

The Research of Interactive APP Design Based on 3E-Mental Models

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Abstract. The interactive design of APP products highlights the users' experience based on meeting users' needs, which is the important significance of researching the interaction design of an APP. However, there are still some problems in the interaction design of APP products, such as low target visibility, information hierarchy, complex interaction design, and so on. This paper uses the interdisciplinary research method to conduct in-depth research on users' psychological, cognitive, and behavioral characteristics and constructs a "3E" mental model combined with network information behavior. Based on this model, nine interactive design principles are proposed. A reading APP is designed as a case, and the "3E" mental model and interaction design principles are applied to the interaction design of the case. The results show that the theory and method proposed in this paper play an important role in the interaction design of APP.

Keywords: "3E" mental model, flow experience, network information behavior, Interaction design, user experience

1. Introduction

The popularity of smart mobile terminals has led to the rapid growth of various mobile phones applications such as entertainment, social networking, and reading. These apps undoubtedly provide more convenient services for people's life and work, However, due to the lack of in-depth research on user psychology and behavior in some APPs, users have a problem of poor user experience when using APPS [1]. To improve the user experience, it is necessary to strengthen the interaction design research on APP products. In 1984, American designer Bill Morgridge first proposed the concept of "interaction design" at the International Design Conference [2]. IXDC 2019 conference once again used interaction design as a hot spot for discussion and exchange [3]; therefore, interaction design will occupy an important position that cannot be ignored in the intelligent era [4].

Related scholars have given different definitions of interaction design [5]. For example, the American scholar Jennifer Preece defined interaction design as designing interactive products that support people's daily work and lives [6]. Professor S. D. Li believes: Interaction design is to enhance, improve, and enrich people's experience through the humanization of products [7]. With the continuous development of interaction design, it is increasingly necessary to consider user behavior and pay attention to user experience in APP interaction design. At present, some APPs still have the following three problems in interaction design: The affordance is low; The page layout is complicated; The interaction method is complicated [8] [9] [10].

The root cause of the above problems is that the interaction design does not conform to the user's psychological cognition. To solve these problems, this article takes the user's mental model as a starting point, through an in-depth analysis of the users' psychological cognition and the behavioral traits of using APP products, and combines the user's mental model with network information behavior to solve the problems in the interactive design of APP products, and then design APP products that can meet users' needs.

2. APP Interaction Design Based on the "3E" Mental Model

2.1. Construction of "3E" mental model

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Professor Richard Buchanan defined the object of interaction design as behavior in the 1990s [11]. The American psychologist Albert Bandura also proposed interaction determinism for human behavior. The relationship between the environment and human behavior [12]. We constructed a "3E" mental model based on the influence relationship between interaction and behavior proposed by experts. The mental model is the self-understanding of a certain product in the user's heart and mind, and this understanding is affected by both internal and external factors. In terms of internal factors, it depends on the experience of using similar products and the user's expectations of using the product, and in terms of external factors, it mainly depends on the environment in which the product is used.

- Use experience. Experience is the perception of things generated by the users' senses in the process of contact with external things. From the perspective of cognitive psychology, users will involuntarily transfer their experience to new products when they are in contact with or using new products.
- Use expectations. The expectation is an idea of the users' use process and results before using the APP. This idea is an internal understanding of the users' products. When the real product is closer to the users' expectations, the product is more convenient to use and the users' experience is better.
- In addition to the two internal factors, the construction of the mental model also has the external factor of the operating environment including the hardware environment and software environment. The hardware environment refers to various mobile terminals that carry the APP.

In the process of using the APP, every network information behavior will be affected by internal factors and external factors. The user completes the interaction with the APP through four types of network information behaviors: searching, sharing, publishing, and communicating. Therefore, this article constructs a user mental model that conforms to the user's network information behavior and names the model "3E" mental model. "3E" refers to the experience and expectations of internal factors and the environment of external factors, as shown in Fig. 1.

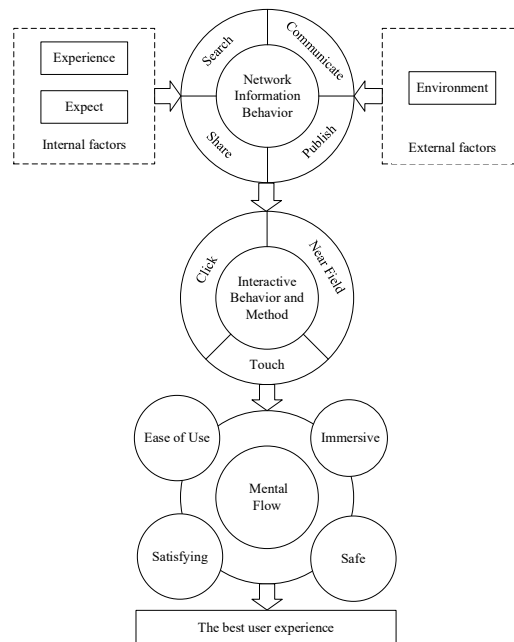


Fig. 1: "3E" mental model.

