Full Length Research Paper

An analysis of preferences in smartphone interface design

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This study focuses on young people between 16 to 25 years of age with experience using smartphone technology. The study conducted face-to-face interviews to investigate the perceptions of smartphone interfaces. Results have revealed that 16 to 25 year olds can be divided into four groups according to the preferences regarding the characteristics of smartphone interface design. An analysis of these four user groups can provide a summary of the primary and customized demands of young people for a smartphone interface. The results of this survey could serve as a reference for professionals designing smartphone interfaces in related industries.

Key words: Smartphone, mobile phone interface, interface requirement.

INTRODUCTION

Due to the rapid development of mobile telecommunication technology in recent years, mobile communication products are now everywhere. With these developments, mobile phones, notebook computers, PDAs, and GPS are garnering increasing attention, and deservedly so because they have introduced a new level of convenience into everyday lives. With the introduction of 3G technology, mobile telecommunication features have become more diverse than ever before. These devices do not only send simple text messages, but are also capable of sending pictures, videos, and other forms of multimedia as part of their service capability (Huang et al., 2008). With the advantages of expandability, convenience, and portability offered by mobile-devices, mobile-commerce has presented the prospect of developing into a potentially massive market.

Mobile telecommunication producers continue to introduce innovative products developed to increase responsiveness and convenience. Mobile-phone functionality is becoming progressively powerful, and advanced features are increasingly prevalent. From the archaic 1G to the present 3G, people now appear inseparable from mobile technology, relying on them not only to maintain contact for business reasons, but also not to lose touch with their personal sphere. Shih (2002) indicated that 3G includes not only 1G (with its voice communication and data service) and 2G (with its digital signal processing, short-message service, e-mail, internet use, and international roaming), but also comprises such features as mobile-office services, virtual banking, online-billing systems, home shopping, video conferencing, and access to telecommunication services.

Currently, numerous well-known manufacturing companies are investing in mobile phone research and development; however, the basic functionalities of all mobile phones share more similarities than differences; and their dissimilarities, if any, are not that notable. In recent years, smart mobile devices have progressed considerably in software compatibility, hardware-computing capability, and volume size (Wireless intelligence, 2006). At present, more than 2.5 billion people use mobile devices, a number approximately double that of internet users. The mobile-device user population is increasing by 40,000,000 users annually. The value created by smart

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phones is no longer limited to high profitability from terminal hardware, software, and services that tend to emerge too slowly from previously sold products. This issue is gradually piquing the interests of large manufacturers busy devising strategies as relevant studies are being researched (Topology Research Institute, 2009). Between May 17 and August 4, 2006, the Taiwan Network Information Center (TWNIC) conducted a survey of "broadband internet use," indicating that a fifth of the age group between 16 and 25 years have mobile-internet experience. Fewer than 15% of users between 26 and 35 years of age had accessed the internet through mobile devices.

For individuals over the age of 36, the percentage was significantly lower. Currently, the majority of mobile-internet users are students and recent graduates. According to a report released by the CNNIC, entitled, "The Behavior of Internet Use Questionnaire Report on Chinese Youth" (2009), the number of young Chinese internet users in December 2009 had reached 195 million, 74% of whom were using their mobile devices for internet use, a figure totaling 144 million people. Mobile phones have become the primary means for Chinese youths to gain internet access. The Foundation for Excellence in Journalism Award (2008) conducted a national study on teenage media use, indicating that a teenage mobile phone user averages purchasing one mobile phone approximately every 1.3 years. This time period is shorter than that of 2004, when the average mobile phone lasted more than 2 years. Mobile phone ownership has increased by approximately 10% since 2004 (rising from 62.5 to 73%). Smartphones have increased in popularity, with young people being the primary users.

Therefore, the chief objective of this study is to identify the key features of a smartphone interface deemed essential by young people. The ultimate purpose of a computer system is to help users complete their tasks. Therefore, from a practical viewpoint, the primary function of an effective human-machine interface is to facilitate users to achieve their goals. Smartphones are an example of high-involvement purchase decisions for consumers. Regarding interface design, a smartphone interface always adopts images, and consumers determine the functions through the presented imagery. To provide easier and more convenient functionality, smartphone interfaces must undergo development according to the usage behavior of consumers.

