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Measurement and Optimization of Navigation Bar Icon Design in Mental Health Apps

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Abstracts. Iconic symbols in the digital age, as an important part of app design, play a central role in transmitting information between the app and the visitor. To optimize the design of mental health app navigation bar icons and improve the user experience of mental health apps. The design features are summarized by analyzing the current design status of existing mental health app navigation bar icons; the hierarchical analysis method is used to determine the evaluation index system of the navigation bar icon of the mental health app, the fuzzy judgment matrix is determined through the expert survey and the SPSS software is used to calculate the weight value of each evaluation element; redesigning mental health app navigation bar icons by refining design elements through icon recognition experiments and user preference surveys; evaluation and analysis of the program using fuzzy comprehensive evaluation to demonstrate the feasibility of this design solution. The evaluation results show that the scheme achieves the effective integration of recognizability, interactivity and aesthetics. In conclusion, a method for designing and evaluating the navigation bar icon of mental health apps based on fuzzy hierarchical analysis is proposed, and the feasibility of the method is verified through a specific design scheme.

Keywords. Mental health app, icon design, iconography, fuzzy hierarchical analysis, icon recognition

1.Introduction

Icons are not only used to beautify and decorate the application to bring the user the most direct visual experience of the interface components, but also to facilitate the user to understand and guide the user to operate the application functions of the important hub. The word "icon" is derived from the Greek word "eikon", which means image. In computer science, an icon is a graphical symbol displayed on the screen that guides or indicates a program, command, data file, window, option, or concept [1]. Usually, the icon used is related to the function of the project it needs to perform, in which the navigation bar icon mainly plays a role in connecting different contents or interfaces and is mainly used to guide the user how to go to the next target page or access the next target content, and when the user clicks on icon, the current interface will jump.

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There are many research results on icon design, from the perspective of icon cognition, Chun-Ching Chen investigates the icon design of applications for different mobile operating systems by designing icon identification experiments based on the key components of icons, to understand the recognition performance and user preference of different icon types [2]. Romain Collaud et al, developed icon design principles of aesthetics, complexity, and concreteness [3]. Provide a reliable reference source for navigation bar icon design evaluation metrics. Weili Li et al. proposed a fuzzy hierarchical analysis based on the underground station name graphic symbol design and evaluation method to validate the feasibility of this method through specific through specific case design, to improve the visual recognition of the name of the underground station. The visual recognition of subway station names is improved [4]. The above study provides a design research methodology for mental health app navigation bar icon design.

The research on navigation bar icon design of mental health apps is mostly summarized in the interface design research, and there are few specific studies on navigation bar icon design of mental health apps. Although the design of icons is included in the overall design of the interface, it also has its unique design thinking and design rules, based on mental health app design features, the fuzzy hierarchical analysis method is used to establish an evaluation index system for the design of icons in the navigation bar of mental health apps, and the design elements are extracted through icon recognition tests and preference surveys, so as to optimize the design of the navigation icons of mental health apps and verify their feasibility, so as to increase the efficiency of the use of the mental health apps.

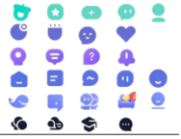
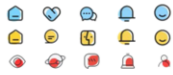
2.Mental Health App Navigation Bar Icon Design Feature Analysis

2.1 Mental health app navigation bar icon design expression analysis

On the app application platform, the search was conducted by entering the keywords mental health and emotion, and 10 apps with distinctive navigation bar icon features were selected from the top 20 apps with a platform app (iOS system) rating higher than 4.7 and ranked in the top 20 apps to be analyzed.

Icons are mainly in the form of linear icons, faceted icons or line-face combination icons, and different styles of icon styles are formed by giving different design details.

Table 1. Mental health app navigation bar icon design expressions.

Form of expression	Hidden Meaning	Icon Classification
Linear Icons	Graphics are visually represented through lines, creating a variety of design styles through the thickness of the line, the color of the line, and whether or not the line segments are notched.	
Faceted Icons	Relative to the linear icon has a larger visual area, more can attract the attention of the user, so set often appear in the first screen of the home page function of the entrance area, or the bottom of the navigation of the selected state.	
Line-face Combination Icons	Based on the line thickness, color pattern, etc. of the linear icon, the area size and color variation of the surface icon, we can design the line and surface icon that combines with each other, outline the outer shape of the line, fill in the inner shape, or add the bottom shape outside of the line, and other design methods.	

