

How the app designs influence the app use and optimization measures in Chinese internet market

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Abstract. With the rapid expansion of Chinese Internet mobile app market, being conscious of the mobile app success determinants performs a vital aspect for enterprises. To overcome the common strait that many enterprises fail to achieve profitability by exploiting commercial mobile applications on account of few app downloads and low customer utilization rate, this essay mainly focuses on the predicament that application operation is confronted with in the current Chinese mobile app market and interprets three general interfering factors affecting app profitability. With selected data and correlation analyses, it confirms the impact icon's aesthetic design, customer satisfaction and customer loyalty on improving the profitability of mobile applications. According to the research results, some feasible optimization measures are proposed for mobile application developers. The results could help assist entrepreneurs in making profits by improving app user utilization. However, some objective factors and limitations are ignored in the discussion of influencing factors and more in-depth researches are suggested.

Keywords: App; Aesthetic design; Customer satisfaction; Customer loyalty; Customer loss.

1. Introduction

Since 2021 witnessed soaring Chinese netizens which has reach to about 1.011 billion people [1], an enormous Chinese network marketplace has arisen for commercial mobile app enterprises. As software exclusively exploited for mobile electronic equipment, apps are downloaded and used habitually owing to various application collocations. The term application collocation is generally defined as the functional design or the operation mode of mobile application programs [2], which is the work product of company program development practitioners. However, the common strait is that many enterprises fail to achieve profitability by exploiting commercial mobile applications on account of few app downloads and low customer utilization rate. This is experienced especially in hyper-competitive Chinese app marketplace environment [3] with over 740 thousand mobile app programs being eliminated through competition in 2021 [1]. With the rapid expansion of Chinese Internet mobile app marketplace, being conscious of the mobile app success determinants performs a vital aspect for enterprise app developers [4]. This essay mainly focuses on the predicament that application operation is confronted with in the current Chinese mobile app marketplace and interprets three general interfering factors affecting app profitability. It is followed by quantitative analyses on the relationship between the explanatory variables, x , and the response variables, y . Using datasets collected from specialized Chinese mobile application analysis platform, these correlation analyses will strive to confirm that there would be certain correlations between selected variables. It will attempt to advocate the methods for enhancing mobile app utilization and give evaluation about the current Chinese mobile app marketplace conditions and its envisioned future.

2. Aesthetic design of app icons

2.1 The disclosed problem and practical solutions

Firstly, applications could be unable to appeal to a great quantity of customers when it comes to launch, is generally regarded as a highly typical difficulty faced by the Chinese network application marketplace. Although the emergence of the COVID-19 epidemic has contributed to the surge of Chinese network business in certain degree, the hyper-competitive commercial competition has still

saturated Chinese mobile program development marketplace [5]. The direct manifestation of this situation is that mobile applications are continuously put into the marketplace and eliminated from the marketplace at all times. The overloaded mobile pages of the Chinese app store could result in blundering away potential target customers of newly launched mobile applications to a large extent [5]. Therefore, the representative dilemma while launching newly developed mobile applications is the lack of user attention. If netizens and mass media could pay more attention to the newly launched products to a certain extent, the frequency of downloading mobile software applications might increase significantly [6]. As the essential and tough product operation period of the whole life cycle, the real performance during the app introduction stage could heavily determine the length of life cycle of the product [4]. The importance of logo design to product identification has been revealed by previous research results, which is to significantly promote the public attention to newly launched app programs. Based on the study results of Guzman and others on the influence of logo design in the process of app operation, a generally effective method to attract the attention of mobile app users is to apply excellent aesthetic design into the pictures of app icons [7]. Icons, which are considered as small images with conceptual graphical signals, could occupy the main field of the app display in the App Store. In the display page of the App Store, when a considerable number of application icons appear at the same time, icons with unique aesthetic design would tend to stand out and attract more users. Scholars Hou and Ho believe that attractive icons could arouse users' curiosity and force them to learn more about applications [8]. More importantly, their research results also state that icons perform an essential aspect in stimulating user interest and intention.

