Research on Factors Affecting Behavior of Taking Selfies in China Based on Logistic Regression Analysis

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Abstract. With the popularity of smartphones and photo-based social networking sites, taking selfies have become a trend among young people. A number of camera apps developed by third-party with face-beauty feature have become popular in China and original camera apps (developed by phone manufacturer) such as HUAWEI have also added face-beauty feature. However, smartphones such as iPhone without face-beauty feature are criticized by the majority of Chinese users. At present, there is little research on the design of original camera apps. In this paper, behavior of taking selfies of Chinese users were focused. An online questionnaire was used to investigate Chinese behavior of taking selfies and the design of face-beauty feature in original camera apps. The analysis of variance and Ordinal Logistic Regression analysis were used as the primary method of data analysis. This study concluded the factors affecting the user's frequency of taking selfies, high-frequency scenes of taking selfies, the relationship between face-beauty feature and recognition of taking selfies, the function usage of original camera apps and third-party camera apps, as well as the influence of face-beauty feature on taking selfies. It can help to design the functions of original cameras of foreign smartphone brands entering the Chinese market to a certain extent.

Keywords: Behavior of taking selfies · Logistic regression · Face-beauty feature

1 Introduction

Selfie is a self-portrait photograph taken for oneself. The history of selfie can be traced back to 1839. The history of self-portrait can be traced back to 1839. Robert Cornelius, the pioneer of American photography, used Daguerre photography to take the first portrait of a human figure outside his own store, which was also the first self-portrait photograph in human history [1]. However, due to the limitation of devices, taking selfies did not get popular until Steve Jobs launched the "smartphone" iPhone 4 in 2010, and the era of taking selfies really came.

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According to Zenith's mobile advertising forecast in 2017, 66% of people 52 of key countries would have smart phones in 2018, and China, as the country with the largest number of smartphone users, will have 1.3 billion users [2]. This widespread popularity of smartphones has created a boom in taking selfies in China. After the emergence of a third-party camera app called "Metuxiuxiu" in 2012, many third-party camera apps such as "camera 360", "Chaozipai" and "tiantianPtu" emerged in endlessly in China. The third-party camera apps also promote the development of original camera apps (developed by phone manufacturer). Huawei, OPPO and other Chinese mobile phone brands have vigorously promoted their face-beauty features during brand promotion. There is even a "Meitu" mobile phone in the Chinese market which is mainly aimed at taking photos, especially selfies. However, there are few face-beauty features added to the iphone, which has a high market share in China, so whether the face-beauty features will become a factor affecting the Chinese users' behavior of taking selfies has become a trigger point of this study.

This study aimed to explore the use of original camera apps in taking selfies by Chinese users, and how face-beauty features affect the behavior of taking selfies. Based on the previous research, the development of behavior of taking selfies and the development of China's original camera apps and third-party camera apps were summarized. The research involved the purpose of taking selfies in China, frequency of taking selfies, whether the original camera apps have face-beauty features, the satisfaction of the original camera apps, and the function selection of third-party camera apps, etc. Factors affecting Chinese users' satisfaction with original camera apps are still being explored. The variables affected were presented in the form of scales. Therefore, multiple ordered logistic regression is considered for subsequent data processing and analysis.

Logistic Regression, also known as generalized linear model, belongs to a statistical model. The goal of Logistic Regression is to find the most appropriate model to describe the relationship between explanatory and interpreted variables, which can help predict the discrete results of a group of variables, which may be continuous, discrete, dichotomous, or a mixture of these variables [3]. Logistic Regression model of binary data includes Simple Logistic Regression model and Multivariate Logistic Regression model. The first type involves the modeling of the relationship between an explanatory variable and binary explained variables. The second type can be used to model K explanatory variables, each explanatory variable has m levels. The application of Logistic Regression also extends to the case where the dependent variables appear in the form of ordered categorical response, also known as Ordinal Logistic Regression model [4]. Ordinal Logistic model can be applied to epidemiological investigation, which can be divided into first, second, third and fourth levels of illness. It can also be applied to many sociological studies that classify people's well-being or satisfaction [5].

