

Empirical Analysis of Distribution Methods of Mobile Applications in China

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ABSTRACT: *This research examines distribution methods of mobile applications in China. To address, four research questions are proposed. Based on a sample from 262 respondents from the biggest city in central China, the results indicate that the most used mobile application in the Chinese market is instant messaging tools. It is found that majority of Chinese users are more likely to install mobile applications via the PC. Further, most respondents do not accept additional costs for software installation. In general, they are willing to pay less than one dollar for a mobile application. And, men are always more technology-affine than women. Last but not least, among the available transmission methods, the transfer of data between mobile devices via Bluetooth receives the highest ranking.*

Keywords: Mobile Computing, Bluetooth, Chinese Mobile Market

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1. Introduction

The rapid growth of mobile communication and usage of mobile devices in recent years has provided a great opportunity for creating a variety of mobile applications. Today, people can access information from many different locations (home, in the client's office, on a plane), using a variety of electronic devices based on what is available and practical at the time, including stationary PCs connected to a LAN or WLAN, portable PCs, and smartphones connected wirelessly to the network.

There is no doubt that the use of mobile technologies is growing. There are more and more mobile applications in our working and social life. The advanced mobile devices enable users to try out new mobile applications, but the adoption of mobile applications often do not progress as expected [1] [2]. While there has been an increasing availability of mobile applications, limited attention has been given to users' perception and behavior of mobile applications.

According to the report from the Chinese Ministry of Information Industry, the number of mobile phone subscribers in China exceeded 1 billion in the first week of March 2012 as more Chinese people began to consider mobile phones as an everyday necessity. Previous studies [3] [4] found that when it comes to advanced mobile applications, not many users start installing and

trying them. It is expected that some advanced mobile applications fulfilling users' needs, such as mobile banking, instant messaging tools, are supposed to be accepted by some early adopter. However, what is the current status of distribution methods of mobile applications in the Chinese market.

The objective of this research is to study the current situation of the distribution methods of and mobile applications in China. In order to address this objective, we define four research questions as outlined in section 3. Consequently, a survey based on these four research question is carried out with 262 respondents in the biggest city in central China.

The remainder of the paper is structured as follows: Section 2 reviews relevant literature. We present the research methods in Section 3. Section 4 presents the survey results. Section 5 discusses the results. In section 6, we conclude this research and point out some future research directions.

2. Literature Review

This section presents some literature relevant to this research.

2.1 Mobility

Mobility emerges as an important trend in the realm of mobile computing. It makes deeply social transformations and technical transformations along with the development of mobile technologies. Those transformations create increasing demands for the system or application which supports the mobility occurring in real life. Mobility is a term that denotes the physical movement of an object from one place to another in the desire to obtain resources or to move away from the scarcity of them [5]. Mobility can involve both physical and logical objects [6]. Physical objects can be people or mobile computing devices migrating in the physical space. Logical objects can be a running software application (process) or a mobile agent. These may migrate in a local area network, or to anywhere in a global network like the Internet.

The basic concept of mobility that people most commonly recognize and consider are: mobile workers are freed from geographical constrains in terms of the advanced mobile computing technologies such as mobile phones and smartphones. Mobile workers are able to work whenever they want and wherever they are. However, mobility is a broader multi-dimensional concept. By looking at the interaction people perform, the concept of mobility can be defined in three dimensions, namely spatial, temporal or contextual [7].

Spatial mobility primarily refers to people moving in space and having wireless access to information and services. In addition, as explained in [8], there are several other aspects of spatial mobility in modern society. Spatial mobility relates to the mobility of objects, the mobility of symbols and the mobility of space, which can evoke complicated patterns of human interaction and influence the ways of communication between people. As a result of new mobile technologies, the temporal mobility is enhanced in our social life. The temporality of human interaction is now mobilized into multiple temporal modes such as monochronicity and polychronicity [9]. Context in which people reside can lead their interactions with others, including social context, personal background, degree of mutual recognition, and so on. Thus, contextual mobility is of equal importance in constituting human interaction just as spatial mobility and temporal mobility do.

