shows that 77% of users will not download or use an App with a rating lower than 3 [1], and every 1 point increase in user rating can increase the economic income of developers by 5%-9% [2]. Therefore, the continuous updating of multiple versions of App has become a popular way for developers to enhance service and improve satisfaction.

Existing studies have paid attention to the uniqueness of App updates and their importance to users' satisfaction, analyzed the impacts of App attributes and version updating deployment on users' satisfaction from the perspective of developers[3, 4], and abstracted user requirements by semantic mining from user comments with different algorithm [5-8]. Currently, the research focus is more on the effective mining of content, focusing on the mining methods and processes. In fact, the different developers in the process of version updating respond to users' comments with different extent. However, whether the response behavior makes sense, also the question of correlation between the degree of response and users' satisfaction has not yet been empirically studied. So this paper tries to explore the influences of developers' responses to users' comments on their satisfaction, and to help developers improve user experience.

App store divides apps into 26 categories, including shopping, social networking, tourism, news games and so on, according to application types. Considering the influence of the number of user groups, user utilization rate,

number of App products, and other factors on sample size, and data concentration, this paper selects shopping apps as research objects, to study the impact of App version updating on users' satisfaction.

2. BACKGROUND

2.1 App version updating

Compared with traditional software, apps are unique in that developers can iterate quickly, deploy updates easily, and improve the quality of software constantly. Scholars mainly study the frequency of updates and the effect of updates.

(1) Version updating frequency

App version updating frequency, which has been studied on users' emotions, the speed at which users install updated software, and the downloads after the update. Stuart McIlroy found through the tracking of App version updatings that the update frequency would not generate negative emotions for users [9], but Maleknaz Nayebi's research showed that users prefer to install apps with low update frequency [3]. Ed Novak's research measured the speed of user experiencing software updates, and the delay time between application update and actual installation According to his results, more than 10 of the 12 most popular apps are updated more frequently than once every two weeks[10]. Every 56 hours, a user may install at least one app averagely. W.Liu found that App version updatings significantly increased user downloads within 10 days, but the effect disappeared after 45 days[11]. But the effect of version updating frequency on users' satisfaction is unclear.

(2) Version updating effect

Developers are constantly making changes to their in-store apps, but the results aren't always satisfying. Some scholars analyze the reasons behind particular updates (such as failed updates or urgent updates). Safwat Hassan analyzed and studied the causes of the failed parts, found the sharp rise in user negative comments after their updates, and then divided the update into the emergent update and the general update. It is found that the emergent update would receive higher users' satisfaction. The reasons for failed updates are more likely to be application crashes, user interface, and other version-level problems. These problems appear always at the version level instead of application level[1, 12]. Chong Wang found by analyzing version updating logs that developers pay more attention to the realization of non-functional requirements than functional requirements during version updating, among which usability and maintainability are the most frequently mentioned non-functional requirements [12]. However, there is a lack of studies on the effects of more generalversion updatings.

2.2 Managerial responses

Managerial Responses (MRs) refers to the management communication adopted by managers to realize service recovery where consumers express their attitudes and opinions on services or products. Its goal is to provide economic or social resources to compensate for customer losses caused by a service failure. In response to customer complaints, service providers can provide a variety of resources, from financial compensation (such as relief of this service) to social resources (such as apology), to adjust customers' perception of fairness and justice to influence customers' satisfaction[13] and improve the reputation of the enterprise[14]. Some scholars have found that compensation is an important way of remedial efforts, and online mode is more convenient. So operators adopt the way of MRs to users of online comments to realize service recovery[15].

In the service industry, MRs have been proven to significantly improve customers' satisfaction and thus corporate performance. Taking the hotel industry as the research object, Ye Qiang confirmed that MRs to users with low ratings would significantly improve their satisfaction, but the users who observed other users receiving MRs did not receive the same treatment, and their satisfaction then would be significantly reduced[16]. Stuart E.Levy's research also confirmed that hotels with the highest online ratings were able to make good use of MRs methods, and were more receptive to customer feedbacks. They would apologized for customers' poor experiences,

and carefully explained the reasons for service failures[17]. Karen L. Xie also proved the promotion effect of MRs on enterprise performance by data analysis[18]. Biagio Palese's further exploration of the effect of MRs shows that the consistency of review response positively affects the competitive performance of hotels[19].