According to the presentation of the dependent variables in this study, Ordinal Logistic Regression is used as the primary method for data analysis.

2 Method

2.1 Procedures

This research mainly adopted the methods of literatures, interviews and questionnaires. The research was divided into two stages. The first stage mainly carried on methods of literatures and interviews. Some users whose frequency of taking selfies were in low, medium and high three categories were consulted about reasons for taking or not taking selfies and the usage of face-beauty features and third-party camera apps, etc. The above work helps to improve the presupposed answers in the questionnaire and design the overall logic of the questionnaire. In the second stage, the questionnaire release, data recovery and analysis were mainly carried out. During the research phase, we ensured that all the participating users clearly understood the purpose of our research.

2.2 Materials

The questionnaire in this study is divided into six parts.

Part 1: Demographic Information
Questions including gender, educational background, age and region were designed to ensure the validity of sampling.

Part 2: User Classification
The users were divided into four types including: non-self-timer users (never took selfies), low-frequency users (sometimes take selfies except taking lots of selfies in certain circumstances), medium-frequency users (often take selfies per week), high-frequency users (always take selfies every day).

Part 3: Reasons for Taking or Not Taking Selfies
This part mainly inquired about the reasons and frequencies related to taking selfies. The relationship of the purposes and frequency were analyzed by Logistic Regression. Then, purposes of taking selfies which had positive and negative correlation effects on frequency of taking selfies can be obtained. It can help determine high-frequency scenarios and low-frequency scenarios of taking selfies in order to determine the functions that the camera may need according to the situation.

Part 4: Investigation of the Original Camera Apps (Developed by Phone Manufacturer)
This part included questions like “Is there any face-beauty features in your **original camera apps**?”, “How much do you approve of your **original camera** apps?”, “What are the common face-beauty features you always use when taking selfies”, etc. Then, we focused on whether the original camera apps had face-beauty features or not would affect the recognition of the original camera apps, and whether the recognition will affect the use frequency of the original camera apps and the third-party camera apps.

Part 5: Investigation of the Third-Party Camera Apps
This part included the reasons for using third-party camera apps and the commonly used functions of third-party camera apps. Logistic Regression was used to analyze which functions led users to use third-party camera apps and which functions led users to take selfies with original camera apps.

Part 6: Relationship Between Face-Beauty Features and Taking Selfies
According to different types of users, whether face-beauty will affect the frequency of behavior of taking selfies was focus in this part.

2.3 Participant

A total of 430 respondents completed the questionnaires and 413 questionnaires were valid. Questionnaires were sent out through links in Chinese social networking app called WeChat. The user's age range was from 8 to 60 years old. Within this age group, users had a clear understanding of selfie behavior. Among them, 28% respondents were under 18 years old, 48% respondents were between 18 and 30 years old, and 24% respondents were between 30 and 60 years old. 84% of them have undergraduate education or above. 34% respondents were male users and 66% respondents were female users.

2.4 Data Analysis Methods

The main purpose of the data analysis is to find out the correlative factors that significantly affect behavior of taking selfies. The main methods used are Ordinal Logistic Regression analysis and chi-square test. We focused on (1) the correlation between purposes and frequency of taking selfies, (2) the relationship between face-beauty features and recognition of taking selfies, (3) whether recognition of taking selfies affected the usage of third-party camera apps, (4) which factors would lead users to use third-party camera apps or original camera apps, and (5) whether face-beauty features will affect frequency of taking selfies.

3 Results and Discussion

3.1 User Classification

In this questionnaire, all users were asked to choose their own frequency of taking selfies. There were five situations: "never took selfies", "almost take no selfies", "only take selfies in certain circumstances (such as travel, gathering, etc.)", "often take selfies per week" and "always take selfies every day". Users who didn't take selfies or almost took no selfies were both classified as users who never took selfies. The proportion of four types of participants is shown in Fig. 1. The proportion of different types of male and female participants in their respective gender is shown in Fig. 2.