Therefore, the second research objective of this study is to analyze the needs for an effective smartphone interface. Various current studies in mobile-information technology have chiefly focused on image perceptions and icon preferences for the human-machine interface of mobile phones (Lin and Huang, 2004), information visualization on the interfaces of portable mobile-communication computers (Chen et al., 2006; Liarokapis and Conradi, 2007; Gerrit, 2009), and human-computer interaction and

cross hetero-interfaces for mobile commerce (Su et al., 2007). Regarding the topic of user interface, most studies have concentrated on digital interfaces for the elderly (Tang and Shiao, 2009), the effects of multimedia-message services on mobile advertisements (Huang et al., 2008), and multimedia learning interfaces (Passig and Levin, 1999; Tung and Tseng, 2007).

However, research specifically on smartphone interfaces has been scarce. Therefore, this study investigates 16 to 25-year-olds to assess their preferences regarding smartphone interface designs (separately analyzing presentation interfaces, conversation interfaces, navigation interfaces, and mousing around). Using cluster analysis, a test group was divided into four clusters, and the study offers an examination of the results according to their various preferences for smartphone interfaces. This study also provides a summary of smartphone usage behavior and customized requirements of various clusters. This work could prove as a significant reference for professionals in the mobile communications industry preoccupied with smartphone interface designs principally concerning this age group. The study can also provide a number of suggestions to serve as a basis of reference for decision-making bodies.

LITERATURE REVIEW

This study referred to the four dimensions proposed by Weiss (1994), and the digital system presented by Horton (1994), along with its mandatory functions, imagery, and color design, derived from research into multimedia interfaces. An outline of the research regarding the aforementioned four interface design factors, is presented as follows.

Presentation interface

Huang et al. (2009) constructed a homepage of interface designs as a green 3C information platform. The main consideration in this design was to provide a user-friendly community discussion and platform for interaction, to enhance the website's visibility and to promote environmental values and green commodities. Chen et al. (2006) performed a study comprising portable mobile communication and color selection for human-computer interactions and cross hetero-interfaces for mobile commerce, dividing the information into four categories (leading type, flash type, scroll type, and full-page type). They further separated the screen-setting interface color settings into four groups (self-customized group, reference group, gray-scale group, and random group) to discover their effects on user-search performance.

The study also constructed a "color selection   decision

support system" to assist subjects to adjust color settings for the screen interface. Results indicated that during subject-setting customization with "color selection decision support system" assistance, not only does the color of the screen interface match the subject's personal preferences on color combination, but it also raises the subject's visual search performance. Passig and Levin (1999) studied gender regarding multimedia user interfaces, and discovered that men prefer green and blue, whereas women favor red and yellow.

Conversation interface

Baumann and Thomas (2001) stated that electronic instrument interface design should comprise a simple input and output interface, allowing users to input data and efficiently retrieve information when necessary. Crockett et al. (2002) suggested that interactive design requires scrutinizing the operating practices and humanized feelings of consumers, to raise the interaction level between the user and the product. Wu et al. (2008) focused on users with visual disabilities who, through tactile and auditory feedback (braille and tactile image, and voice), have acclimated to different interface modes (different functions on the number buttons and hierarchical menus). By considering the operation of various combination patterns, the best interfaces were, "tactile image interface" and "voice-assisted interface," and the second and third level were, "braille and voice assisted interface," "tactile image and voice-assisted interface," and "voice-assisted interface." Lin and Huang (2004) targeted young people for their study of perceptual images and preferences for mobile phone human-machine interfaces, dividing mobile phone perceptual images into three factors of "conveyed semantics," "symbolization," and "design quality." The results presented, "image subject" as the most significant design element in imagery design. Specifically in the "image subject" category, "large-size picture" received the most positive responses, while "photo realism" received numerous positive responses in the "image style" category.