Some scholars believe that online comment response has two main functions: as an efficient and prudent mechanism to solve problems, and also as a way to establish deeper relationships with customers [20]. For apps, the most important means for developers to respond to the appeal of online reviews is to release a new version of the App. At the same time, users can get the self-satisfaction from participation and establish a deeper relationship with developers. With the same in the service industry, however the mobile application field has not been empirically studied about the value of MRs.

3. RESEARCH MODEL AND HYPOTHESES

Given the important role of MRs in improving users' satisfaction, this paper divides the developers' MRs to users in version updating into response consistency and response timeliness, and then explores their influence on users' satisfaction. The research model is shown in Fig.1. In this paper, the semantic similarity between version updating log and user requirements is measured as response consistency, and the number of App version in the past year is measured as response timeliness, and the user's rating on current version is measured as users' satisfaction[21]. In order to control the other factors, App attributes (such as App publish time, number of apps from the same developer, platform recommendation, free or not) and user comments (such as comment length and number of comments) are taken as control variables[22].

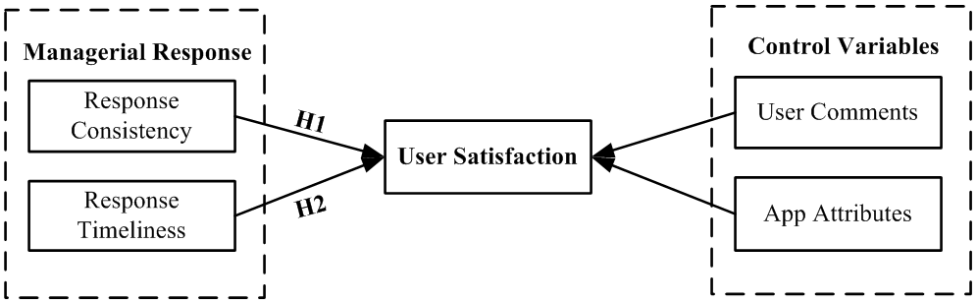

Figure 1. Research model

3.1 Response consistency

Users participate in App update design by releasing rating and comments, and developers manage and respond to users by releasing new versions. According to user participation theory, users can obtain their needs in emotion, self-creation, and self-realization by participating in App update design[23], and user participation is closely related to the success of software[24-26]. The MRs of developers are clearly fed back to users in the form of version updating logs. However, not all developers respond to all the requirements of users. Different developers respond differently to user participation, and the satisfaction degree of users is also different.

H1: The more consistent the developer's response to the users' requirements, the higher the users' satisfaction.

3.2 Response timeliness

Developers respond to users in the form of releasing a new version. On the one hand, users can use the application with better performance to improve user experience; on the other hand, downloading and installing the updated version is a complicated behavior for users, which requires a certain amount of time and other efforts or costs. Previous scholars have carried out many studies on App version updating frequency, but different scholars hold different views. Stuart McIlroy's research shows that high version updating frequency will not lead to negative emotions of users[27], while Maleknaz Nayebi believes that users prefer apps with low update frequency. In the researches on update frequency, most scholars adopt the emotional attitude of user comments and the rate

of installing the new version as the measurement variables of users' satisfaction[3].Rating, as an important expression of user attitude, indicates the users' satisfaction. This paper studies the influence of update timely on the App version rating of users as a measure of users' satisfaction.

H2：The timelier the developer's response to the users' requirements, the higher the users' satisfaction.

4. DATA AND METHOD

4.1 Data collection and measures

The data in this paper comes from the website of the Domestic App market "qimai" (www.qimai.cn), which is a professional mobile application data analysis platform in China and can provide multi-dimensional data of iOS and Android App markets at the same time. This article crawled the data about the type of site shopping App, including app's version logs, corresponding user comments, and publish time, the number of developed applications of each developer, whether recommended by platform, whether free and other properties from July 7, 2020 to July 7, 2021.There are 297 shopping Apps, eliminated some abnormal data (such as: No version has been updated within one year, the product has been removed from the shelves during collection, and there is no product description). After that, the final data set for this paper includes 241 apps with 4797 updated versions and 463176 reviews. Text processing such as word segmentation and deletion of stop words for user comments and version logs.