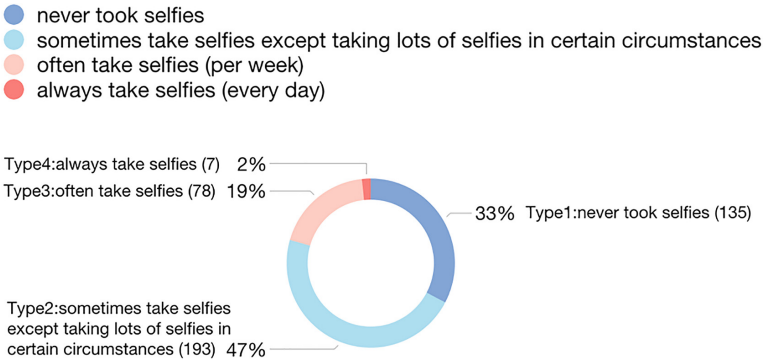

Fig. 1. Participants classification

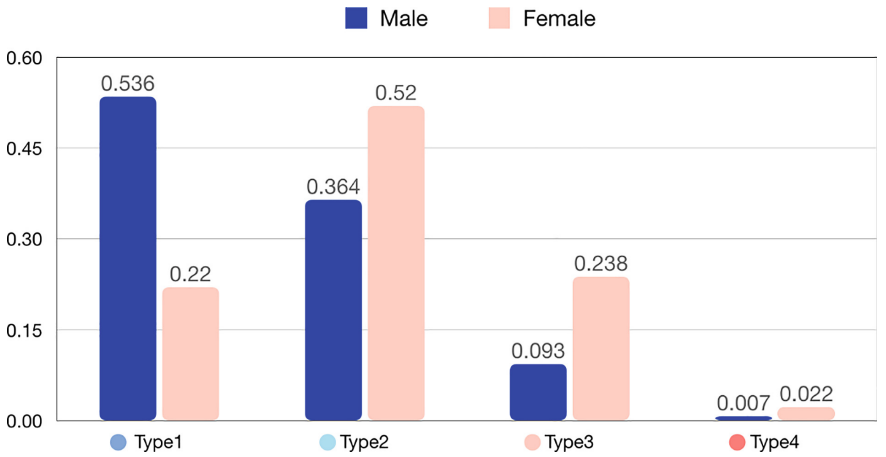

Fig. 2. The proportion of different types of male and female participants in their respective gender

According to the cross-analysis in this study, most of Chinese users had no regular behavior of taking selfies, in which the proportion of female users in irregularly taking selfies has exceeded half of female users, and the data of male users of taking no selfies had exceeded half of male users. High-frequency users who took selfies every day still accounted for a small value. Female users who took selfies every week were more than one-fifth of the female users who never took selfies.

The frequency of female users' behavior of taking selfies was significantly higher than that of male users. Most users focused on irregular selfie behavior, that is, frequency of taking selfies is not high, but once taking a selfie, there would be a large number of continuous behavior. We suspect that the frequency of taking selfies will be affected for most user-specific scenarios and purposes.

3.2 Effect of Selfie Purpose on Selfie Frequency

The purpose of taking selfies was taken as the explanatory variable, and the frequency of taking selfies was taken as the explained variable to carry out an Ordinal Logistic Regression analysis. Table 1 shows the test results of parallel lines. According to the parallel line test, if significance level alpha is 0.97, the null hypothesis cannot be rejected because the probability p-value is greater than significance level alpha, indicating that there is no significant difference in the slope of each model, so it is appropriate to choose the Logit connection function.

