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Research on user needs for gesture interaction of foldable smartphones: comparison between current and potential users

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The foldable smartphone is one of the key trends in personal mobile devices, and a topic worth investigating is the classification and structure of user needs of foldable smartphones. This study profoundly explores the user needs for gesture interaction of foldable smartphones by comparing current and potential users. The needs of 20 current users were obtained through the interview, and observational experiments were conducted to obtain the needs of 20 potential users. Following the principles of grounded theory, a theoretical model which includes 4 categories and 7 subcategories was generated from current users' needs. Also, a theoretical model which includes 5 categories and 11 subcategories was generated from potential users' needs. This study concludes that consistency is a specific need for potential users through comparison. At the same time, accessibility, comfort, control, and visibility are common to both potential and current users. The results of this study can be helpful and contribute to understanding user needs for gesture interaction of foldable smartphones and improving the gesture design to meet the needs.

Keywords: foldable smartphones; user needs; current users; potential users

1 Introduction

Foldable smartphones came forth in 2019, which breaks the situation that smartphones have faced years of stagnation and same-looking glass rectangles. A foldable smartphone has a folding form factor, which means that a smartphone can switch from a small and folding screen to a large screen at will, and people can use a smaller size to make a large screen smartphone more portable. From an early start with Samsung and Huawei (Terry, 2019), many more manufacturers are joining the fray, making the phone industry much more energetic. Moreover, with the progress of technology and the emergence of more and more excellent designs, foldable smartphones are expected to change the entire mobile phone market and become the most widely used form in the future (Huang, 2021).

However, although the foldable form has emerged, there is a lack of research on the user needs of these new pattern smartphones, which is not conducive to the long-term development of foldable smartphones in this ever-changing intelligent era. In addition, the existing research on the user needs of mobile phones is mostly for current users but seldom considers the needs of potential users (Buzzi et al., 2017; Suh et al., 2017), even though most of the people are now potential users of foldable smartphones (According to IDC, 1.9473 million foldable phones were shipped globally in 2020, compared with 1.292 billion smartphones in 2020). Comparing the needs of potential and current users will help holistically understand the needs for the interactive experience of foldable smartphones, so as to transform potential users into current users and provide better services to current users (Hewing, 2013; Phonthanukitithaworn et al., 2016) .

At present, there is a lack of research on the user needs for interaction (e.g., gesture interaction, voice interaction) of foldable smartphones, while gesture interaction is now becoming the norm in mobile phones and applications (Beauchesne et al., 2019). The experience of gesture interaction dramatically affects the experience while using mobile phones. In order to better understand the user needs for gesture interaction of foldable smartphones, the paper explored the needs of 20 current users and 20 potential users for the gesture interaction of foldable smartphones. As a result, the theoretical framework of current and potential users' needs was obtained, respectively. Then the similarities and differences between them were compared and analyzed to better understand user needs for gesture interaction of foldable smartphones.

2 Related work

2.1 Interactive experience of foldable smartphones

With the advent of foldable smartphones, research on the interactive experience of foldable smartphones has emerged in recent years. For example, Soonkyu Jang (Jang, 2021) investigated usability and user experience related to privacy and the intention of reuse depending on the angle of the folding screen from the perspective of privacy protection to avoid privacy information leakage brought about prying on the big screen as far as possible. To determine ergonomic forms with comfort and user satisfaction for hand-held foldable display devices, Songil Lee et al. (S. Lee et al., 2019) examined the effects of hand length, screen size, and task on the suitability of screen size and preferred screen folding methods. Steven Schirra (Schirra & Barta, 2021, p. 1) explored how users use foldable smartphones affordances in their everyday lives and how they experience through interviews with 15 diverse foldable smartphone owners. As a result, use cases, pain points and design recommendations of foldable smartphones were obtained. At present, research on interaction experience of foldable smartphones in academia focuses on the functional experience of foldable smartphones or the exploration of new folding forms that can bring better experience, such as the tri-fold display (S. Lee et al., 2019), the rollable screen (Gomes et al., 2018), and the accordion-fold interactive display (Pauchet et al., 2019). There is a lack of research on the user needs for gesture interaction of existing foldable smartphones.