2.2 Correlation analysis

According to Stine and Foster, correlation is generally considered as a standardized measurement of association between two numerical variables, which is proved to be always between -1 and +1. Since the correlation has no units, this measurement could be unaffected by the scale of variables' metrics [9]. Therefore, the certain connection between application icons' aesthetic design and the app downloads will be tested and verified by applying quantified numerical values successively to the correlation analysis.

By consulting the actual time app downloads in China App Store in August 2022 from Qimai research institute [1], the top 10 iPhone downloads applications and their corresponding downloads are obtained. Table 1 shows the detailed ranking and data and Figure 1 reveals the top 10 iPhone Downloads App's Icon Images.

Table 1. China App Store iPhone Downloads Ranking - August 2022

Ranking	APP	Downloads
1	SubwaySurfers - Official Chinese Version	8532178
2	Pinduoduo	7273393
3	Tik Tok	6419281
4	National Anti-fraud Center	5791145
5	Kwai	5749989
6	Capcut	5114450
7	Quark	4530798
8	Kwai Extrem Edition	4464060
9	WeChat	4463214
10	Tik Tok Extreme Edition	4389057



Figure. 1 Top 10 iPhone downloads app's icon image

Based on the previous research results of Wang and Li, the color, complexity and symmetry of app icons are identified as the potential main factors that might affect application icons' aesthetic design [4]. These three image factors are quantified by the computer image processing technology. Take 0 as the representative which has few color types, low brightness, simplicity, or asymmetry. Take 1 as the representative having rich colors, high brightness, complexity, or symmetry. Supposing that these three image factors influence equivalently on application icons' aesthetic design, the quantified numerical value of an app icon image will be calculated as the arithmetic mean of the three image factors' values. The detailed scores of these 10 apps are shown in the Table 2 below. By adding the quantified values of color, complexity and symmetry and dividing them by 3, the comprehensive icons' aesthetic design score of an app could be obtained.

Table 2. Detailed Sores of Top 10 Apps

Ranking	APP	Score			Comprehensive score
		Color	Complexity	Symmetry	
1	SubwaySurfers	1	1	0	0.6667
2	Pinduoduo	0.5	1	1	0.8333
3	Tik Tok	0.5	0.5	0	0.3333
4	National Anti-fraud Center	0.5	1	1	0.8333
5	Kwai	0.5	0	0	0.1667
6	Capcut	0	0	1	0.3333
7	Quark	0.5	0	0	0.1667
8	Kwai Extrem Edition	1	0	0	0.3333
9	WeChat	0.5	0	0	0.1667
10	Tik Tok Extreme Edition	0.5	0.5	0	0.3333

Take the comprehensive scores of application icons' aesthetic design as explanatory variables, x , and the app downloads as response variable, y . The numerical values of the explanatory variable, x , and the response variable, y , are shown in detail in the following Table 3. Using these data, establish a rectangular coordinate system and complete the scatterplot in the Figure 2. By function calculation, the correlation between x and y is $0.66269351 \approx 0.66$, which indicates that there could be a positive correlation between app icons' aesthetic design and app downloads. Specifically, app icons with rich colors, high brightness, complexity, or symmetry could promote app downloads.

Table 3. The Numerical Values of x and y

x	0.6667	0.8333	0.3333	0.8333	0.1667	0.3333	0.1667	0.3333	0.1667	0.3333
y	85321	72733	64192	57911	57499	51144	45307	44640	44632	43890
	78	93	81	45	89	50	98	60	14	57