The model is divided into three levels: the first level is the internal and external factors and the network information behavior under their influence; the second level is the interactive behavior and methods; the third level is the mental flow experience. Clear goals can make users feel easy to use. When the user has a clear goal task, the APP product should help the user complete the task quickly and effectively, that is, the user can use this APP to easily and efficiently achieve their goal needs, thereby creating a sense of ease of use for the APP.

In addition to the above three levels, the "3E" mental model also has the "optimal user experience" part. Optimal user experience refers to the good psychological feelings generated by users subjectively. It is the overall feeling of APP products based on the mental flow experience, and it is also the ultimate goal of APP interaction design.

2.2. Interaction design principles based on the "3E" mental model

- Reduce the information level of the page. To ensure the ease of use of the APP, cumbersome interaction methods should be avoided in the interactive design, and information level settings should be reduced.
- Provide friendly feedback. Friendly feedback can allow users to understand what is happening in the app at an appropriate time, and can cleverly grasp emotional elements to increase user stickiness.
- Set up appropriate metaphors. When the user is unable to determine which buttons are on the page, the problem can be solved by applying appropriate metaphors.
- Enhance the responsiveness of the target. Regarding drag and long press, which are not easily recognized by users, how to enable users to complete the goal without obstacles requires enhancing the responsiveness of the goal.
- Introduce sliding appropriately. When there are too many levels of information, the user's "workload" will increase. If the information level cannot be changed, then the appropriate introduction of sliding interaction methods can also reduce the user's burden.
- Incorporate feedback sound effects. For the near-field interaction methods of shaking, blowing, blowing, and sweeping, the APP should provide corresponding feedback on sound effects during the user's behavior.

2.3. Interactive design process based on the "3E" mental model

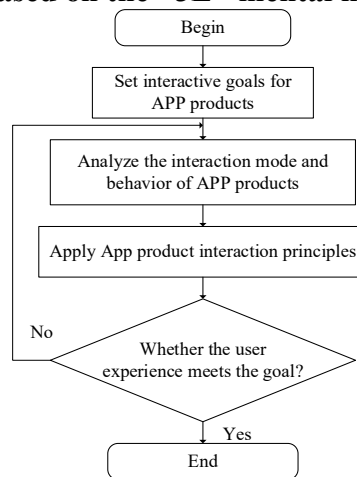


Fig. 2: Interactive design process.

As shown in Fig. 2. Firstly, formulate the interaction design goals of the product. Determine the target users and interaction design goals of the product. Clear and clear goals are conducive to the orderly process of product interaction design; Secondly, analyze the user's interaction behavior and methods. Clarify the needs of users in the interaction process, as well as important information such as users' habits and preferences during the interaction; Thirdly, the information architecture is carried out according to the analysis results, and the interaction design of APP products is completed based on the interaction principles proposed from the perspective of interaction behaviors and methods. Finally, the designed product is tested for user experience, that is, whether it meets the ultimate goal of the "3E" mental model. If it does, the interaction design is completed; otherwise, it returns to the first step of the interaction design process, repeats the above process, and continuously corrects it. Existing problems.

3. Case study on the Interactive Design of Learning Apps

From the perspective of user interaction behaviors and methods, and based on the "3E" mental model, this study designed a learning APP-"Lemon photography" as a case study.

First step: It is to determine the interactive target of the "Lemon photography" APP. Young photographers are the target users of the "Lemon photography" app. It will eliminate the cognitive friction between the user and the APP, make the entire interaction process smooth and natural, and then enhance the user experience as the interactive goal of borrowing APPS.

*Second step:*It is to design the interactive behavior and interaction method of the learning APP "Lemon Photography" based on the user's network information behavior and the results of the questionnaire. Choose the most convenient interaction method and interaction behavior for different usage scenarios.

*Third step:*It is to apply interactive principles to complete the interactive design of the "Lemon Photography" APP. As shown in Fig. 3, the APP product homepage uses a carousel effect to recommend wonderful photographic works to users, which reduces the user's browsing burden on the same page. The "favorite" and other buttons all adopt the style of circular buttons to ensure that users can quickly find the target and click clearlythe APP's LOGO and the slogan "The world is different Because for you" narrow the distance between the user and the APP product, as shown in Fig. 4. At the same time, this case improves the availability of the product, which is embodied in the design of buttons with different functions.