Navigation interface

The study conducted by Zhuang and Yang (2006) concentrated on the four common presentations of personal PDA text: turn page type, scroll type, leading type, and fast-forward continuous type, to study their effects on reading performance and reader preference. Their study showed that reading rate, efficiency, and satisfaction were highest under turn page type and lowest under scroll type. Huang et al. (2008) used information presentation, product type, and consumer type as

research variables, to determine the influence of marketing strategies of multimedia message services on advertising. Their results demonstrated that moving image presentation is the most effective variable for advertising, followed by dynamic presentation, and lastly, static presentation.

In terms of product categories, no matter what product type was used, moving image advertising was the most effective, whereas static was the least effective. Joseph (2008) indicated that the design of current PDAs has many added features: 3 Mbps Bluetooth 2.0 EDR-assisted GPS for direction guidance, a microSD slot for expanded storage capability, and full-featured HTML webpage browsing with single-handed zoom-in and zoom-out interaction, and no scrollbar interface. These features have increased user friendliness for searching and viewing webpage content.

Mousing around

Fisk et al. (2004) indicated that when elderly people use touchscreen products, certain factors (such as button size and location) influence usage duration and personal intentions. Lee and Kuo (2004) studied the use of small touchscreens by senior citizens, asking each subject to perform 30 tasks (5 button sizes × 2 input types × 3 operation gestures). The entire experiment comprised the usage of PDAs with the physical inputting of phone numbers as the exercise. The results showed that, for any key size or input method, the time required by elderly subjects to complete the task was longer than for middle-aged or young people. Overall, concerning various groups using fingers for inputting, the smallest button size recommended was 9 × 9 mm, and 5 × 5 mm for stylus input.

RESEARCH METHODS

The need for PDA interface design was analyzed according to the perspective of presentation, conversation, navigation, and mousing around in the literature review. Therefore, this study presents smartphone interface features deemed essential by youth consumers, examining user-interface needs via cluster analysis to understand the differences between these requirements.

Definition of terms and measurements

This study refers to the four dimensions proposed by Weiss (1994), the digital system and its mandatory function of imagery and color design proposed by Horton (1994), and the study conducted by Wang and Tsai (2010) to establish the questionnaire definitions, as follows:

1. Presentation interface: Controls user perception of the message. The subject must answer 14 questions, with each question measured using the five-point scale method.

Table 1. Cohesive coefficient.

Cluster number	Cohesive coefficient	Increasing value of coefficient
10	8971.457	127.863
9	9108.682	137.225
8	9251.955	143.273
7	9396.191	144.236
6	9554.310	158.119
5	9752.593	198.283
4	9951.772	199.178
3	10327.899	376.127
2	11349.465	1021.566

Source: Compiled by this study.

2. Conversation interface: Controls the mode of communication between the system and its user, and vice versa. The subject must answer 7 questions, with each question measured using the five-point scale method.
3. Navigation interface: Responsible for the mode of user movement from one area to another. The subject must answer 18 questions, with each question measured using the five-point scale method.
4. Mousing around: Controls user activities on photos and screen. The subject must answer 21 questions, with each question measured using the five-point scale method.

Research subjects

This study targeted the age group between 16 and 25, for the convenience of sampling. The main survey locations were in the Kaohsiung and Pingtung areas in Taiwan, and the candidates for the survey interview had to be smartphone users. To increase the validity of the study, upon selecting the subjects, they were given an explanation of the study's motivation and purpose once they were selected, and their consent was acquired prior to the commencement of the onsite questionnaire interview.

Data analysis

The obtained data was statistically analyzed using the following methods:

1. Cluster analysis - A two-stage cluster sampling approach was adopted for group users according to their demands for an effective smartphone interface. The results can serve as a basis for customized interface categories.
2. Comparison of means - The mean of 3.5 was adopted as the base value to test the importance of interface design for users.