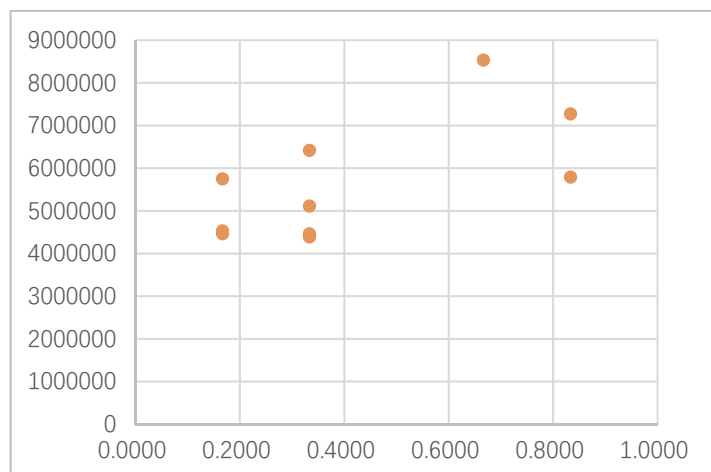


Figure. 2 The scatterplot

2.3 Optimization solutions

Through the correlation analysis, the point that app icon designs have significant influence in customer behavior has been generally confirmed. According to the empirical research and the above correlation analysis based on the data collected from Chinese largest App Store, these three aesthetic aspects, app icon color, complexity and symmetry could significantly affect user app download behavior. More specifically, app icons with rich colors, high brightness and low saturation design tend to be more easily noticed and downloaded by Chinese netizens [4]. Scholars advocate that icon design seeks to achieve an appropriate balance between simplicity and complexity, which would help enhance the attractiveness of icon design. In addition, adding a slight asymmetry element to the icon design would help enhance the aesthetic preference of Internet users and increase the amount of app downloads [4]. Therefore, on the basis of previous research and analysis, it is certain that the aesthetic design of application icons performs a crucial role in improving user attention for newly launched applications [19]. Focusing on the color, complexity, and symmetry of application icons could significantly increase the download volume of app users.

3. Customer satisfaction of app services

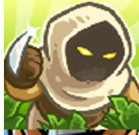
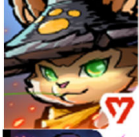
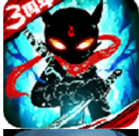
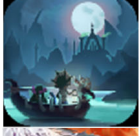
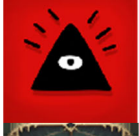
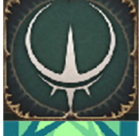
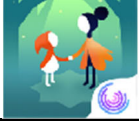
3.1 The problem of customer churn

Another difficulty faced by enterprises who are implementing profitable operation business is the unpredictable mobile app consumer churn. Although mobile applications may obtain a large quantity of registered customers and downloads at the introduction stage of launch, researchers found that the application would intermittently lose some registered users in the later stages of the product life cycle [10]. Although continuous customer loss is unavoidable in nearly each operation project [10], it would further accelerate customer loss if enterprises do not take measures to limit customer loss. Eventually, there might even be a large loss of customers, shortening the life cycle of app products, shrinking the market scale of enterprise application products, and profit loss of enterprise projects. Therefore, it is of great importance to explore what factors affect customer churn and how to curb this effect through correlation analysis.

3.2 Correlation analysis

To explore the key factors that affect the continuous loss of app customers, 10 samples will be used for correlation analysis. By consulting Qimai Research Institute [1] about the real-time activity of game applications in China's app stores in September 2022, the top ten game applications and their corresponding user experience scores are obtained. Table 4 shows the detailed rankings and scores.

Table 4. Top 10 Game Apps

Ranking	APP	Images	User experiencing scores
1	THE LAST SHOP		4.6
2	Kingdom Rush Frontiers		4.9
3	Gunfire Reborn		4.8
4	Dissimilated Land		4.8
5	Stickman League 2		4.7
6	The Greedy Cave: Race Version		4.7
7	The Age of the Crowd		4.7
8	Isoland		4.4
9	Pascal's Wager		4.2
10	Monument Valley 2		4.0

Take the user experiencing scores of these game apps as the explanatory variables, x , and the ranking of app activity as the response variable, y . The numerical values of the explanatory variable, x , and the response variable, y , are shown in detail in the following Table 5. Using these data, establish a rectangular coordinate system and complete the scatterplot in the Figure 3. By function calculation, the correlation between x and y is $-0.79772404 \approx -0.80$, which indicates that there could be a strong negative correlation between user game experience and game app activity. User experiencing scores close to 5 implies higher customer satisfaction and ranking numbers of apps close to 1 expresses high frequency of app users going online. Hence, the results of the correlation analysis suppose that game experience of players could be a key factor leading to high activity rate of app users. Considering the

essential role of customer experience in game applications, game experience of players could be formulated as customer satisfaction [11].