Table 1. Variables and their measures

Variables	Measures
Independent Variables	
Response Consistency（RC）	Match the App version updating log with user requirements
Response Timeliness（RT）	The number of updated versions of this App in the last year
Control Variables	
App Attribute	
Publish Time（PT）	App launch time (in days)
Same developer application（DA）	The number of apps developed by the developer of the App
Whether Recommend（WR）	Whether App is recommended (1 = "Yes" and 0="No")
Whether Free （WF）	Whether the App is free (1 = "Yes" and 0="No")
User Comments	
Comments Account（CA）	The number of user comments in that version
Comments Average Length（CL）	The average length of user comments for that version
Dependent Variables	
Users' Satisfaction（US）	User ratings for the version

4.2 Descriptive statistics

This paper conducts a preliminary descriptive statistical analysis of all variables and finds that the variance value of the comments number and publish time is too large, which will be processed in the subsequent analysis. The following table shows the descriptive statistics of the above data items.

Table 2. Descriptive statistics

Variables	Unit	Max	Min	Mean	SD
US	—	5	0	4.456	0.664
RC	—	0.536	0	0.275	0.123
CA	Piece	20550	0	96.560	582.092
CL	Byte	78	0	23.161	24.555
PT	Day	4435	49	1788.710	1062.779
RT	Piece	90	0	31.350	17.932
DA	Piece	159	1	8.020	16.502
WR	—	1	0	0.240	0.426
WF	—	1	0	0.990	0.105

4.3 Semantic similarity analysis

Commonly used similarity calculation methods include Euclidean Distance, Jaccard Similarity, Cosine Similarity etc. Euclidean Distance is used to calculate the absolute distance between two vectors, which is very sensitive to the position and order of text. So it is more suitable for coding detection and other fields requiring higher accuracy, not suitable for text similarity analysis. Jaccard Similarity is suitable for text matching with low text sequence and low requirement for word order. When a certain word appears frequently in the text, the similarity will be directly judged to be 100%.

Cosine Similarity is to calculate the included Angle of two space vectors to measure the similarity between them, which can well solve the problem of inconsistent measurement standards. Meanwhile, it considers the factor of word frequency, which can make up for the defects of the above method. In order to solve the problem of indiscriminate assignment in cosine similarity, this paper uses TF-IDF method to extract keywords from documents and then uses cosine similarity to calculate consistency.

(1) Keyword extraction

TF - IDF (word frequency, inverse document frequency) algorithm is a kind of statistical method, to evaluate a word for a set of files or a corpus of one of the importance of the document, that the importance of words as it is directly proportional to the number of occurrences of increase in the file, but at the same time as it is inversely proportional to the frequency of fall in the corpus. This algorithm has been widely used in data mining, text processing, and information retrieval.

Word frequency (TF) indicates how often a term appears in document D. The same word in a long document may have a higher frequency than in a short document, regardless of the importance of the word. Where the total number of files in the corpus is D, DJ represents a document in the corpus, and TI represents a word in a specific document. $N_{i,j}$ is the number of occurrences of a certain word.

$$TF_{ij} = \frac{n_{i,j}}{\sum_k n_{k,j}} \tag{1}$$

Reverse document frequency (IDF) is a measure of the general importance of a word. The IDF can be obtained by dividing the total number of files by the number of files containing the term and taking the logarithm of the resulting quotient, if there are fewer documents containing the entry t, the smaller n is, the larger IDF is, it indicates that the entry T has a good classification ability. If the number of documents containing entry T in a certain category is M, and the total number of documents containing t in other categories is K, it is obvious that the number of documents containing t is n= M + K. When M is large, n is also large, and the IDF value obtained according to the IDF formula will be small, indicating that the classification ability of entry T is not strong.

$$IDF_i = \log \frac{|D|}{|\{j : t_i \in d_j\}|} \tag{2}$$

In this paper, TF-IDF model is used to extract key words from the text of user comments and the text of version updating log, which can filter out common words well and retain important words.