Table 1. The test results of parallel lines[a] for effect of selfie purpose on selfie frequency

Model	-2Log-Likelihood	Chi-Square	Df	Sig.
Null Hypothesis	280.388			
General	278.070	2.317	8	.970

The null hypothesis states that the location parameters(slope coefficients) are the same across response categories.
a. Link function: logit

Table 2 shows the statistics of goodness of fit described by the model. The value of Nagelkerke is 0.393, which is not close to 1 which indicates that more of the variation is explained by the model, while the value of McFadden is 0.250, which is not in the range of 0.3–0.5. The goodness of fit is not good enough.

Table 2. Pseudo R^2 values for effect of selfie purpose on selfie frequency

Cox and Snell	0.218
Nagelkerke	.248
McFadden	0.117

Link function: logit

Table 3 shows the significance test results of zero model and current model regression equation. It can be seen that the log-likelihood value of −2 times of zero mode is 378.657, the current model is 1059.715, the likelihood ratio is 98.270, and the probability P-value is 0.000. If the significance habit-level is 0.05, the null hypothesis is rejected, indicating that the significant linear relationship between all explanatory variables and the connection function is selected correctly.

Table 3. Model-fitting information for effect of selfie purpose on selfie frequency

Model	-2Log-Likelihood	Chi-Square	Df	Sig.
Intercept Only	378.657			
General	280.388	98.270	8	.000

Link function: logit

Table 4 shows the results of parameter estimation of the output model. Reason4 "self appreciation", reason7 "pass the boring time" and reason8 "show yourself on social platforms" have significant relevant with frequency of taking selfies based on the 0.05 significance level. According to the positive or negative of the estimates value of the logit coefficients, people who chose these three reasons were more likely to take selfies with high frequency.

Table 4. Parameter estimates of the relationship between reasons and frequency of taking selfies

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[frequency=3]	5.227	.790	43.726	1	.000	3.678	6.776
	[frequency=4]	8.873	.010	77.209	1	.000	6.894	10.852
Location	reason1	-.088	.190	.217	1	.641	-.460	0.238
	reason2	.148	.201	.543	1	.461	-.246	0.543
	reason3	-.342	.189	3.284	1	.070	-.713	0.028
	reason4	**.427**	**.195**	**4.801**	**1**	**.028**	**.045**	**0.809**
	reason5	.237	.205	1.335	1	.248	-.165	0.640
	reason6	.130	.188	.483	1	.487	-.237	0.498
	reason7	**.569**	**.211**	**7.281**	**1**	**.007**	**.156**	**0.983**
	reason8	**.526**	**.178**	**8.718**	**1**	**.003**	**.177**	**0.876**

Link function: logarithm

Reasons for taking selfies were divided into two categories: category 1 = external reason {commemorating special events, recording daily life, displaying social activities} and category 2 = internal reason {self-appreciation, interesting, showing yourself to good friends or relatives, passing boring time, showing yourself on social platforms}. We sum them up by the frequency at which we always, often, and sometimes take selfies and ranked them from highest to lowest as shown in Fig. 3. In the sample data, "commemorating special events", "recording daily life", "displaying social activities" were three kinds of reasons to motivate users to take selfies. However, according to the data shown in Table 4, these three reasons did not increase the users' frequency of taking selfies. Therefore, external reasons are the factors that drive most users to take selfies, but the self-timer frequency can only be improved by internal reasons. In design, external drivers are mostly generated by specific situations, so combining situational awareness may be a way to improve self-timer user experience.