RESULTS

Cluster number

This study collected 243 questionnaires from the

interviews. This study involved using categories such as presentation interface, conversation interface, navigation interface, and mousing around as input attributes for grouping. The chief purpose was to determine whether a new user group was emerging due to demands for a preferred smartphone user interface. In the first phase of the cluster analysis, results indicated that the cohesive coefficient value for cluster numbers of more than 10 groups did not significantly change, and therefore, only cohesive coefficients of 10 clusters or less are listed (Table 1).

As seen in Table 1, when the four clusters jump to three clusters, the "increasing value of coefficient" becomes 376.127. To go from four clusters to three clusters evidently generates significant differences. Therefore, this study discovered that the appropriate number of clusters should be four. In the second phase of the cluster analysis, four clusters were used as the input, employing the K-means method to analyze interface requirements between the demand of various groups for the presentation interface, conversation interface, navigation interface, and mousing around. In terms of sample size for the four groups after cluster analysis (Table 2), Group 1 had the most with 29.63%, and Group 4 had the least with 20.58%.

Interface analysis

This study required executing a descriptive statistical analysis on each question item in the questionnaire focusing on collected data to understand the characteristics of each question item.

Presentation interface

The mean, standard deviation, and topic items for the presentation interface are listed in Table 3. Regarding the

Table 2. Number of clusters.

	Group 1	Group 2	Group 3	Group 4
Samples	72	53	68	50
Percent	29.63	21.81	27.98	20.58

Source: Compiled by this study.

Table 3. Presentation Interface.

Presentation Interface	Mean	Standard deviation	$H_1:\mu>3.5$
I would like seeing many images on the screen	3.831	0.949	V
I would like to see many colors on the screen	3.593	0.920	V
Blue and gray make me feel good	3.173	0.830	
I would like a lot of green	3.091	0.843	
Motion graphics attract me for using this device	3.819	0.818	V
I would like a lot of yellow or red	3.091	0.793	
I would like to set my own background image	4.498	0.652	V
I would like the homepage to show the date and time	4.444	0.692	V
I would like the homepage to show my most frequently used software	4.226	0.864	V
I would like an animated boot screen	4.082	0.932	V
I would like a button type selection menu	3.930	0.833	V
I would like animated buttons	4.029	0.855	V
I would like buttons with text	3.930	0.823	V
I would like many screen templates to choose from	4.082	0.854	V

Sources: Weiss (1994), Horton (1994), and this study.

initial page on the mobile phone, most users prefer seeing the date, time, and a list of the most frequently used software. Regarding video durations, most users watch short videos, and interfaces incorporating motion graphics have more appeal for smartphone users. Concerning screen display, most users prefer seeing many patterns and colors onscreen. Concerning buttons, most users wish to see more animated buttons.

Conversation interface

The mean, standard deviation, and topic items of conversation interface from this study are listed in Table 4. The study assumed that one is free to use the entire system as they wish. When operational errors were to occur, the computer would assist the user with voice instructions.

Navigation interface

The mean, standard deviation, and topic items of navigation interface from this study are listed in Table 5.

For smartphone usage, a general feeling permeated that learning how to use the entire system is necessary, and that retracting to the previous step was easy and simple. Seeing a step guide button at all times was also a requirement. Each time the interface switched from one to the other, users felt a sense of surprise. Users enjoyed the ability to switch between interfaces quickly, but when this action slowed the system, they disapproved. When clicking on a page's new links, users preferred the ability to always view the current browsing path. When too much data were displayed at once, users preferred scrolling type and vertical browsing.

Mouse around

The mean, standard deviation, and topic items of mousing around interface from this study are listed in Table 6. In summation, for smartphone use, users preferred large buttons, with colorful buttons yielding the highest choice preference, followed by patterned buttons. Buttons with arrows, and buttons that under different conditions, change shape were preferred for their convenience. Touch interfaces would require a leave (log off) button.

Table 4. Conversation interface.