2.2 Gesture interaction needs of mobile touch devices

In terms of research on gesture interaction needs of mobile touch devices, most of the previous research concerned some specific gestures and the needs of particular groups. In particular, Li Dengyun et al. (Li et al., 2022) systematically evaluate how touch gestures perform on folded screens

under the influence of various fold angles and holding postures . A controlled experiment concerned three gestures for moving objects on touch screens (Direct Drag, Hold & Tap, and Throw & Catch) and five fold angles was conducted, and the result shows that Throw & Catch is the most recommended gesture for target movement on folded screens, considering its relatively high efficiency, user preference and flexibility to suit various angles. To determine what factors might prevent users from adopting expert- level gestures, Jeff Avery and Edward Lank (Avery & Lank, 2016) surveyed 106 ipad users about their gesture habits, awareness of expert- level gestures, and how they are used in everydaytasks. They found that users are willing to perform expert- level gestures but it is always difficult for users to discover and learn. Since the popularity of smartphones is much higher than that of other mobile touch screen devices, there are relatively more studies on gesture interaction needs of smartphones. And most of them concern the needs of particular groups for gestures to meet daily use of these groups. Buzzi et al. (Buzzi et al., 2017) analyzed how the visually impaired performed gestures on the smartphone, reported their preferences in terms of the number of strokes, multi-touch, and shape angle, as well as their execution in geometric, kinematic and relative terms. Ngip Khean Chuan (Chuan et al., 2017) evaluated the gesture interaction needs of mobile applications for deaf users. The results showed that deaf users are satisfied with the current implementation, but there is still room for improvement, such as the segmentation aspect of the cognitive workload. Yizhao (Zhao & Men, 2016) researched the interactive effects and differences among the elderly in interacting with different types of smartphones to determine the most suitable design method of gesture interaction for the elderly, thus meeting their needs for gesture interaction and making them have a good experience. Besides, there are some studies about user experience on gesture interaction in specific application scenarios. In particular, to define guidelines for optimal sonic interaction design practices in mobile music applications, Clément et al. (Clément et al., 2021) conducted an experiment to learn links between control gestures and musical parameters, such as pitch, duration, and amplitude.

2.3 Methodology of user needs for interactive experience

The interview is one of the most common methods to obtain empirical insight into user needs (Ensslen et al., 2016). The interview is highly flexible, and users can explain issues based on how well they know them (Adhabi & Anozie, 2017). For example, Seul Chan Lee (S. C. Lee et al., 2021) conducted expert interviews and focus group interviews (a special form of interviews) on eliciting user needs and design requirements for user experience in fully automated vehicles. Since the interview lacks behavioral analysis and is not convenient to understand the needs of potential users (Pfleging et al., 2016), experimental methods (e.g., observation) are also commonly used to in-depth study user needs. Hsinwen Chang (Chang & Li, 2020) explored user needs and critical experience factors of smartphone-automobile interactive features through in-depth interviews and field observation. A three-level recognition threshold, six types of outside-of-vehicle features and four types of in-vehicle features were obtained through phenomenological approach and grounded theory. In this paper, the gestures interaction needs of current and potential users for foldable mobile phones were studied by interview and observational experiment, and data analysis was conducted by grounded theory.

3 Study design

3.1 Participants

Forty participants were recruited through online questionnaires, as shown in Figure 1. They come from different cities, and their ages, occupations and educational backgrounds are also different. Participants were defined as "current users" if they had more than three months of experience using foldable smartphones. In order to make the results more representative, the foldable smartphones used by the selected current users are two typical foldable smartphones, Samsung Galaxy Z Fold2 and Huawei Mate X2. Participants were defined as "potential users" if they: (1) had never used a foldable smartphone, (2) earned more than ¥15,000 per month, (3) spent more than ¥6,000 per month, (4) had a bachelor's degree or above, (5) had a positive attitude toward foldable smartphones and were willing to explore smart devices. Twenty (50%) participants were current users, aging from 18 to 50 years (M=27.1, SD=6.48). Thirteen of them were male, while the remainder were female. Twenty（50%）participants were potential users, aging from 18 to 35 years (M=26.3, SD=3.03). Twelve of them were male, while the remainder were female. The gender ratio of participants was based on the company's market research. All the participants could use smartphones proficiently, with normal or corrected-to-normal vision and without a history of neurological or psychiatric disorders.