2.2 Mobile Applications

Mobile applications will change the way people live, play, as well as how businesses conduct transactions. The trend of mobile business will be toward increased real-time interaction between companies and their customers, employees and suppliers [10]. Mobile business can also be interpreted as the utilization of mobile technologies to improve or extend existing business processes.

With the evolution of mobile technologies and the appearance of new innovative business models, we are seeing the growth of mobile applications in people's everyday life [11]. Mobile applications provide an entirely new way for applications providers to better serve their users through a variety of mobile devices over a wireless network in a wireless environment.

Many scholars attempted to make classifications on various mobile applications. We summarize these classifications as follows.

- The first classification is based on the context of mobile applications. For example, Schilit, Adams& Wants [12] divided mobile applications into three categories: the applications under computing context (where you are); the applications under user context (who are you with \dot{y} and the applications under physical context (what resources are nearby).

- The second classification classifies mobile applications based on how the mobile applications relate to work place and time. Such as, Zhao, shin & Reich [13] categorized mobile applications into the following categories: notifications, location tracking, navigation, and real-time mobile job scheduling.

- The third classification categorizes mobile applications according to their different functions. For example, Zarm pou et al. [14] divided mobile applications into entertainment application, communications application, transactions application, and information application. And Yuan and Zheng [15] categorize mobile applications into four categories to address the need of mobile workers: mobile communications applications (including general mobile voice communications and SMS); mobile information search applications (including looking for information via a wireless to the Internet or company’s systems); mobile transaction and processing applications (including capturing transaction data, real-time transaction processing, such as orders, payment processing, inventory management), and mobile office applications (such as word processing, spreadsheets, presentation software, etc.).

As shown in Table 1, by taking into consideration the various classification methods above and our understanding of current Chinese mobile business market, we attempt to classify the major existing mobile applications in China.

Communication	M1	Instant messaging tools (e.g., QQ, MSN, WeiXing, etc.)
	M2	Social network applications (e.g., Micro-Blogs, renren, etc.)
Information search	M3	Search engine query
	M4	Read news through a browser
Transaction	M5	Mobile trading applications (e.g., online buying, mobile payment, etc.)
	M6	Financial applications (e.g., stock software, accounting, etc.)
Learning/office tools	M7	Office software (e.g., WORD, PDF, PPT, E-Mai, etc.)
	M8	Learning tools (e.g., dictionaries, formula conversion, etc.)
Entertainment	M9	Online entertainment applications (e.g., online games, videos, etc.)
	M10	Download games, music

Table 1. Major types of mobile applications in china

2.3 Distribution Methods of Mobile Applications

The transfer of applications to be installed on an end device is called distribution. The distribution of applications to mobile devices can happen through different ways of transmission. There are different interfaces for data transmission, and either the software providers or the application marketplaces regulate their usability. The common distribution possibilities for mobile applications are summarized as follows.

- Mobile Network (e.g., GPRS, 3G, CDMA) [16]. To enable the installation of mobile applications via the mobile network, a user needs to access the network via a web browser or specialized software (e.g., Android Market client) and download the applications.
- Bluetooth. Bluetooth is a short-range network. Hotspots can be established via Bluetooth, which grants Bluetooth-compatible devices, such as mobile devices, to access mobile applications.
- NFC. Near Field Communication (NFC) is a short-range technology, with a range of about 20cm. To transfer data between a NFC-compatible end device and a sending station, the end device has to be as close as a few centimeters to the sending station or has to touch it.
- WLAN. WLAN stands for wireless local area network. Once a mobile device connects a WLAN access point, the device can then download mobile application from the network.

2.4 Research on the Adoption of Mobile Applications

Prevalence of mobile applications depends not only on technology advancement, but also on user adoption. To our knowledge,

the research on the adoption of mobile application is still quite limited. Most Current research on the adoption of mobile applications tends to concentrate on the acceptance of the application.