Conversation interface	Mean	Standard deviation	$H_1:\mu>3.5$
When I want to perform a function, I would like to hear a voice note	4.140	0.759	V
The ability to use the entire system as one wishes is a good thing	4.222	0.727	V
I would like the computer to assist me with instructions when I make an operating error.	4.066	0.774	V
I would like diverse choices when operating the system	3.165	0.917	
When starting the system, I like it when the computer asks for information	3.206	0.917	
When I select a feature, I would like see a simple description of its function	3.823	0.842	V
When an icon is unclear, I would like see a simple description of its function	4.041	0.732	V

Sources: Weiss (1994), Horton (1994), and this study.

Table 5. Navigation interface.

Navigation Interface	Mean	Standard deviation	$H_1:\mu>3.5$
I have to learn how to use the entire system	4.226	0.712	V
I must be able to easily retrieve my steps in the system	4.288	0.738	V
I must be able to see the step guide button at all times	3.798	0.826	V
I would like to click on each button and be surprised	3.695	0.903	V
I would like a quick switch interface	4.169	0.788	V
I would like the pace of the system to be slow	2.564	0.922	
When moving images appear, I would like to be surprised	3.687	0.873	V
When moving images are playing, I would like a full screen display	4.193	0.904	V
I would like moving images at the top of the screen	3.152	0.999	
I would like moving images at the bottom of the screen	2.872	0.907	
I must always be able to see the browsing path of the current view	3.778	0.755	V
I would like the screen to switch with the rotation of the mobile phone	4.173	0.850	V
I would like the guide button to be located at the top of the screen	3.255	0.988	
I would like the guide button to be located at the bottom of the screen	3.469	0.937	
When too much information is displayed, I would like full-page style browsing	3.453	1.095	
When a lot of information is being displayed, I would like scroll view	3.733	0.940	V
When a lot of information is displayed, I would like to use the vertical scroll view	3.704	0.933	V
When a lot of information is displayed, I would like to use the horizontal scroll view	2.979	0.985	

Sources: Weiss (1994), Horton (1994), and this study.

Users disliked designs with no buttons. Whether the shape of the screen cursor could change under certain circumstances made no difference to users. Regarding button design, users felt that buttons placed at the bottom of the screen were more convenient than buttons placed at the top or to the sides. Too many buttons caused user confusion during system use. Concerning actual user operation of the system, users preferred using their fingers to browse pages, and to enlarge or unlock the screen. Regarding direction of sliding on the page, more users were accustomed to sliding to the right. Enlarging the screen image using two-way finger movements was preferred. Unlocking the screen with an unlock slider was preferred as well.

DISCUSSION

The characteristic of each cluster

This study required sorting the first third of each group from the four groups, according to their preferences regarding smartphone interfaces. The results are presented in Tables 7 and 8, and as follows:

Group 1: For the presentation interface, this group likes setting their own background image. The first page displays the date, time, and frequently used software. The screen shows a variety of options, and moving images during startup. They dislike seeing too many colors or

Table 6. Mousing around.

Mousing around	Mean	Standard deviation	H1:μ>3.5
I would like big buttons	3.597	0.854	V
I would like colorful buttons	3.687	0.928	V
I would like round (rounded rectangular) icon buttons	3.440	0.843	
I would like square icon buttons	3.255	0.716	
Arrow buttons are more convenient	3.519	0.815	V
I would like buttons with pictures	3.901	0.908	V
I would like to change the shape of the cursor on the screen at any time	3.979	0.845	V
Buttons at the bottom of the screen are more convenient	3.646	0.880	V
Buttons at the top of the screen are more convenient	3.058	0.816	
Button design on both sides of the screen is convenient	3.300	0.860	
I would like buttons that change to different shapes under different conditions	3.881	0.894	V
Too many buttons tend to confuse me	3.815	0.906	V
I would like screens designed with no buttons	2.909	0.886	
I would like to move a mouse around the screen to view pictures	3.951	0.943	V
I would like to use fingers to slide left to the next page	3.366	1.122	
I would like to use fingers to slide right to the next page	3.753	0.998	V
I would like to use two fingers (index finger and middle finger) to enlarge a screen image using the extension method	3.733	1.048	V
Clicking the button is the way I would like to enlarge the screen image	3.626	0.938	V
I would like to use sliding unlock	3.584	1.074	V
I would like finger-tap (twice or three times) to unlock	3.309	1.000	
I would like to use circle-type unlock	3.317	1.054	

Sources: Weiss (1994), Horton (1994), and this study.

patterns in the design. For the conversation interface, they like running the entire system as they see fit. During system operations, they like multiple choices, but dislike computers requesting data inputting and hearing voice instructions. If operating errors occur, they hope to see assistance provided promptly by the system.