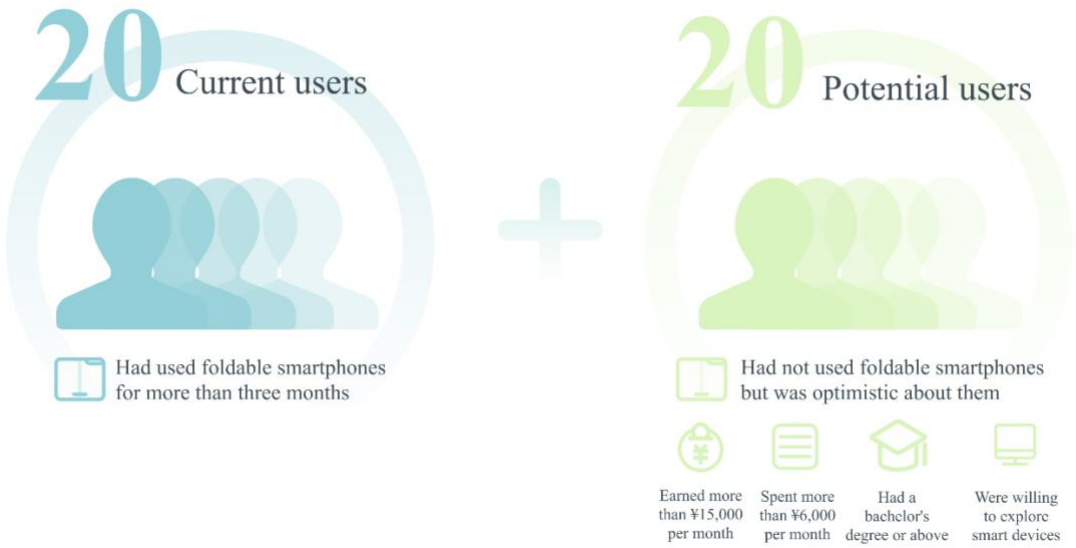

Figure 1. Classification of participants.

3.2 Methods

Two methods were used to explore their needs for gesture interaction, considering the different familiarity of current users and potential users with foldable smartphones. Current users are familiar with the functions, gesture interaction, and performance of foldable smartphones. It can maximize the information obtained (Adams & Cox, 2008) and understand the underlying reasons behind the needs through semi-structured interviews. Potential users would be using foldable smartphones for the first time in the study, and they probably do not know how to interact with a foldable smartphone. Therefore, the observational experiment（a method that mixes structured observation and interview）was undertaken with potential users (Jamshed, 2014; Valsiner, 2017). Potential users were

guided to interact with foldable smartphones through structured tasks in the experiment. In this process, the experimenter observed potential users' behaviors, expressions and movements (Ciesielska et al., 2018) while interacting with a foldable smartphone and asked the users questions after tasks to discover potential users' needs for gesture interaction. Relevant corpus was obtained from interviews and observational experiments to analyze the gesture interaction needs of the current and potential users on foldable smartphones.

3.2.1 Research method for current users

An interview mainly consisted of three parts, the purpose, the views and the behavior, following a step-by-step approach. The first part concerns figuring out the buying motives of current users and their expectations. Users were asked about their motivation to buy in terms of experience, in other words, what features or interactive experiences attract them to buy a foldable smartphone. The second part concerns views and opinions on gesture interaction for foldable smartphones (Clemmensen, 2004). Users were asked about the differences in gesture interaction between the smartphones and the foldable smarthones, and to point out the advantages and disadvantages of each from their personal perspective. This helps to draw on smartphones' advantages and avoid smartphones' disadvantages in the gesture interaction design. Furthermore, the third part concernes behavior in specific scenarios to obtain the user's gesture interaction problems and corresponding needs in daily use scenarios. This part focused on scenarios that were found through research to be high-frequency scenarios on a daily basis, including Office, Entertainment, Daily Life, and Sports. We wanted to know which software users would use in each of these four scenarios, what actions they would do and how they would accomplish these actions through gestures. This allows users to put themselves in the scenario, to better recall the problems they ever met when interacting with the foldable smartphone on a daily basis. The interviews lasted around 120 minutes and were digitally recorded. During the interview, if participants mentioned certain gestures or specific scenarios, they would be asked to demonstrate them with their foldable smartphones (with the user's consent) or foldable smartphones (Samsung Galaxy Z Fold2 or Huawei Mate X2) that we had prepared for the demonstration. Furthermore, the experimenter would record the participants' demonstration on screen.

3.2.2 Research method for potential users

The observational experiment was conducted in four stages: (1) time for participants to be familiar with the foldable smartphones, (2) structured observation (Figure 2), (3) naturalistic observation, and (4) interview. Before the experiment started, participants were asked to choose Samsung Galaxy Z Fold2 or Huawei Mate X2 according to their habits and were given about 10 minutes to get familiar with the device. The tasks for the structured observation section were drawn from relevant studies (Faleel et al., 2020; S. Lee et al., 2019), from gesture interaction tasks commonly used in daily life, and from features of foldable smartphones. For example, participants were asked to respond to Wechat messages during online meetings, answer phone calls while watching videos, and use the parallel view to compare the prices of two items while shopping online. The naturalistic observation stage was set for observing the user's gesture learning of the foldable smartphone and some common scenarios and gestures they use in their daily life. In the last part of the observa-tional experiment, the interview focused on the participants' experience of gesture interaction during operation, the experience compared with ordinary smartphones, and the expectation of the gesture. Participants were guided to think aloud during structured observation and naturalistic observation. Two cameras were set up

to record the participants' status and specific operation gesture interaction. The duration of each experiment was about 150 minutes.