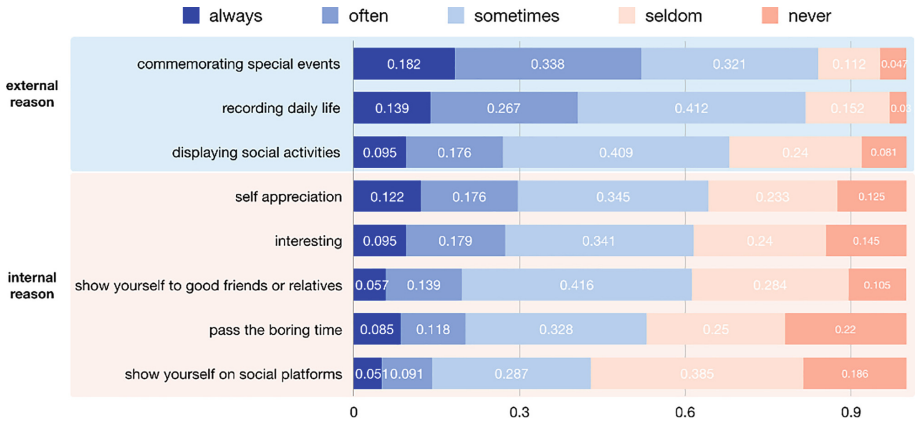

Fig. 3. Reasons for taking selfies

3.3 The Effect of Face-Beauty Features on Recognition of Original Camera Apps and the Effect of Original Camera Recognition on Camera Selection During Taking Selfies

Taking face-beauty features as the explanatory variable and recognition of original camera apps as the explained variable, Ordinal Logistic Regression was conducted. The result was shown in Table 5. Face-beauty1 "the original camera apps come with facebeauty features" has significant relevant with recognition of original camera apps based on the 0.05 significance level. According to the positive or negative of the estimates value of the logit coefficients, when the original camera apps have face-beauty features, the recognition of the original camera apps will be higher. To some extent, it can be explained that the face-beauty features of smartphones can improve the user experience when taking selfies with original camera apps. Due to the space limitation and to avoid repetition, the evaluations of the Logistic Regression Model like Tables 1, 2 and 3 would not be described in the following text of this paper.

Table 5. Parameter estimates of the relationship between face-beauty features and recognition of original camera apps

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[recognition1=1]	-2.694	.302	79.559	1	.000	-3.286	-2.102
	[recognition1=2]	-1.234	.192	41.248	1	.000	-1.610	-.857
	[recognition1=3]	-.112	.171	.432	1	.511	-.448	.223
	[recognition1=4]	1.294	.189	46.981	1	0.000	.924	1.664
Location	face-beauty1	.670	.220	9.294	1	.002	.239	1.101
	face-beauty0	0[a]	.	.	0	.	.	.

Link function: logit
a. This parameter is redundant, so set to 0

Ordinal Logistic Regression was conducted with recognition of the original camera apps taken as the explanatory variable and selection preferences of the camera app type when taking a selfie taken as the explained variable. As the Table 6 shows, recognition of the original camera apps has significant relevant with recognition of original camera apps based on the 0.05 significance level. The estimated coefficient is $-0.536 < 0$, indicating that the recognition of the original camera apps has a negative correlation with selection preferences of the camera app type when taking selfies. In other words, the more satisfied users are with original camera apps, the less likely they are to use the third-party camera apps to take selfies.

Table 6. Parameter estimates of the relationship between recognition of the original camera apps and selection preferences of the camera app type

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[choice=1]	-3.112	.412	57.090	1	.000	-3.919	-2.305
	[choice=2]	-2.069	.390	28.101	1	.000	-2.834	-1.304
	[choice=3]	-1.517	.381	15.851	1	.000	-2.264	-.770
	[choice=4]	.692	.393	3.104	1	.078	-.078	1.461
Location	recognition	-.536	.099	29.244	1	.000	.730	-.342

Link function: logit

In summary, face-beauty features can make the user experience better and gain more recognition when taking selfies with original camera apps, while the user will choose to use original camera apps more when the recognition of original camera apps is higher. In other words, users will use third-party camera apps less often when the face-beauty features are available on original camera apps. In essence, both the original camera apps and the third-party camera apps aim to provide users with satisfactory selfie results. The above conclusions also verify the existence value of the current third-party camera apps online, that is, to provide effects that the native camera is not enough to achieve, such as beauty effect, stickers and so on. There's still plenty of room for original camera apps to be optimized for selfies.