For the navigation interface, they like screens shifting according to the rotation of the mobile phone, and a quick switch interface. For moving image broadcasting, they prefer full screen playback rather than playback at the bottom of screen. For system operations, they like retrieving their steps easily, with a clear understanding of how to use the entire system. In addition, unlike the other three groups, this group wishes to see step guides at all times. During mousing around, they like changeable screen cursor shapes, touch screen navigation, finger slide down page turning, image filled buttons, button-shape-change under different conditions, and sliding unlock. They dislike too many buttons because they cause confusion.

Group 2: For the presentation interface, this group likes setting their own background image. The first page

displays the date, time, and frequently used software, an animated startup and buttons. They dislike too many colors or images on the screen. For the conversation interface, they like running the entire system as they see fit. During system operation, they like multiple choice, but they dislike computers requesting data input and hearing voice instructions. If operating errors occur, they expect the system to provide assistance promptly. For the navigation interface, they like screens shifting according to the rotation of the mobile phone, and quick switch interfaces.

For moving image broadcasting, they like full screen playback rather than playback at the bottom of the screen. They like to be surprised when a moving image appears, and they want a clear understanding of how to use the entire system. They dislike step guide buttons and moving image playback at the top or bottom of the screen. For mousing around, they like changing the cursor shape at any time. For button design, they like pointing and selecting images, and seeing exciting and shape-changeable buttons. They dislike square buttons, or buttons located along the top or both sides of the screen. In system operation, they like clicking a button to

Table 7. Cluster interface design preference ranking.

Content	Group 1	Group 2	Group 3	Group 4
Presentation interface				
I would like to set my own background image	1	1	1	1
I would like my screen's first page to display the date and time	2	2	2	2
I would like my screen's first page to show my most frequently used software	3	3	3	
I would like selections on my screen layout	4		5	3
I would like an animated startup screen	5	4	4	
I would like a button-down menu				4
I would like animated buttons		5		5
Conversation interface				
I would like the computer to assist me when an operating error occurs	1	1	1	3
Using the entire system as I see fit is beneficial	2	2	2	1
When the purpose of an icon is unknown to me, I would like a simple description of its function				2
I would like a range of choices when operating the system	3	3	3	
Navigation interface				
I would like the screen to rotate accordingly with the mobile phone	1	2	6	5
I need easily retrieve steps when operating the system	3	1	1	1
When a moving image is playing, I would like it to fill the entire the screen	2	4	4	4
I would like a quick switch interface	5	5	2	3
I wish to learn how to use the entire system	4	3	3	2
When a lot of information is present, I would like to browse in the full screen format			5	
I require a step guide button at all times	6			
When moving images appear, I always feel surprised		6		
When a lot of information is present, I would like scroll and view				6
Mousing around				
I would like to change cursor shapes at any time	1	1	1	
I would like touchscreen navigation	3	2		1
I would like to click on image buttons	2	4		4
Too many buttons confuse me	5		2	2
I would like the button to assume a different shape according to circumstances	4	3		5
I would like a finger-tap (two or three times) unlock function			3	
I would like to use my fingers to slide to the right for the next page	6			3
Buttons with arrows are more convenient			4	
I would like to click on colorful buttons		5		
I would like to use my fingers to slide to the left for the next page			5	
I would like the click-the-button method to enlarge the screen image		6	7	
I would like to tap on large buttons			6	

Table 7. Contd.