Figure 2. The structured observation stage in the observational experiment.

3.3 Data analysis

Firstly, audio-recorded data from the interview and thought aloud protocol was transcripted in Microsoft Word software. Then, a continuous and repeated cross-comparison was conducted for the text data to exclude irrelevant, repeated text data and text data with prominent wrong theories and cognition. Then, following the principles of grounded theory (Glaser & Strauss, 2017), text data was processed through a qualitative analysis procedure (MAXQDA Analytics Pro 2020) in three steps: open coding, axial coding, and selective coding. In the open coding stage, text data was broken down, examined, compared, conceptualized and categorized (Table 1). A total of 146 initial codes were obtained from the text data of current users, forming 7 categories, while 198 initial codes were obtained from the text data of potential users, forming 11 categories. In the axial coding stage, data broken down into units of meanings in the open coding stage was reassembled back in new ways to create a coherent whole. Then 4 categories from 7 subcategories and 5 categories from 11 subcategories were generated. In the selective coding stage, by sorting out and analyzing the relationship between the main categories formed in the axial coding stage, the core categories for current users and potential users were finally extracted respectively: "Gesture interaction needs of current users for foldable smartphones" and "Gesture interaction needs of potential users for foldable smartphones". In the process, a coding team was established to ensure reflexivity and credibility of the category coding, and members checked and discussed the coding until the three reached an agreement. The coding team members are all postgraduate students majoring in interaction design.

Table 1. Example of initial codes, sub categories and categories at the end of axial coding

Initial codes	Sub categories	Categories
Waking up the split view should be easier and require fewer steps	Simplicity	Accessibility
"Flipping between windows" takes time to learn		
The difference between the sidebar wake-up gesture and the back to previous level gesture should be greater	Forgiveness	

4 Results

4.1 Gesture interaction needs of current users for foldable smartphones

A theoretical model of current users' needs for gesture interaction of foldable smartphones was constructed based on coding following the principles of grounded theory, as shown in Figure 3, to facilitate the quantification and understanding of the category. Current users' gestural interaction needs for foldable smartphones are reflected in accessibility, comfort, visibility, and control. The details of these categories are as follows.

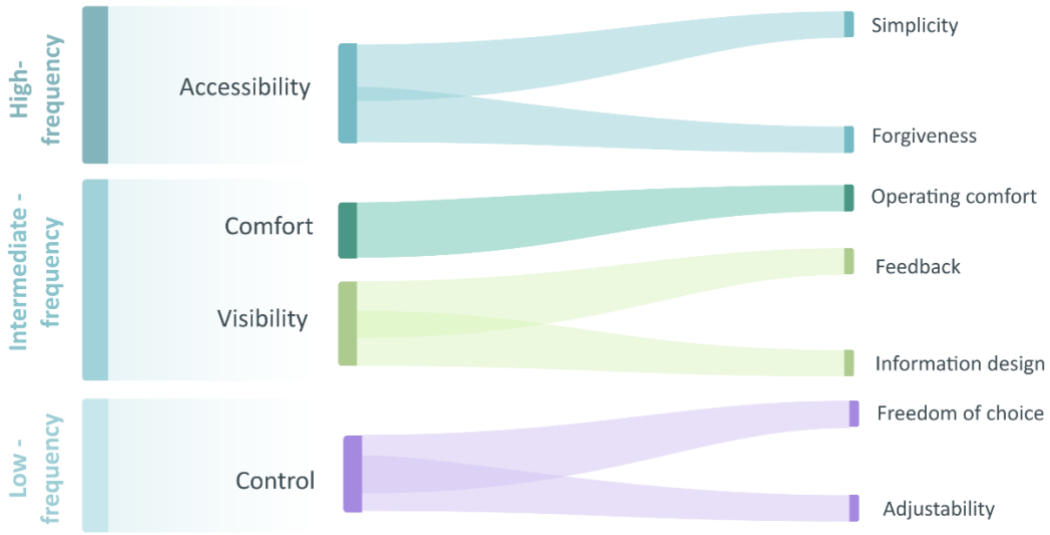

Figure 3. The theoretical model of current users' needs for gesture interaction of foldable smartphones.