3.4 The Effect of the Reasons for Using Original Camera Apps and Third-Party Camera Apps on Selection Preferences of the Camera App Type

Table 7 shows that reason(2)3 "I am used to taking photos with an original camera app and then using a third-party camera app for photo processing." is more likely to lead users to use original camera apps. Similarly, Table 8 shows that reason(3)3 "Face-beauty feature of third-party cameras are powerful and need not edit later" and reason (3)4 "All processes can be implemented in one application" are more like to cause people to use third-party cameras, while reason(3)6 "I used to take photos with the

original camera and use the third-party camera for post-processing" are more likely to cause people use original cameras as result shown in Table 7.

Table 7. Parameter estimates of the relationship between the reasons for using original camera apps and selection preferences of the camera app type

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[preference=1]	-.239	.289	.684	1	.408	-.805	.327
	[preference=2]	1.592	.319	24.886	1	.000	.967	2.218
Location	reason(2)1	-.294	.309	.909	1	.340	-.899	.311
	reason(2)2	-.120	.317	.144	1	.704	-.742	.501
	reason(2)3	1.007	.348	8.369	1	.004	.325	1.690
	reason(2)4	0.522	.470	1.234	1	.276	-.399	1.444
	reason(2)5	-.012	.427	.001	1	.977	-.849	.824
	reason(2)6	-.430	.425	1.026	1	.311	-1.263	.402
	reason(2)7	.665	.509	1.704	1	.192	-.333	1.662
	reason(2)8	.289	.986	.086	1	.770	-1.644	2.221
	reason(2)9	-.046	.541	.007	1	.932	-1.106	1.014
	reason(2)10	-.383	.347	1.216	1	.270	-1.063	.298

Link function: logit

Table 8. Parameter estimates of the relationship between the reasons for using third-party camera apps and selection preferences of the camera app type

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[frequency(3)=3]	.449	.434	1.071	1	.301	-.402	1.300
	[frequency(3)=4]	4.004	.577	48.172	1	.000	2.873	5.134
Location	reason(3)1	.209	.448	.217	1	.641	-.669	1.087
	reason(3)2	.175	.409	.184	1	.668	-.627	.977
	reason(3)3	1.655	.434	14.520	1	.000	.804	2.507
	reason(3)4	1.356	.435	9.731	1	.002	.504	2.208
	reason(3)5	.082	.737	0.012	1	.911	-1.363	1.527
	reason(3)6	-1.469	.659	4.964	1	.026	-2.760	-.177
	reason(3)7	-.187	.883	.045	1	.832	-1.918	1.543
	reason(3)8	.608	.825	.543	1	.461	-1.008	2.224
	reason(3)9	.731	.878	.693	1	.405	-.990	2.453
	reason(3)10	.422	.507	.693	1	.405	-.571	1.415

Link function: logit

Figure 4 shows reasons why users use native camera apps and third-party camera apps in order of frequency. According to the ranking of the frequency of the reasons, it can be concluded that the main reason for users to use the third party is the post-processing and rich face-beauty effects. On this basis, users do not want to leave the current app for post-processing, and users prefer to solve the problem of photo optimization in the same app. And the effects of many original camera apps are not mirror images, which also lead users to choose third-party camera apps. The advantages of the original camera apps are the realism and simple operation. Compared with the complicated retouching, the users hope to get a high-quality selfie quickly and easily. Therefore, when face-beauty features

are added to the original camera apps, try to add a one-click beauty effect which is not exaggerated to ensure the formality and quality of the photos.