Many scholars have proposed different models to measure the users' acceptance of mobile applications, such as, TAM [17], DOI[18], UTAUT[19]. TAM has been established as a fundamental model to examine mobile application adoptions. Some studies based on TAM and the other theories presented above have explored factors affecting consumer adoption of mobile applications. For instance, Lu et al. [20] studied the acceptance of wireless Internet via mobile technology (WIMT) in China and indicated that the acceptance of WIMT is related to perceived usefulness, ease of use, social influence, trust, and facilitating conditions. Yang [21] extended TAM to study factors affecting Singaporeans' attitudes toward mobile commerce. Evidence to support the extended TAM was found in this study. By expanding TAM, Gao et al. [22] proposed the mobile services acceptance model that examined the factors which determine consumer acceptance of mobile services. Significant support for the model was found in the data collected from a survey of potential mobile information services users.

However, there is only few studies on the distribution methods of the application (e.g., how ease is the application distributed or installed). For example, Geisler [23] examined the usage and acceptance of software distribution methods on mobile device in Germany.

To our best knowledge, we have not found any research studying distribution methods of mobile applications in China. This motivated this research work. It is believed that an exploratory study to investigate the distribution methods of mobile applications in China is necessary. We believe that this research will contribute to current mobile technology diffusion literature, as well as provide some insights for mobile application providers and designers to better understand potential users in China.

3. Research Methods

To study distribution methods of mobile applications in China, we define four research questions in this section. These research questions are examined in terms of a survey, which was carried out with college students in the biggest city in Central China. The survey instrument is developed based on extensive review on the existing literature and discussions with some experts in the field of mobile business. In this survey, Special emphasis is laid on the acceptance of different ways of distribution of mobile devices and mobile application in China.

3.1 Research Questions

We developed the following research questions (RQ) in this research.

RQ1. Which mobile application is the most popular one in China? This question is concerned about the usage of mobile applications in China.

RQ2. Which distribution method do users of mobile devices currently use most often in China? The question is designed to study the usage of distribution method of mobile applications in China.

RQ3. Which distribution method would users like to use in the near future? The question aims to investigate the potential trend of distribution method of mobile applications in China.

RQ4. How is users' experience with installing mobile applications on their mobile device in China? The question is concerned about Chinese users' experience with mobile applications installations.

3.2 Survey Instrument

The survey consists two parts. The first part is intended to study users' personal background (e.g., age, gender, educational background, etc). The second part is designed to measure the distribution methods of mobile application in China. The development of the instrument for the second part of the survey is described as follows.

Development of appropriate survey items stem from previous literature. Some of our survey items can be selected from the existing scales from prior studies. For example, part of the survey items in this research is adopted from the previous research [23]. We also make necessary adjustments to fit the scenario of this study.

Further, we develop some items by some discussions with some senior researchers in mobile business and some postgraduate students majoring in electronic business in China.

As a result, a total of 18 questions are included in this survey. A Five-point Likert scale, with 1 being the negative end of the scale (strongly disagree) and 5 being the positive end of the scale (strongly agree), was used to examine participants' responses to the items in the survey.

3.3 Sample

In sampling, college students in the biggest city in central China were chosen to finish the survey. The survey was distributed in terms of online questionnaires from December 15, 2011 to January 15, 2012. As a result, 280 completed questionnaires were collected, among which 262 were valid questionnaires (i.e., valid respondent rate 93.6%).

4. Results

In the section, we present some selected results from the survey.

4.1 Descriptive Results

A total of 262 valid questionnaires is collected in this survey. As the test persons are all college students, the age structure is relatively young, with 99.2% of the participants between age 19 and 25. The sample consisting of 40.5% male and 59.5% female participants can reflect a relatively balanced ratio. Meanwhile, every participant has a mobile device and 57.5% of them own a smartphone. Table 2 shows the shares of manufacturers used by the test persons. It can be assumed from the results that, the sample is adequate for the purpose of the study as the research aims at people who use their mobile devices frequently.

The shares of operating systems used by the test persons are depicted in Table 3. According to these results, it is clear that a large number of the participants use Symbian. Another 26.1% have chosen Android as their Operation Systems. The other kinds of operating systems shown by Table 3 are seldom used.