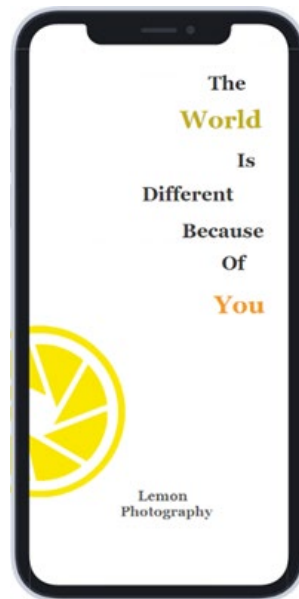


Fig. 3: APP enters the welcome interface.

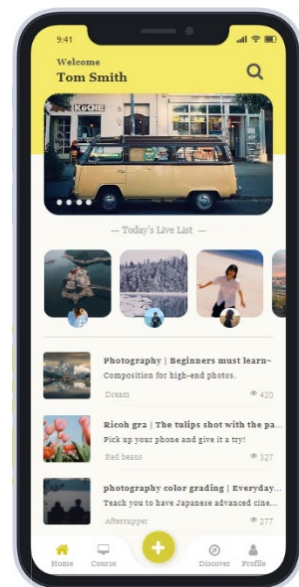


Fig. 4: Home page interface.

Fourth step: It is to invite users to test the usability of APP products. Usability testing, also known as usability evaluation, refers to organizing test users to complete a set of predetermined operational tasks using the prototype of the APP product and obtaining relevant data by observing, recording, analysing, and testing user behavior, thereby clarifying the shortcomings of the APP product and optimizing it.

The test session includes: observing the participants' operational behavior and recording the problems encountered by the participants, and retaining meaningful findings immediately after the completion of the test. After the start of the usability test, a video camera was used to record the subjects' operational behavior, while the recorder recorded the key information reflected by the subjects for later research. The recorder formed a test record document based on the participants' "thinking aloud" during the test and obtained the most direct and timely feedback information from the participants in the process of completing the task. According to the analysis of the results of this usability test, the following two issues need to be further optimized for borrowing APP products.

- Button position. When the user completes the task of "publishing photographic works", the specific problem that appears is: After selecting photographic works in the album, the "Finish" button on the page is disabled. The reason is that the user did not click the "check mark" button to confirm the selection. The improvement plan is shown in Fig. 5. This improved solution puts the function buttons involved in the same operation process in the same position.
- Interactive response. In the process of the user completing the task of publishing photographic works, when the user selects a photographic work and uploads it to the editing page, the page shows the usage guide of "Slide picture to adjust the order". The improvement scheme is shown in Fig. 6, when the user's finger touches the picture, the picture appears blurred in response to the user's interactive behavior. This improvement scheme is in line with the user's psychological cognition and can make the APP product closer to the user's mental model.



Fig. 5: Button position comparison.

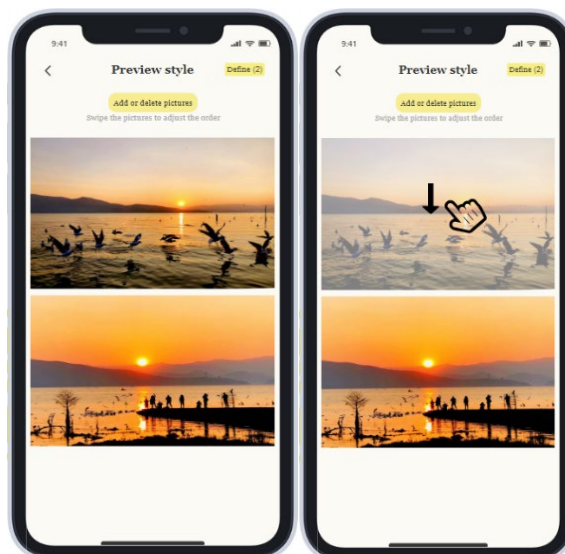


Fig. 6: Interactive response comparison.

4. Conclusion

This article using the research on the user's psychological cognition and behavior traits to compare the user's mental model and network information behavior, a "3E" mental model was established to solve the problems in APP interaction design; then, we summarized the three common types of interaction behaviors and methods in APP interaction design, and the three types of interaction behaviors and methods; finally, based on the above interactive principles, the reading is completed through the formulation of product interaction goals, the analysis of user interaction behaviors and methods, and the application of interaction principles App-like interactive design for borrowing. After testing, the Borrowing APP can enable users to enter the state of mental flow and provide users with the best user experience during the interaction process.

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