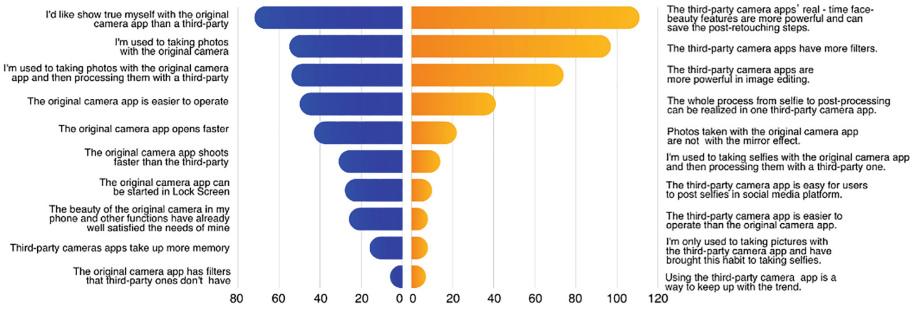

Fig. 4. Reasons why users use native camera apps and third-party camera apps

Figure 5 shows the features selected by the participants in the study taking selfies with original and third-party camera apps. Both cameras have the highest usage rate when users choose one button of beauty, which indicates that most users need a simple operation. The difference is that third-party filters are more abundant, so most users choose filters when using third-party camera apps. On the contrary, the filter function of the original camera apps ranks fourth, which is lower than whitening and adjusting the beauty level, indicating that the original filter is single. Among them, whitening, smooth and enlarging eyes are the most frequently used functions, which show the aesthetic convergence of Chinese users. In other words, Chinese users generally think that white skin, small face and big eyes are kind of beauty.

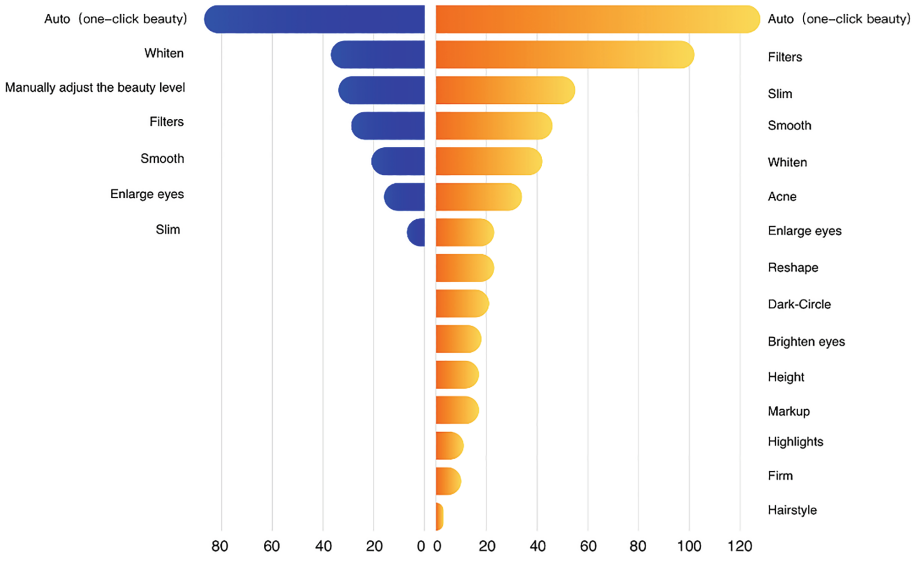

Fig. 5. Features of native camera apps and third-party camera apps

3.5 The Effect of Face-Beauty Features on the Frequency of Taking Selfies

A question "If one day, all the face-beauty feature of camera apps in the world suddenly disappear, will your frequency of taking selfies be affected?" was asked in the questionnaire. Figure 6 obtained by cross analysis shows that people of Type1 won't be affected by missing face-beauty feature. Some high-frequency users of Type4 and Type5 will reduce taking selfies. However, a number of users of Type4 and Type5 get almost no impact. In conclusion, taking selfies is an objective requirement for users. Although face-beauty features can affect the frequency of taking selfies to a certain extent, users still choose self-portraits in the absence of face-beauty feature and most people will not greatly reduce their frequency of taking selfies.