Mobile device manufacturers	Shares
Apple	3.1%
Blackberry	3.1%
HTC	6.5%
LG	1.1%
Motorola	5.0%
Nokia	41.4%
Samsung	10.7%
Sony Ericsson	6.5%
Others	22.2%

Table 2. Shares of mobile device manufacturers

Operation Systems	Shares
Android	26.1%
Blackberry OS	3.4%
iPhone OS	2.7%
oPhone OS	0.4%
Symbian	41%
Windows Mobile	3.8%
Others	21.8%

Table 3. Shares of operation systems of mobile devices

4.2 Results on RQ1: Usage of Mobile Applications on Mobile Devices

With college students as the participants, it comes as no surprise that 93.5% of the test persons have already installed software on their mobile devices. The high installation quota can be explained by the fact that the majority of participants were interested in the topic.

Table 4 shows the frequently used software types. It is not difficult to see that, instant communication (e.g., QQ, Skype) is the most popular software type among college students. At the same time, learning tools (e.g., electronic dictionary), social communication (e.g., Micro-blog), search engine (e.g., Google, Baidu) and entertainment (e.g., mobile games) are also used frequently by the participants.

Software types	Usage percentage
Instant Communication	94.7
Social Communication	70.6
Mobile Banking	7.6
Entertainment	61.8
Learning tools	85.5
Office Tools	32.8
Transaction	16.4
Search Engine	69.1
Others	4.6

Table 4. Frequently used software types

Another interesting question is why the other software types are seldom used. 38.2% of the participants have no interest in those types of mobile software. The other reasons are depicted in Figure 1. 21.2% of the respondents indicate that they have a feeling that it is too complicated to use these mobile applications. Further, 20.6% of the participants indicate that it is too expensive to buy mobile applications via their mobile devices.

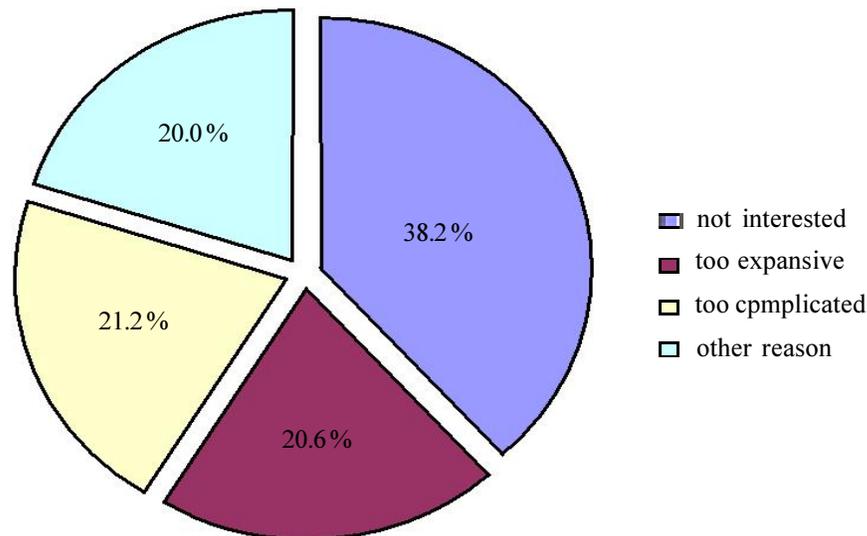


Figure 1. Reasons for not using mobile applications

4.3 Results on RQ2: Usage of Distribution Methods of Mobile Applications

77.1% of the participants have installed applications through the PC, 69.3% have installed applications directly onto their mobile devices and 43.8% have tried to transfer applications between mobile devices.

Table 5 shows the used transmission ways in detail. When installing applications indirectly through a PC, most of the participants use a USB-cable. 81.1% of the test persons use the mobile network when installing applications directly. The participants mainly use Bluetooth to obtain applications from other mobile devices.