Table 5. The Numerical Values of x and y

x	4.6	4.9	4.8	4.8	4.7	4.7	4.7	4.4	4.2	4
y	1	2	3	4	5	6	7	8	9	10

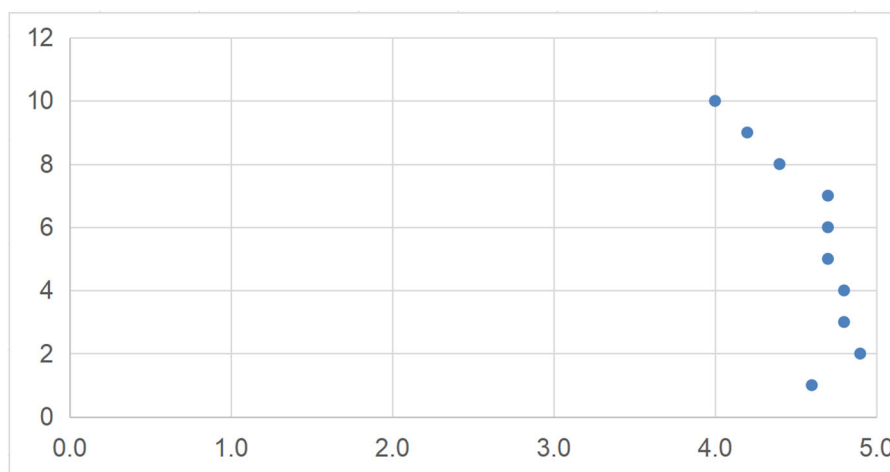


Figure. 3 The Scatterplot

3.3 Optimization solutions

The strong relationship between customer satisfaction and app activity frequency has been demonstrated through the correlation analysis. More importantly, previous studies carried out by professors have reached a general consensus, in which poor customer satisfaction could be a vital component of customer churn [3]. As an important measurement of corporate earning power and value, consumer satisfaction is generally regarded as the degree of matching between consumer future expectations and consumer real experience. In addition, the research results of scholars [11] show that improving customer satisfaction can significantly improve the enterprise valuation and performance of Chinese app operators. To sum up, improving customer satisfaction could be considered as an effective measure to retain existing users to the maximum extent. To make users willing to stay in the app product, the cost of user churn could be large enough. At the same time, the app could be designed to interact with users more, give users enough recognition and respect, providing high emotional value. Based on the study results of two scholars [12], the actual performance of app program, including working speed, smoothness and clarity, could have a significant influence on consumer satisfaction. If the app program has feedback delay situation, system crash condition, failure to load, etc., this might cause users to have negative feelings and impressions about the application. Furthermore, mandatory advertisement insertion in the app operation process would also seriously reduce user satisfaction and user experience [12]. Therefore, improving the smoothness of application operation may be an effective measure to improve consumer satisfaction. In addition, the continuous optimization of application products, as well as the maintenance and upgrading of applications, would help to improve consumer satisfaction. Improving the service quality of application products can bring consumers more experience in using app products than they expected. If consumers' use experience is more interesting than they expected, then consumer satisfaction will be effectively improved.

4. Customer loyalty

4.1 The problem of customer loss

With the intensification of fierce competition in Chinese market environment, constantly more apps could furnish similar services or the same function in the App Store. Peer competition could facilitate comparisons among peer enterprises to achieve better company performance and higher app quality [13]. However, the competition between peer enterprises could contribute to the churn of customer resources and the reduction of profitability. In the later stage of the app product life cycle, whether or not retaining a considerable number of loyal users and thus achieving the high profitability of app business is affiliated with the survival of mobile application enterprises. Therefore, how to retain the existing consumers of app in the fierce competition is another problem puzzling Chinese companies.