I would like to use the two-finger-extension (index finger and middle finger) method to enlarge a screen image			6
I would like to use a sliding unlock function	7	7	
Buttons on either side of the screen (left or right) are more convenient			7

Source: Weiss (1994), Horton (1994) and this study.

amplify the screen, sliding unlock, and touch screen. They dislike circle unlock.

Group 3: In the presentation interface, this group like setting its own background image. The first page displays the date, time, and frequently used software, and animated startup and buttons. They dislike too many colors or images on the screen. For the conversation interface, they like running the entire system as they see fit. During system operation, they like multiple choices but dislike computers requesting data input and hearing voice instructions. If operating errors occur, they expect the system to provide assistance promptly. For the navigation interface, they like the screen to shift according to the rotation of the mobile phone, and they like retrieving their steps.

They like having a clear understanding of how to use the entire system. When too much data are present, they prefer a full-page-style view. They dislike scroll-viewing information, and prefer guide buttons at the bottom of the screen, and moving images at the top of the screen during playback. For mousing around, they like changing the screen cursor shape at any time, arrow buttons, finger-tap unlock, or enlarging the screen to unlock images. They dislike square buttons. They prefer buttons to be located above or at the side of the screen, with finger-point and circle-type unlock. Unlike the other groups, this group prefers sliding the finger left for the next page, and large size buttons.

Group 4: For the presentation interface, this group likes setting its own background image. The first page displays the date, time, and frequently used software. They like animated startups and buttons. They dislike too many colors or images on the screen. Unlike other groups, this group prefers the button-down menu. For the conversation interface, they like running the entire system as they see fit. If operating errors occur, they expect the system to provide assistance promptly. They dislike computers requesting data input and hearing voice instructions. Unlike the other three groups, this group likes simple instructions for features when the icon function is unknown. For the navigation interface, they like the screen shifting according to the rotation of the mobile phone. They like quick switch interface, full screen

playback, and easy return functions.

They like easily retrieving their steps, and wish to have a clear understanding of how to use the entire system. They dislike moving images at the top or bottom of the screen during playback. They like horizontal scrolling, full page browsing, and guide buttons located at the top of the screen. When the smartphone displays much information, they prefer scrolling. For mousing around, they prefer clicking on image icons, and changing button shapes under certain situations. They like touchscreens, but dislike too many buttons or square buttons, circle unlock, or buttons located at the top of the screen. They like the convenience of stretching two fingers to enlarge an image, and prefer buttons to be on both sides of the screen. They dislike arrow buttons.

Comparisons of the four groups

This study made further comparisons for interface preferences of the four groups of young consumers:

1. Presentation interface: All four groups preferred setting their own background image and the homepage to display the date and time, but the preferences differed for button-type selection-menu designs or animated-button designs.

2. Conversation interface: All four groups were unanimous in preferring a computer to assist immediately with operation errors, and for the freedom to use the entire system as they wished. However, when an icon is unclear and even when a basic description of the function is available, the opinion was divided.

3. Navigational interface: All four groups preferred the screen to shift accordingly to the rotation of the mobile phone, and they preferred the ability to retrieve their steps with ease. However, when the phone displays too much information, a consensus for scrolling or full-page style browsing did not emerge.

Table 8. Cluster interface design less preferred ranking.