2.2 Morphosyntactic analysis of navigation bar icon design for mental health apps

At the beginning of the twentieth century, the American semiotician Peirce put forward his famous trichotomy of symbols, which are icon, index, and symbol [5]. The trichotomy lays a good theoretical foundation for later generations to sort out all kinds of symbolic phenomena. According to the conceptual description, the navigation bar icons of mental health apps are categorized, to avoid subjectivity, five professionals engaged in UI interface design are invited to collaborate in the division, and the results are shown in the figure below.

Table 2(left). Semantics of mental health app navigation bar icon design image.

Symbol Type	Hidden Meaning	Fication
Icon	There is some kind of resemblance or similarity between it and the topic.	
Index	Symbols and objects can suggest each other because of some kind of relationship, especially the relationship between cause and effect, neighbourhood, part and whole, etc., so that the receiver can think of the object by perceiving the symbol.	
Symbol	It refers to its object by means of a conceptual association or habitual connection between the name and what it refers to.	
Other	There's no correlation.	

Figure 1(right). Mental health app navigation bar icon design morphological quadrant analysis.

Pierce's symbol trichotomy has some guidance for the classification of icons, but cannot accurately categories all icons, quite a lot of symbols are mixed with these three components, and even some do not have any relevance to the meaning, so it is not possible to determine the type of a particular symbol belongs to, so far there is no specific standard for the division of the icon's image degree, and most of the scholars adopt the scale to assess the user's perception of the image of the icon. Most scholars use a scale to assess the degree of users' perception of icon image [6].

To further understand the morphosyntax of icons and explore the relationship between symbol semantics and the morphological composition of symbols, the different types of symbols in table 2 are marked differently, with the square box representing the Icon, the triangular symbols representing the Index, the circular symbols representing the Symbols, and the heart symbols representing the Other. According to Pierce's semantics of symbols, the synthesis of the division of the opinions of several designers, the establishment of the four quadrants, according to the table 2 icon body pattern of the form of the division, horizontally by the image to the abstract, vertically by the simple to the complex, in which the image of the icon can be simply understood as the icon with a specific semantics, the abstract icon, that is, without any semantics of the icon, simplicity means that the combination of point, line and surface elements of an icon is simple in composition, and vice versa for complexity.

It can be observed from figure 1 that most of the icon forms of mental health navigation bar icons Icon and Index are simple and graphic, and the symbols are strongly related to the topics. The icon forms of Symbol and Other are mostly complex and abstract, and the relevance of the symbols to the topic is weak.

2.3 Analysis of mental health app icon design interaction form

The interaction process is the process of input to the computer and output to the user. Icon interaction is also a "relationship" between the viewer, the icon itself, and the web page [2]. According to the survey analysis, the interaction mode of mental health bar app navigation bar icon is mainly clicking, but the form of operation expression is different, and can be divided into two forms of expression: static and dynamic.

The use of interactive icons makes the user an active participant rather than a passive recipient, which improves the efficiency of icon use. Icons with good interactivity will help to complete the in-depth communication between the interface and the user [7].

3.Mental Health App Navigation Bar Icon Design Evaluation System Construction

3.1 Establishment of design evaluation indexes and model construction

In this study, Fuzzy Analytic Hierarchy Process (FAHP) is mainly used, which is a combination of hierarchical analysis and fuzzy comprehensive evaluation.

Firstly, establish a hierarchical model of mental health app navigation bar icon design indexes, invite experts in the design field to compare the evaluation indexes at all levels, construct a fuzzy judgement matrix based on the obtained index values, calculate the weight values of the indexes at all levels and carry out the ranking, according to the ranking of the weight values and at the same time combining with the icon recognition experiments and user preference surveys to guide the design practice, and finally carry out a fuzzy comprehensive evaluation of the design scheme for the navigation bar icons of health apps.

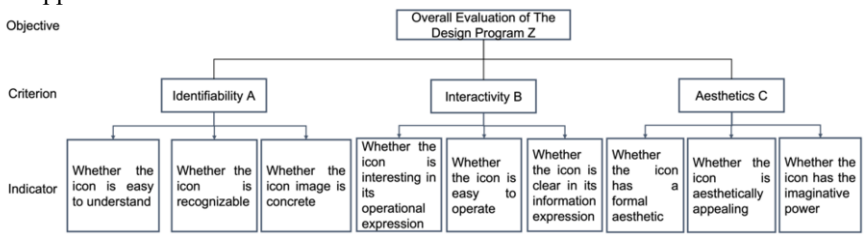


Figure 2. Assessment metrics system.