	Usage Percentage				
	Memory Card	USB Cable	Bluetooth	WLAN	Mobile Network
PC	31.3	85.6	12.7	9.3	N/A
Direct	10.4	9.4	10.4	17.9	81.1
mobile to mobile	N/A	10.7	89.5	N/A	7.5

Table 5. Frequently used transmission ways

In the following, the installation methods used by the participants will be explained in greater detail. The usage scale ranges from 1 (never) to 5 (very often). It is clear to see from Fig. 2 that the participants most likely to install applications via PC or mobile network, while NFC and WLAN (with costs) are rarely used as installation methods.

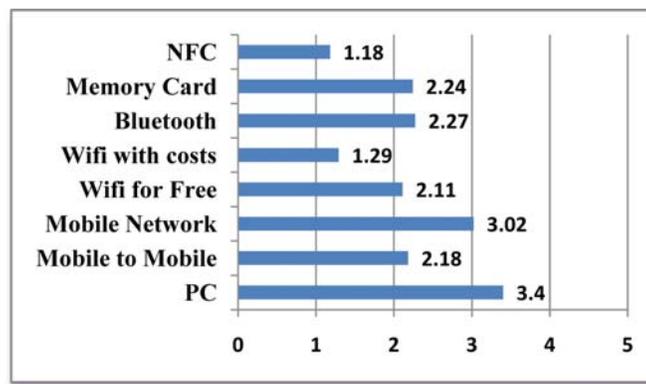


Figure 2. Currently used installation methods

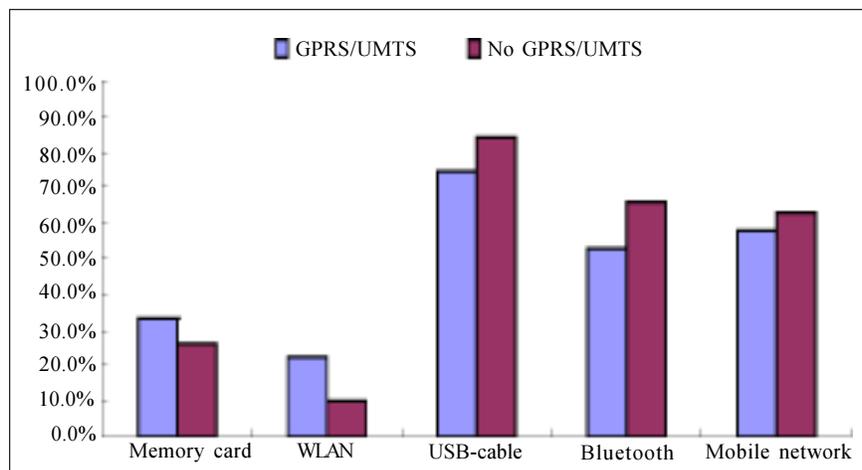


Figure 3. Usage of transmission ways according to end device equipments

As every provider has a data tariff normally, almost all the participants have tariff which provides them with a sufficiently large data volume. 28.6% of the participants do not have GPRS/UMTS which can support mobile web usage well. Users who do not have access to UMTS/GPRS prefer to use the transmission way via a USB-cable than those who have access to UMTS/GPRS. There is a significant tendency for the participants who have access to UMTS/GPRS to use the transmission way via mobile network or WLAN. For more details, see Figure 3.

4.4 Results on RQ3: The Acceptance of Distribution Methods

There are more participants preferring installation via a PC than direct installation method. It is possible to be explained that users are familiar with a PC, and they think installing applications via a PC is safer and easier than installation via mobile network.

Most of the participants would like to choose another transmission method which they did not use before. A possible explanation could be that the test persons are all college students who have more interest in information technology.

80.9% of the participants do not accept additional costs for software installation. In general, the users choose the software with no charge more often than that with costs. Table 6 shows the willingness of the participants to pay for desired software. The average willingness was 2RMB-5RMB in this sample. Only 16.1% of the participants were willing to pay more than 5RMB.