Content	Group 1	Group 2	Group 3	Group 4
Presentation Interface				
I would like a lot of green	1	3	1	1
Blue and gray make me feel good	3	1	3	3
I would like a lot of yellow or red	2	2	2	2
I would like to see many colors on the screen	4	4	4	4
I would like to see many images on the screen	5			5
I would like a button-down menu		5		
Moving images would attract me to use this device			5	
Conversation Interface				
I would like the computer to request information during system operation	2	1	1	1
When I want to perform a function, I would like to hear voice instructions	1	2	2	2
Navigation Interface				
I would like the pace of the system to be slow	1	1	2	1
When a moving image is playing, I would like them at the bottom of the screen	3	2	1	3
When a lot of information is present, I would like to use the horizontal scroll bar for viewing	2	3	3	5
I would like the guide button to be located at the top of the screen	4			
When a moving image is playing, I would like it at the top of the screen	5	4	4	2
When a lot of information is present, I would like full screen browsing	6			4
I would like the guide button to be located at the top of the screen		5	5	6
When a lot of information is present, I would like to use the horizontal scroll bar for viewing				
I would like the guide button to be located at the bottom of the screen		6		
When a lot of information is present, I would like to scroll for viewing			6	
Mousing around				
I would like a screen without any button design	1	1	1	2
I would like to use my fingers to slide left for the next page	5			1
Buttons at the top of the screen design are more convenient	2	2	3	4
Buttons on both sides of the screen (left) are more convenient	4	5	2	
I would like the finger-tap (two or three times) to unlock	3	7		6
I would like buttons with a square pattern	6	3	5	3
I would like to use a circle-type unlock	7	4	7	5
I would like circular (rounded rectangular) patterned buttons		6	4	
I would like colorful buttons			6	
Buttons with arrows are more convenient				7

Sources: Weiss (1994), Horton (1994), and this study.

4. Mousing behavior: The four groups were not unanimous in the design of the touch interface. However, three groups were unanimous in preferring fewer control buttons, button icons, and a variety of icons that could be changed at any time.

Conclusions

This study analyzed smartphone interface requirements of 16 to 25-year-olds. The interface designs have been categorized into four dimensions: presentation interface, conversation interface, navigation interface, and mousing around. The findings are as follows:

Firstly, in their demand for an improved presentation interface, youth consumers prefer to "set my own background image," with the "first page showing the date, time," and the "first page showing the most commonly used software," "animated startup screen," and other

presentation interface designs. Secondly, in their demand for an enhanced conversation interface, users preferred that "computers will help promptly during operation error," and they were "free to use the entire system as one wishes," and "operating system shows multiple choices," and other conversation design features. Thirdly, to meet their requirements for a superior navigation interface, youth consumers prefer that a "screen will change as mobile phone is rotated," "easy to go back to the previous step," "full screen movie playback," "quick switch interface," and "learn how to use the entire system." Finally, for an improved mousing around interface, youth consumers chose "cursor on screen can change shape," "mousing around the screen to browse image," "click on buttons with image," "too many buttons will make me confuse," and "button will change shape as situation change."

This study analyzed the customized interface preferences deemed essential by youth consumers for the design of their smartphone interfaces. This study employed cluster analysis for the four types of demanded interfaces. The findings reveal that a presentation interface should offer "button style menu" and "animated buttons" designs to facilitate user selection. A conversation interface should provide the user with "simple feature instruction" option designs. A navigation interface should provide the user with "full screen browsing mode" and "scroll view" designs and, for page browsing, a "step guide" option. Finally, mousing around should offer "hand tap" and a "sliding" unlock method to unlock the phone. Turnpage should offer "left" and "right" sliding modes for its selection design. Button-click-to-select should offer "colorful," "arrow indicating," and "big button" designs. They should also offer design options with buttons on both sides of the interface. Designs for screen magnification should offer a "click button" and "two fingers (index and middle fingers) stretching mode" options. 1. According to the variability of youth consumers, interfaces should provide multiple functions and operation selections for users to choose and modify, such as selectable startup options and multiple applications. 2. For the type of interface presentation, mobile phones should provide young users with a range of selections, such as selectable screen layouts, the option to add visual effects, adjustable button attributes (like icons, size, shape, and color), and cursor types. 3. The visual design and content of mobile-phone interfaces should aim toward animated presentations, and the technology should develop from 2D to 3D, to provide young people with more options. 4. Mousing behavior should provide customized options for left-handed and right-handed users, and different choices for screen size. For adjusting screen-size functions for videos or photos, button-type choices should also be provided for considering finger-types. This study proposed a multi-options design for customized interfaces, to be used as a reference for companies engaging in new mobile phone development projects, thereby enhancing their understanding of the requirements deemed essential by young smartphone users.

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