4.2 Correlation analysis

To search the factor having impact on retaining loyal customers, the list of update data of popular applications in China in 2021 is adopted for correlation test [1]. The top eight applications, their numbers of application updates and numbers of users are organized in the Table 6.

Table 6. Update data of 8 popular apps in China

APP	Image	Update times	Number of users (100 million)
Tik Tok		51	8.0900
Pinduoduo		49	5.8520
Kwai		47	5.0000
Tencent Video		46	4.5900
Meituan		39	6.9290
Ding Talk		35	2.0500
IQIYI		28	1.0360
QQ Music		26	3.1644

Take the update times of these apps in 2021 as the explanatory variables, x , and the number of app users as the response variable, y . The numerical values of the explanatory variable, x , and the response variable, y , are shown in detail in the table 7. Using these data, establish a rectangular coordinate system and complete the scatterplot in the figure 4. By function calculation, the correlation between x and y is $0.77208197 \approx 0.77$, which supposes that there could be a strong positive correlation

between the update times of apps and the number of app users. Moreover, more frequent application updates and optimizations indicates the enterprise's business strategy of maintaining customer loyalty. Hence, the results of the correlation analysis indicate that maintaining customer loyalty could be an influence factor contributing to considerable number of app users.

Table 7. The values of x and y

x	51	49	47	46	39	35	28	26
y	8.0900	5.8520	5.0000	4.5900	6.9290	2.0500	1.0360	3.1644

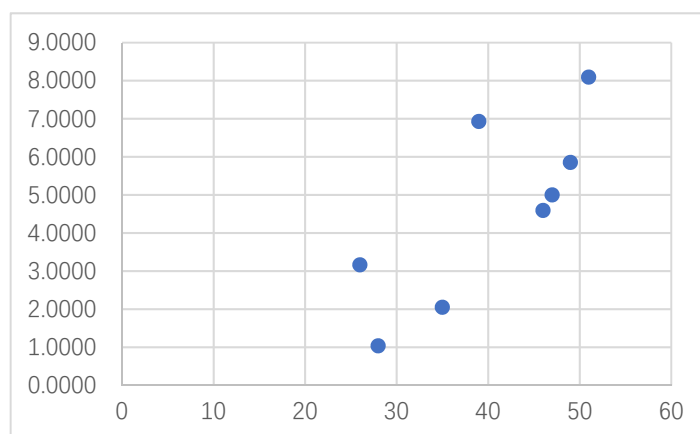


Figure. 4 The scatterplot

4.3 Optimization solutions

Based on the study results of Pham et al., the difficulty of retaining existing app program product consumers could be overcome by improving consumer loyalty. Furthermore, the strong positive relationship between update times and customer retention has been confirmed through the correlation analysis. Customer loyalty could be regarded as a phenomenon that consumers form a dependent preference towards a specific product or service from app programs, buying and using this product or service repeatedly. For example, Pham et al. revealed how Chinese Papergames Company provides emotional value in user interaction [14]. In order to cultivate customer loyalty, the company has designed a user growth system. Stimulate the favorable behaviors of users, and punish the harmful behaviors accordingly. The design of the growth system can not only stimulate the activity of users, but also avoid the loss of customer resources. By creating new interactive entertainment experiences, this method can effectively eliminate customer complaints between enterprises and consumers [14]. Pham et al. systematically stated the importance of customer loyalty for enterprises and consumers [14]. According to their conclusions, setting up a user growth system and planning activities can significantly improve customer loyalty. For example, the "IT Special Recommendation Special Author" activity held by Xiaohongshu app, a Chinese enterprise, is to mobilize the enthusiasm of consumers in the form of an activity, strengthen the connection with users, increase the "focus" data of the app, and enhance user stickiness. In addition, pay attention to after-sales service and abide by the enterprise commitment. Customizing personalized products for consumers with different needs could also significantly improve customer loyalty [10]. In order to maintain customer loyalty, companies should not mindlessly chase the maximization of benefits, and should try to consider the expected price of products in the minds of consumers. In addition, enterprises should not only be skilled in listening to consumers' opinions and handling complaints in a timely manner. In fact, maintaining customer loyalty performs a key aspect in establishing the corporate image. By maintaining consumer loyalty, apps could extend their life cycle maturity, achieve stable revenue and good reputation.