Costs on Mobile Applications	Percentage
Nothing	19.5
Up to 2 RMB	26.1
2 RMB-5 RMB	37.9
5 RMB-10 RMB	13.4
More than 10 RMB	2.7

Table 6. Willingness to pay for mobile applications

The usage of installation methods according to relevance are depicted in Table 7. While on the move, the participants would like to install relevant applications via mobile network. If the applications are less relevant and need not to be installed instantly, the participants would choose the transmission via a PC. There are some possible explanations, such as data transmission is always free via a PC while the users mostly do not accept the additional costs and sometimes end devices are incompatible with new technologies.

	Usage Percentage	
	Relevant Applications	Not Relevant Applications
PC	56.3	64.4
Mobile to Mobile	16.1	13.0
Mobile Network	60.2	28.7
WLAN (for free)	20.3	21.5
WLAN (with cost)	7.7	4.6
Bluetooth	24.9	23.0
Memory Card	19.2	14.9
NFC	1.1	2.3

Table 7. Usage according to relevance of applications

4.5 Results on RQ4: Users' Experience with Mobile Applications Installations

The majority of the participants have installed software on their own mobile end device. With 72.8% of test persons technology-affine, they were interested in the topic.

Figure 4 shows the successful and unsuccessful installations of the participants. There are mainly two kinds of users that have installed on their mobile device. One group have installed software occasionally, namely they have 2-5 applications installed. The other groups have installed more than 20 applications. Meanwhile, most of the participants could not install software successfully for 2-5 times.

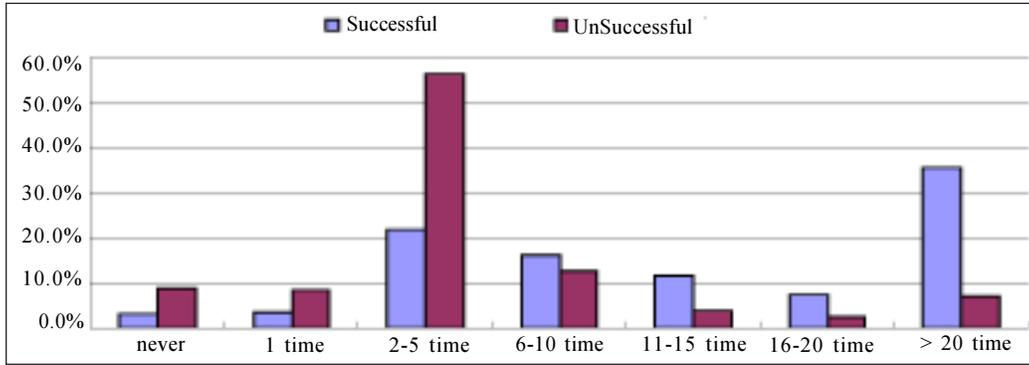


Figure 4. Evaluation of the simplicity of installation processes according to transmission ways

When asked to evaluate the simplicity of the installation processes, most of the participants thought the transmission ways they had chose are relatively easy to use. The evaluation scale ranges from 1 (very difficult) to 5 (very simple). From Fig .5, it is clear to see that the users who transfer data via USB-cable found it relatively simple.

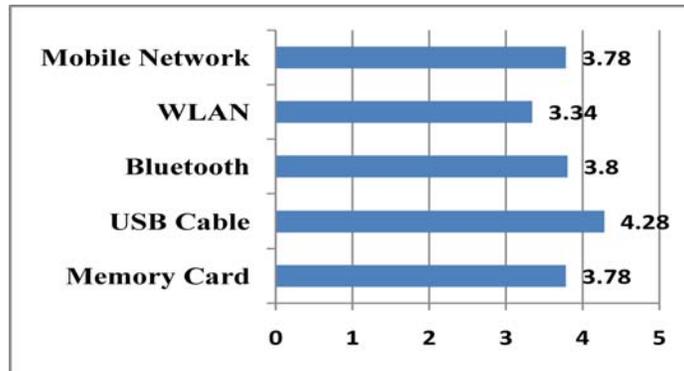


Figure 5. Evaluation of the simplicity of installation processes according to transmission ways

Figure 6 shows the technology-affinity according to device manufacturer. It can be concluded that the relatively technology-affine participants prefer mobile devices made by Apple and HTC.