$$TF\text{-}IDF = TF \times IDF \tag{3}$$

(2) Semantic similarity calculation

In information retrieval, each term is assigned a different dimension, and a dimension is represented by a vector whose values on each dimension correspond to the frequency of occurrence of the term in the document. Cosine similarity thus gives two document similarities. Where A_i and B_i represent each component of vector A and vector B respectively. The cosine of the 0 degree Angle is 1, and the cosine of any other Angle is not greater than 1. Its minimum value is minus 1. The cosine of the Angle between the two vectors determines whether they point roughly in the same direction. When two vectors have the same direction, the cosine similarity value is 1. When the Angle between the two vectors is 90°, the cosine similarity value is 0. Cosine similarity is -1 when two vectors are pointing in opposite directions. It just depends on the direction the vector is pointing in. Cosine similarity is usually used in positive Spaces, so the value given is between -1 and 1.

$$\cos\theta = \frac{\sum_{i=1}^{n}(A_i \times B_i)}{\sqrt{\sum_{i=1}^{n}(A_i)^2} \times \sqrt{\sum_{i=1}^{n}(B_i)^2}} \tag{4}$$

5. RESULTS

5.1 Multicollinearity analysis

To reduce the kurtosis and skewness of the variables, logarithmic processing is performed on the two variables due to the large variance of version reviews and publish time. VIF values of all variables are less than 5, indicating that there is no multicollinearity between variables. The results are shown in Table 3.

Table 3. Correlation between variables

Variables	US	RC	LogCA	CL	PT	RT	DA	WR	WF	VIF
US	1.000									
RC	.149	1.000								1.196
LogCA	.084	.245	1.000							1.109
CL	-.010	.077	.132	1.000						1.029
LogPT	.090	.234	.103	-.010	1.000					1.210
RT	.106	.038	.151	.057	.182	1.000				1.100
DA	-.032	.120	.069	.021	.025	-.007	1.000			1.030
WR	.050	.306	.181	.100	.377	.215	.136	1.000		1.307
WF	.257	.111	.069	.019	.041	.136	-.002	.054	1.000	1.032

5.2 Linear regression

Since the users' satisfaction and is a continuous dependent variable, this paper chooses linear regression analysis, and uses SPSS to analysis the data. The results are shown in Table 4.

In model 1, only control variables are added. In this paper, basic App attributes (such as App publish time, number of apps from the same developer, whether recommended, whether free) and user comments (such as comment length and number of comments) are taken as control variables. The results show that, except for

platform recommendation, other control variables all have significant effects on users' satisfaction. The length of users' reviews and the number of apps by the same developer have a negative impact, while the time of App publish, charging status and the number of reviews have a positive impact.

In model 2, control variables and independent variables are included. Main joined the response consistency and response timeliness of two independent variables, the results showed that both independent variables have significant positive impact on users' satisfaction, namely the developer response to user requirements the higher the degree of consistency and timeliness, the higher the satisfaction of the users.

Table 4. Linear regression results

Model	**Model1**		**Model2**	
Variable	**B**	**Sig.**	**B**	**Sig.**
Control Variables				
LogCA	.048**	.000	**.027***	.011
CL	-.001	.111	**-.001***	.048
LogPT	4.510E-005**	.000	**3.099E-005****	.001
DA	-.002**	.006	**-.002****	.001
WR	.008	.725	-.043†	.079
WF	1.606**	.000	**1.498****	.000
Independent Variables				
RC			**.638****	.000
RT			**.002****	.000

Note: *** p < 0.01, ** p < 0.05, * p < 0.10

5.3 Robustness check

This paper explores the robustness of the results. We consider that the longer the App is on the shelf, the stronger its unobserved dynamics are, and the weaker the impact of version updating on users' satisfaction is. We repeated our primary estimations excluding outlier observations in the terms of the publish time. Following the standard deviation method[28], the projects with a publish time which exceed three standard deviation about its mean were exclude from the estimation procedures. 4437 data items, about 92.5% of total observations, were kept for further estimation. We have re-estimated our major estimation for the subsample. The results using the subsample are shown in Table 6. Most of our results remained unchanged in terms of magnitude and significance compared to the full sample estimation, suggesting the robustness of our results.