5. Evaluation

This essay mainly states three difficulties and corresponding solutions in different operation stages of app application products. These three dilemmas correspond to different life cycle stages of app products from the introduction stage to the maturity stage. In the analysis of the first method, improving the aesthetic design of application icons can provide practical guidance for application developers, help enterprises improve the profitability of app products, and increase product revenue. However, the solution of this first strait still has some limitations. The proposal of it neglects the influence of other objective factors, such as different regional preferences in China have a significant impact on application user downloads [15]. Future relevant studies could consider exploring the cross-platform differences of different App Stores in China. Moreover, the discussion on this issue mainly focused on the color, complexity and symmetry of the app program icon, without taking other aesthetic factors into consideration. Future surveys can explore the impact of other aesthetic features of icons on the product life cycle, or consider using other quantitative economic models to evaluate the effect of icon aesthetics [15]. In addition, the aesthetic design of products will also affect the length of the entire life cycle of products, which is not discussed in depth in this paper. The second solution mainly overcomes the common strait of how to remain the churn of users [10]. However, this phenomenon that applications sometimes provide various contents to customers is ignored. It is impossible to retain customers with complicated content. Only by continuously pushing personalized customized content to customers and firmly grasping their content preferences can we do [11]. Future research might study the impact of a large number of non-preferred content recommendations in the App Store on consumer satisfaction. As for solutions to the third strait is establishing consumer loyalty. In the analysis of how to establish consumer loyalty in this part, relevant research and discussion are mainly considered in the process of app use from the perspective of consumers. However, this part of the analysis also has ignored the environment and factors. Customer loyalty performs different aspects in app program competition with different abilities [16]. In many conditions, consumer loyalty does not have enough influence on the profitability of enterprises. Furthermore, the connotations of these three stages in the business process of app products are not stated detailedly enough. Considering the product life cycle theory, the launch period of the app could belong to the product introduction stage [17]. The second stage of the app product could be the growth period in the product life cycle, which performs an essential aspect in improving user satisfaction. The third stage of the app product could belong to the maturity period in the product life cycle, in which the product maturity period should be extended by maintaining user loyalty to maximize the profitability of the enterprise's app business.

6. Conclusion

In recent years, Chinese Internet mobile application market is booming with the development trend of combining emerging technology fields with traditional industrial fields. With the continuous improvement of industry convergence and industry centralization, the competition in mobile application market is more intense, and the monopoly trend of app products in various fields would be more obvious. Monopoly, that is, a few of companies have the dominant position in their corresponding fields, which could greatly inhibit economic vitality of innovative development of many enterprises [7]. With the formulation of relevant anti-monopoly laws and regulations, China has made it clear that it does not advocate monopoly. After the outbreak of New Coronary Pneumonia in 2020, the strong development of China's mobile market has improved the profitability of the monopoly app [18]. Considering the current monopoly of the app market in China, it is almost impossible for new app development and operation enterprises entering the competitive market to make profits immediately through app products. In the current domestic market situation, enterprise decision-makers and app developers need to focus on icon aesthetic design, consumer satisfaction and consumer loyalty. In fact, this consideration can significantly improve the operating data of app products and help enterprises accelerate their profitability. Moreover, adhering to the pursuit of first-

class enterprise spirit, constantly increasing the quality of app program products, and improving the spiritual value that the products could provide would also help attract more customers and retain product customers to the maximum extent.

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