Accessibility is a high-frequency need for current users, and it asserts that gesture design should be usable by people of diverse abilities, without adaptation or modification (Lidwell et al., 2010). Historically, accessibility in design focused on accommodating people with disabilities. As knowledge and experience of accessible design increased, it became increasingly clear that many required "accommodations" could be designed to benefit as many people as possible. Under the category, there are two corresponding categories: simplicity and forgiveness. Simplicity requires gesture design to be easily understood and used by everyone, regardless of user experience, education level, or their concentration. For example, Current users hope that the gesture design of foldable smartphones can be more reasonable and more accessible, specifically in the hope of expanding the operation area of

the sidebar and reducing operation steps of commonly used tasks such as using the split view to get started with multitasking. In addition, air gestures can also make interaction easier when it is not convenient for hands to control the smartphones. Forgiveness requires gesture design to minimize the occurrence and consequences of errors and is mainly reflected in the distinction between gestures of different functions to avoid misoperations. For instance, the distinction between the back to previous level gesture and the sidebar wake-up gesture should be sufficiently high.

The needs for comfort and visibility are at an intermediate frequency compared with accessibility. Comfort refers that current users want to be more comfortable with gestures. Gestures such as taking screenshots through knuckle-knocking and palm-scanning use parts of the hand that is not commonly used, which can easily cause discomfort.

Visibility is a need for visual experience brought by gesture interaction. Current users' needs for visibility include feedback and information design. Feedback means responding promptly to user input by returning information about what action is underway or completed. In gesture interaction, it is necessary to give the user visual or tactile feedback in time, such as button vibration feedback while pressing a button, so that the user can understand the task's status. Information design is the study and practice of bringing clarity and comprehensibility to visual materials that are meant to direct, teach, explain or otherwise inform (Lipton, 2011, Black et al., 2017). In the scenario, information design refers to presenting the information involved in the gesture interaction process that should promote the user's understanding. In particular, current users pointed out the advantages of "flipping between windows" (the combination of long-press and dragging, mainly for copying pictures, texts, and files to another page of the split view or sending them). The interface will not be switched during the process, so important information will not be blocked, as shown in Figure 4.

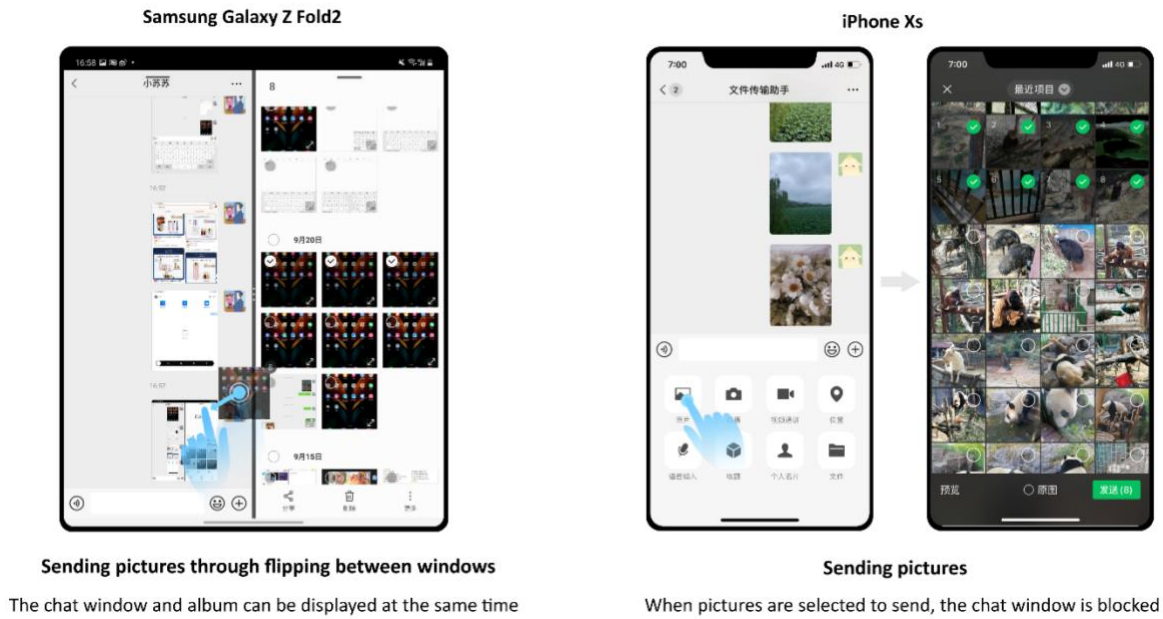

Figure 4. One of the advantages of flipping between windows.

Control is a low-frequency need for current users. It requires an appropriate level of control provided by the system. Current users' needs for controllability is manifested in selectable and adjustable gesture. It will help to meet current users' needs for control if adding the custom gesture of foldable

smartphones and allowing users to adjust the size and scale of the screen when multiple screens are present.