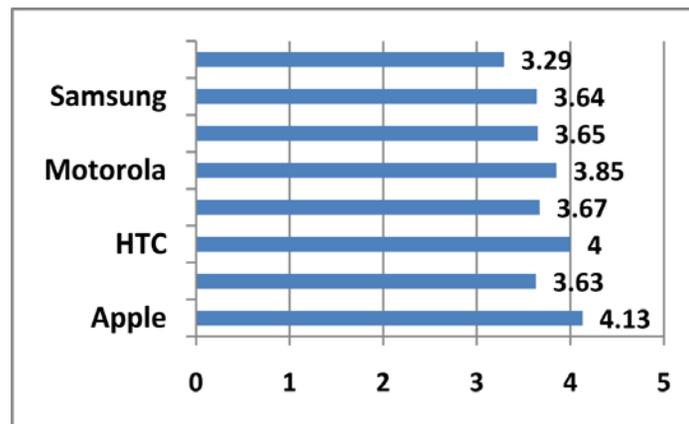


Figure 6. Technology-affinity according to mobile device manufacturers

In general, men are always more technology-affine than women. We made this assumption before the user study, but the result does not accord with the previous viewpoint. The sex-dependant evaluations of installation methods are depicted in Figure 7. The result can reflect a fact that the preference of transmission ways depend on the user's sex is not apparent.

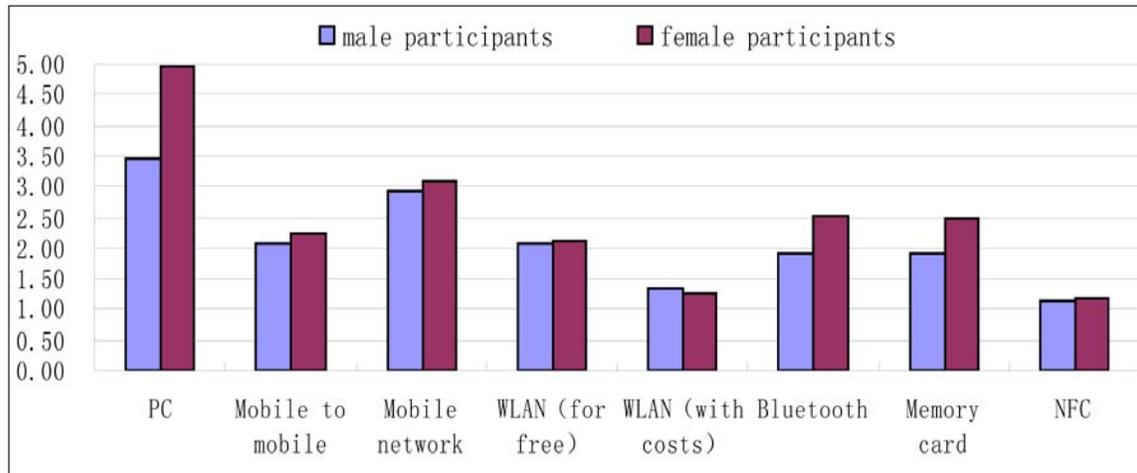


Figure 7. Sex-dependant evaluation of installation methods

There are other findings related to the participants' major. We simply divided the test persons into two majors. One is Humanities and Social Sciences while the other is Science. The sample consists of 47% students major in Science and 53% students of the other major. The participants major in Science are more technology-affine than those major in Humanities and Social Sciences (see Figure 8). Furthermore, the users major in Science are more likely to use new technology in this study.