Table 5. Robustness checks: Excluding outlier observations (Publish Time)

Model	**Model1**		**Model2**	
Variable	**B**	**Sig.**	**B**	**Sig.**
Control Variables				
LogCA	.056	.351	**.020****	.018
CL	.000	.732	**.000****	.047
LogPT	.000***	.000	**.000*****	.000
DA	-.001	.351	**-.001***	.077
WR	.016	.630	**-.105*****	.002
WF	1.618***	.000	**1.399*****	.000
Independent Variables				
RC			**1.343****	.000
RT			**.005*****	.000

Note: *** p < 0.01, ** p < 0.05, * p < 0.10

6. DISCUSSION

The research results of this paper mainly include:

First, response consistency has a significant impact on users' satisfaction. The higher responsiveness of user comments, the higher satisfaction of users. Compared to the developers innovating blindly, users are more focused on their own requirements. Developers should focus more on meeting requirements in the balance between creating and meeting requirements, such behavior is more likely to win the user's favor. Users are willing to respond to developers' efforts by giving high ratings.

Second, the response timeliness plays an important role in improving users' satisfaction. Research shows that the behavior of developers constantly updating App versions to improve App quality can have a positive impact on customers. Users will not feel bored by frequent software updates, on the contrary, they will be delighted because of the software quality continuous improvement and the continuous optimization of function design. Therefore, developers should continue to track and monitor application usage and actively update and iterate to achieve better service results.

Third, platform recommendation has no significant impact on users' satisfaction, but the users' satisfaction will be affected by the payment status, App publish time and other factors. The results show that users pay more attention to the application itself and do not change their attitude towards the application because of the platform recommendation. Developers should focus on responding users' requirements, which will more directly improve users' satisfaction and thus lead to higher revenue.

6.1 Implication for research

First, this paper enriches the application scenarios of MRs theory and user participation theory. It broadens the application scope of the theory. Previous studies have widely applied MRs theory to the hospitality industry, but there is still a lack of relevant research in the field of software development. The design and use of App are essentially to provide users with a service, and the quality of service is directly related to the revenue of App. MRs can improve the service quality of App and achieve higher users' satisfaction.

Second, the research results of this paper show that App version updating has a significant impact on users' satisfaction, and the content and frequency of version updating have a positive impact on users' satisfaction. Existing research only explore the influence of partial update characteristics on users' attitudes, in fact, developers do two aspects of efforts to update version. On the one hand is to update the content, the developer can choose to response of demand put forward by the user comments, also can choose according to their plans to innovate, and the results show that the version updating deployed according to user needs can gain users' favor. On the other hand is the choice of the update frequency, the different developers for the disparity in the version of software update, some developers will actively deploying software updates, constantly improve the quality of software, some developers are seldom update their App stores, the research results show that frequent updates the software will improve users' satisfaction.

6.2 Implication for practice

From the perspective of version, this paper studies the influence of version updating on users' satisfaction. When studying the influencing factors of users' satisfaction, scholars mostly explore the influence of App different attributes on satisfaction from the perspective of App. However, users' ratings and comments are dynamic, and users can rate their preferences for a certain version. Compared with the overall attributes of the App, it is easier to find specific update problems and update directions from the perspective of the version. It has practical guiding significance for developers.

This article takes App version updating as the research object, and the semantic similarity between user reviews and version logs is used as the satisfaction degree of users for version updating, then studying the influence of version updating on users' satisfaction. This paper explores the scholars and developers pay attention

to the user reviews and research whether has practical value, and whether can bring tangible benefits to the developers for the first time.

6.3 Limitations and future research directions

There are still some limitations in this paper, which deserve further study. First, this paper only takes shopping apps as the research objects, and an increasing types of apps should be paid attention to explore whether the impact of MRs on satisfaction will be interfered by App types in subsequent studies. Second, the calculation method of semantic similarity analysis used in this paper is not mature, and the accuracy of scoring needs to be improved.

7. CONCLUSION

App version updating is an effective means for developers to respond users' requirements. In order to explore whether developers' MRs has an impact on users' satisfaction, this paper divides two behaviors of response into response consistency and response timeliness. Then we analyze their impacts on users' satisfaction respectively. Using 241 shopping apps on "qimai" website as examples, the empirical research is carried out. The results show that the response consistency and response timeliness have a significant positive impact on users' satisfaction. The research provide more valuable suggestions for developers. Developers should focus more time and energy on users' comments. It is very important and necessary for developers to manage user responses.

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