4.2 Gesture interaction needs of potential users for foldable smartphones

A theoretical model of potential users' needs for gesture interaction of foldable smartphones was also constructed following the principles of grounded theory, as is shown in Figure 5. Potential users' gestural interaction needs for foldable smartphones are reflected in accessibility, visibility, comfort, consistency and control (Lidwell et al., 2010) The details of these categories are as follows.

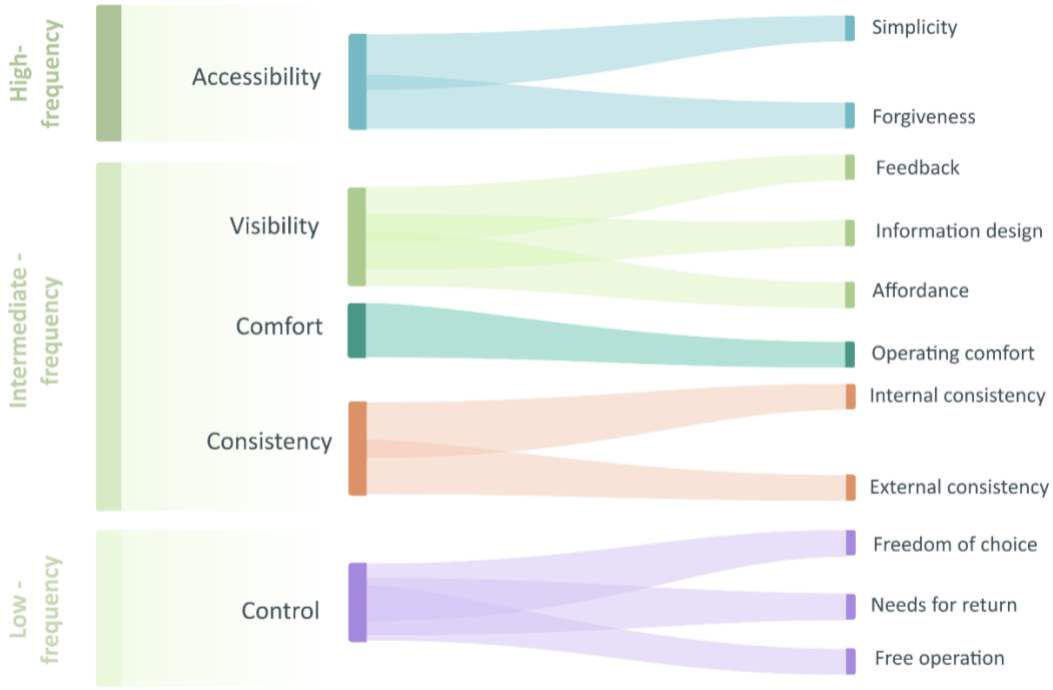

Figure 5. The theoretical model of potential users' needs for gesture interaction of foldable smartphones.

In terms of accessibility, potential users want to achieve multi-touch or complete frequently used tasks to improve interaction efficiency with just a single tap. It should also be more straightforward and with fewer steps for users to complete multitasking-related gestures (e.g., gestures to wake-up split view and floating window), thus satisfying potential users' needs for the simplicity of foldable smartphones. Besides, potential users' needs for simplicity are also reflected in the desire for easy-to-learn gestures. For example, flipping between windows is not easy enough for potential users to learn.

Potential users' needs for visibility, comfort and consistency are at an intermediate frequency compared with accessibility. Visibility for potential users consists of three corresponding categories: affordance, feedback, and information design. When the affordance of gestures corresponds with its intended function, the design will perform more efficiently and be easier to use. Zooming in or out of the floating window and sliding off the split view is not indicative, so it is not easy for potential users to discover these features independently. The user's needs for feedback mainly come from the vibration feedback of long-press and the feedback of flipping between windows. For information design, potential users hope that the number of dragged images can be displayed clearly in time while flipping between windows.

Potential users' needs for comfort are mainly reflected in two aspects: (1) the closing button of the interface or pop-up window should not be far from the comfort control area, and (2) using the palm for gesture interaction should be avoided.

According to Lidwell et al. (Lidwell et al., 2010), people tend to perceive objects as constant and unchanging, despite changes in perspective, lighting, color, or size. That's why there's a need for consistency. Potential users will subconsciously compare the gestures of a foldable smartphone with how a computer operates and want the foldable smartphone to follow some of the operations of a computer, such as splitting the view through the background and casting the presentation through dragging and dropping. This is the need of potential users for external consistency. In addition, the size adjustment and transparency adjustment of the floating window and floating keyboard should be consistent with achieving internal consistency, so does the interface proportion adjustment of the parallel view and the split view.

In terms of control, the category at the lowest frequency among five categories, potential users hope that they can: (1) customize the shortcut gestures, (2) quickly return to the split view after sliding off it, and (3) drag anywhere on the floating window to move it.