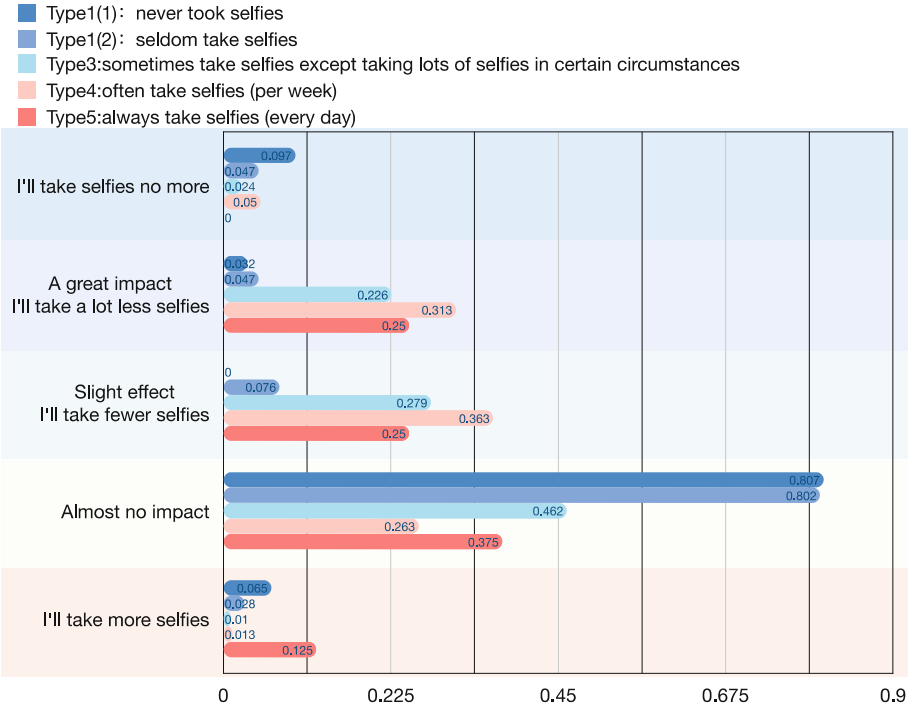

Fig. 6. Features of native camera apps and third-party camera apps

4 Conclusions

This study reflected the current situation of self-timer behavior of Chinese users, including purposes of taking selfies, frequency of taking selfies and usage of camera apps. According to Ordinal Logistic Regression analysis and cross-analysis, the design

suggestions of original camera apps were obtained. The specific conclusions are as follows:

(1) The majority of Chinese users taking selfies are still female, and most of them do not take selfies regularly, which is largely related to the scene of the user at that time. When optimizing the self-timer mode of the camera, the combination of situational awareness should be considered to improve the user's self-timer experience.
(2) The user's behavior of taking selfies is dominated by the environment, but the frequency of selfie is largely influenced by the internal purpose. High-frequency selfie-takers often take a large number of selfies because they are bored to kill time, consider taking selfies as an interesting thing and eager to show themselves on social platforms. The function design of camera selfie mode should not only meet the basic selfie needs, but also provide more interesting and social functions for high-frequency users.
(3) Most Chinese users take selfies with original camera apps and use third-party camera apps to apply photo retouching, but users are more inclined to complete a series of operations of photo retouching within the same app. Users not only need rich post-processing effect but also need simple and flexible operation process. Therefore, retouching and adjusting functions should be as simple and effective as possible to reduce the hesitation time for users.
(4) The face-beauty features can improve the recognition of the camera apps, but users will not stop taking selfies due to the lack of face-beauty features, only to a certain extent reduce the corresponding selfie frequency and satisfaction.
(5) Chinese users tend to use one-click beautification (advanced beautification, intelligent beautification) when taking selfies. The requirement of image processing is constantly increasing. The combination of artificial intelligence technology and camera apps will be a general trend.

There are still some shortcomings in the current work. Some differences in the self-timer effects of different smartphone brands' original camera apps will also affect the frequency of taking selfies. However, in order to present a general rule, this study did not introduce the variable of smartphone brand into the study. In order to optimize the original camera app of one smartphone brand, the comparative analysis between different smartphone brands can be carried out in order to complete the corresponding optimization.

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