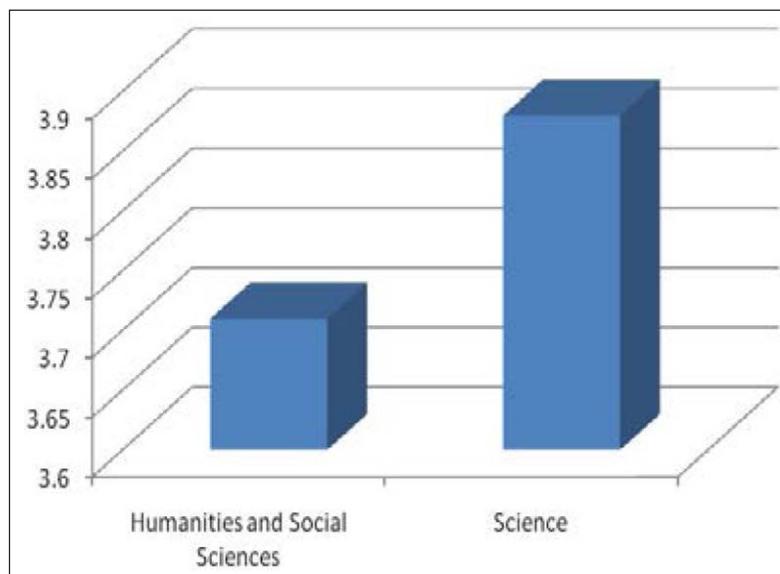


Figure 8. Technology-affinity according to their majors

5. Discussion

These results have implications for the future distribution of mobile applications in China. It can be expected that mobile applications will also become more popular in the future due to the availability of advanced mobile devices. However, in the college students' context, students majoring in Humanities and Social Science as a target group should be more strongly addressed, as they are less likely to use new technology than students majoring in Science (see section 4.5). Thus, application developers should more clearly explain to students majoring in Humanities and Social Science users which added value their applications have.

Further, the services providers need to free transmission services if it is possible. This is because users rarely accept transmission and program costs, and fees also prevent those users from using the application who install the relevant software at home through their PC.

In addition, an effort should be made to improve the quality of the applications by increasing compatibility, in order to reduce installation interruptions. And future installation processes should be fast and simple, as this is very important for the users.

6. Conclusion

This research studies distribution of mobile applications in China with the responded valid 262 questionnaires from the biggest city in central China. The results of survey has provides some insights into many new findings, especially with respect to the detailed evaluation of different distribution methods of mobile applications and the installation process of mobile applications. The results showed that the most used mobile application in the Chinese market is instant messaging tools. It is found that majority of Chinese users are more likely to install mobile applications via the PC.

Other interesting findings are as follows: 1). When installing applications indirectly through a PC, most respondents use a USB cable for transmission. 81.1% of the respondents use the mobile network when installing application directly. 2). Among the available transmission methods, the transfer of data between mobile devices via Bluetooth receives the highest ranking. 3). More than 80% of the respondents have already installed mobile application on their mobile device. 4). Concerning the simplicity of the installation processes, most respondents thought the transmission ways they had chose are relatively easy to use. 5). 80.9% of the respondents do not accept additional costs for software installation. In general, they are willing to pay 2RMB to 5RMB for a mobile application. 6). Respondents are generally interested in mobile devices made by Apple and HTC.

These results have implications for the future distribution of mobile applications in China. It can be expected that mobile applications will also become more popular in the future due to the advanced mobile technology and available mobile devices. Further, telecommunication operators should try to make the cost on data transmission cheaper. According to our study, it seems users rarely accept transmission costs. These additional costs also prevent those users from using the application who install the relevant software at home through their PC. Alternatively, various transmission options can be offered to users from mobile applications providers. As a result, users can choose the appropriate transmission method according to their situations and needs.

To conclude, this study analyzed distribution methods of mobile applications to obtain a better understanding of the Chinese mobile business market. This research contributes to current literature on mobile applications diffusion. It also offers some insights for mobile applications providers to better target their potential consumer on the Chinese market.

We were also aware of some limitations in this research. Firstly, the sample size of the study was relatively small. This might reduce the power of our findings. Moreover, the sample used for analysis was drawn from a city in the central part of China, so the generalizability of the results remains to be tested.

As for future research, we plan to make a deeper exploration on distribution methods of mobile applications by attempting a nationwide sample. Another possible direction is to update the present study with a longitudinal design.

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