5 Discussion

5.1 Comparison of gesture interaction needs between current and potential users

The results show that the categories of gesture interaction needs for foldable smartphones from potential users are more than current users, as shown in Figure 6. Both potential users and current users have needs for accessibility, visibility, comfort, and control. However, as potential users and current users are in different stages of the life cycle of foldable smartphones, they have different sensitivity to issues, different perspectives on issues, different emphasis on different demand categories, and different specific user needs. It can be seen from the figure that both current users and potential users are most concerned about the basic gesture interaction need, accessibility. Moreover, potential users have higher requirements for this category than current users. In addition to accessibility, current users are relatively more concerned with comfort, while potential users are more concerned with visibility. Furthermore, potential users have lower requirements for comfort than current users and higher requirements for visibility than current users. In the category, visibility, potential users require affordance compared to current users. Affordance shows whether a gesture is guided and determines whether the gesture will be discarded. Both require the least amount of control and less from potential users than from current users.

By contrast, potential users have one more category of needs than current users: consistency. Consistency shows whether the gestures of the foldable smartphone are consistent with those of other similar electronic devices (external consistency) and whether they are the same as those of similar functions within the system (internal consistency). External consistency determines the learnability of gestures, while internal consistency determines the system logic and memory cost of foldable smartphones. However, as current users are accustomed to various gestures of foldable smartphones, they lose the ability to explore the consistency of foldable smartphones and the affordance mentioned above, which also reflects the necessity of understanding the gesture interaction needs of foldable smartphones in conjunction with potential users' needs.

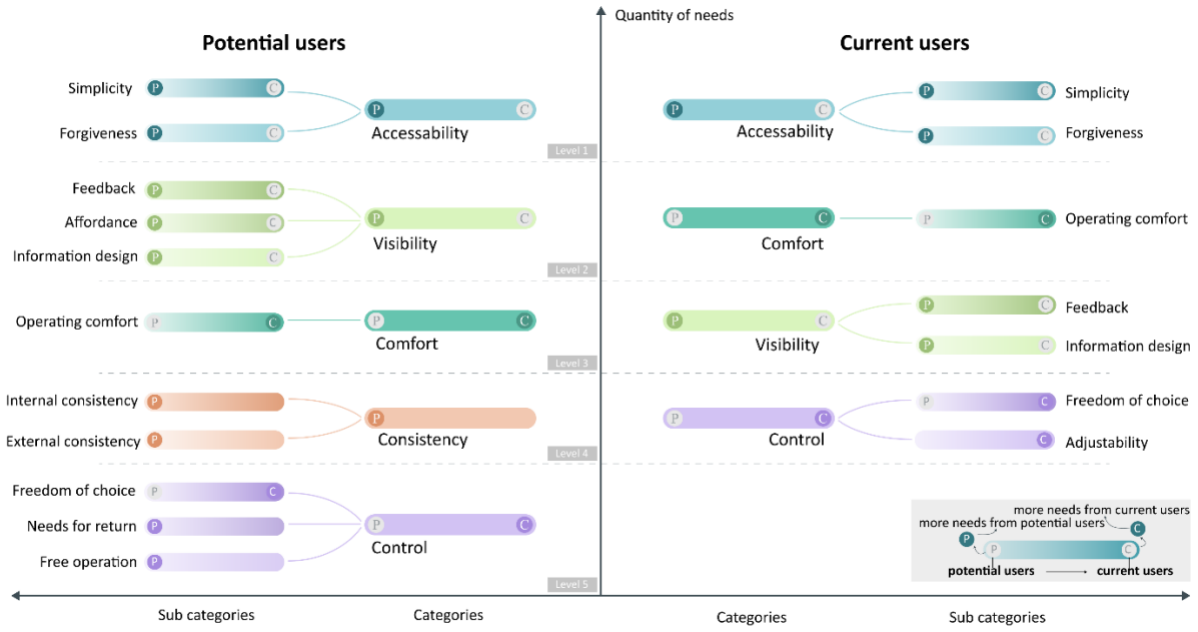

Figure 6. Comparison of gesture interaction needs between current and potential users.

5.2 The differences in gesture interaction needs between current and potential users

5.2.1 Accessibility

Accessibility is the basic need of gesture interaction and the premise of ensuring the usability of gesture interaction. Both potential users and current users require accessibility, and both in terms of simplicity and forgiveness. However, since it was the first time for potential users to use a foldable smartphone in the experiment, they learned new gestures in the process. So compared to current users, they will quickly find out the existing gestures that are not easy to learn. Gestures formed by combining two or more gestures, such as flipping between windows, are relatively difficult to learn. Gestures for foldable smartphones should be natural and not be complex so that new users can quickly master them. Potential users have a positive attitude towards the user guide and think it helps to get started quickly. On the contrary, current users find the instructions tedious for even new features due to their long-term use of foldable smartphones. The user guide of gesture interaction can be set soon afterwards the new foldable smartphone is activated and used, that is, the period for the user to transition from novice to skilled.

5.2.2 Visibility

Potential users have more needs in terms of visibility than current users. Both have needs for feedback and information design, and the specific content of the needs remains broadly consistent. Nevertheless, in addition to feedback and information design, potential users are also concerned about affordance. If the gestures are not instructive or not consistent with cognition, it will be difficult for first-time users to discover, leading to the abandonment of the function and ultimately causing inconvenience. The "invisible" gesture mentioned most frequently by potential users was the resizing of the floating window. The lack of icons on the floating window to guide users to resize will be troublesome for potential users experiencing the floating window resizing for the first time. It is a significant direction to improve the affordance of gesture design by hinting users with gestures through visual elements such as icons.

Regarding making gestures easier to use, the views of current users and potential users are the same. They both hope to reduce the operation steps of gestures to complete tasks, increase the operable range of gestures, and improve the operation efficiency of gestures. In terms of inclusiveness, both mentioned that there is little difference between the sidebar wake-up gesture and the back to previous level gesture in Huawei Mate X2. It is easy to confuse each other and cause misoperation. Since the sidebar is located on the left or right side of the screen, its wake-up gesture needs to distinguish from other system gestures.

5.2.3 Comfort

Current users have higher requirements for the comfort of gestures than potential users. This conclusion suggests that improving comfort can help retain current users and attract them to purchase foldable smartphones for a second time. Both potential and current users believe that the hand parts for gesture interaction would affect operation comfort. It is not recommended to use knuckles, palms and other unusual parts for gesture interaction because people tend to use existing common gestures and are instinctively resistant to new things (Fogg, 2009). Besides, the large screen size of the foldable smartphones will bring disadvantages: the buttons on the upper part of the screen are difficult to reach, so it will be uncomfortable to click. However, in contrast, current users will use the advantages of the large screen to complete some tasks that are not comfortable finished on the small screen. For instance, it will be more convenient to edit videos on a larger screen because it is more comfortable to interact with objects on the screen, such as adjusting the time axis.

5.2.4 Consistency

Compared with current users, potential users require consistency. The need for the consistency of the gestures of the foldable smartphone is generated through comparison. The need of potential users for external consistency is mainly reflected in the consistency of gesture interaction with computers and iPads. In the foldable smartphone system, consistency means that the same operation for similar elements should be consistent. The floating keyboard and floating window are similar elements within the same system, as well as the split view and the parallel view. The gestures for adjustment (e.g., the size, proportion, transparency) should maintain the consistency of the two. In terms of different elements, consistency also works. Users always expect new gestures on foldable smartphones to be consistent with existing gestures that they are familiar with. For example, some users hope that the zooming of the floating window can be consistent with that of the picture, which is easier for users to learn and understand.

5.2.5 Control

Current users and potential users have apparent differences in the need for control. Current users pay attention to the adjustment of the interface proportion when there are multiple images on the screen. In contrast, potential users pay more attention to the details of the adjustment. For example, the floating window can only be adjusted in a specific position (lower left or lower right of the floating window), which causes dissatisfaction among potential users. Although both need to customize gestures, current users prefer to customize the gestures for completing existing tasks, while potential users, who are new to the novelty of foldable phones, have more expectations for new functions and a better sense of control. Current users want to customize gestures for screenshots and taking pictures, while potential users would like to add some new shortcut gestures to their using foldable

smartphones. From the perspective of potential users, it is a good idea to quickly turn on the flashlight by drawing a "V" on the screen.

6 Conclusion

This study explored the differences in user needs for gesture interaction of foldable smartphones between current and potential users. The results demonstrated that potential users require more categories of needs than current users. Both potential and experienced us-ers have needs for accessibility, comfort, control and visibility, but the specific needs under the same category are significantly different. Compared with current users, potential users require consistency. In general, potential users were more concerned with the operation experience and focused on experience details, while current users were more concerned with advanced needs and focused on comfort and control.

This study will help better understand the needs of different types of users of foldable smartphones, improve the gesture design of foldable smartphones and establish innovative design directions. As a result, current users' satisfaction and loyalty will improve, and potential users may become current users. The current analysis is a qualitative exploration of user needs from the perspective of gesture interaction. Further studies will explore other types of interaction experience, such as voice interaction, to further improve the user needs of foldable smartphones.

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