Through the literature reading to collect the indicators that affect the icon design, to screen out the most influential indicators, through the questionnaire survey, to collect the opinions of professionals engaged in the design, a total of 15 questionnaires were issued and 15 valid data were retrieved. According to the results of the questionnaire survey, interactivity > recognizability > design aesthetics > artistry (in order of importance) was selected as the first level indicators, and the top three second level indicators were also selected. Merge design aesthetics and artistry into aesthetics and then filter.

As shown in figure 2, according to the results of the questionnaire, based on the theories of cognitive psychology and semiotics, combined with the relevant icon design methods, the icon design indicators of the navigation bar icon design of mental health apps are divided into three levels: the overall evaluation of the design scheme Z is the Objective; recognizability A, interactivity B, and aesthetics C are the first-level

indicators, i.e. the Criterion; and nine second-level indicators are divided into the Indicator based on the indicators of the Criterion. The details are as follows.

(1) Recognizability A includes the following indicators: a1 whether the icon is easy to understand; a2 whether the icon is recognizable; a3 whether the icon image is concrete.

(2) Interactivity B includes the following indicators: b1 whether the icon is interesting in its operational expression; b2 whether the icon is easy to operate; b3 whether the icon is clear in its information expression.

(3) Aesthetics C includes the following indicators: c1 whether the icon has the form of aesthetics, i.e., the way of expression, which is the way of experience of obtaining aesthetics in the form of visual elements; c2 whether the icon has the aesthetic attraction, i.e., whether it produces visual attraction; c3 whether the icon has the imaginative power.

3.2 Judgement matrix construction and weight determination

Adopting the 1-9 scale method, 1-9 scale values and meanings are shown in table 3 six experts in the field of design were invited to make a two-by-two comparison of the evaluation indexes of the navigation bar icon design of mental health apps, and the scale numerically embodies the level of importance between the two indexes.

Table 3. Scoring Scale weights of indicators of the evaluation system.

Factor i Over Factor j	Quantitative Value
equal importance	1
slightly important	3
more important	5
high priority	7
extremely important	9
the median of two neighboring judgments	2 , 4 , 6 , 8
inverse comparison	1 , 1/2 , … , 1/9

Table 4. weights of indicators of the evaluation system.

AHP Hierarchical Analysis Results			Summary of Results of Consistency Tests				
Items	Eigenvector	Weight Value	Maximum Eigenvalue	CI	RI	CR	Consistency Test Results
			Z				
Identifiability A	2. 121	70. 706%	3. 096	0. 048	0. 520	0. 092	pass
Interactivity B	0. 604	20. 141%					
Aesthetics C	0. 275	9. 153%					
			A				
Ease of understanding a1	1. 668	55. 593%	3. 054	0. 027	0. 520	0. 052	pass
Discriminatory or not a2	1. 061	35. 372%					
Is the icon image specific a3	0. 271	9. 035%					
			B				
Is the icon manipulation presentation interesting b1	0. 814	27. 137%	3. 029	0. 015	0. 520	0. 028	pass
Ease of use of icons b2	1. 702	56. 731%					
Clarity of presentation of icon information b3	0. 484	16. 132%					
			C				
Whether the icon has formal beauty c1	1. 645	55. 593%	3. 018	0. 009	0. 520	0. 018	pass
Whether the icon is aesthetically appealing c2	0. 723	24. 091%					
Is the icon imaginative c3	0. 632	21. 061%					

Comprehensive six experts of the scoring value, remove the maximum value and the minimum value, take the average value, through the SPSSAU platform for online analysis, the software uses the sum product method of calculation, the number of orders of the judgement matrix for the third order, the analysis of the weight value of the indicators, and at the same time to carry out consistency tests in order to illustrate that

the judgement matrix use as well as to get the weights are reasonable, scientific, usually the smaller the CR value, the better the judgement matrix is. Usually the smaller the CR value, the better the consistency of the judgement matrix, generally the CR value is less than 0.1, the judgement matrix to meet the consistency test. As shown in table 4.

From the weight value of each indicator, it can be obtained that the importance of each element in the mental health navigation bar icon design is ranked, which provides a reference for the mental health app navigation bar icon design. According to the weight value of each indicator, it is concluded that the recognizability indicator of mental health app navigation bar icon design is the most important, and the weight ratio of the ease of understanding of the icon is the largest among the secondary indicators, followed by the interactivity indicator, and the weight ratio of the ease of operation of the icon is the largest among the secondary indicators, and lastly, the aesthetics indicator, and the weight ratio of whether the icon has a formal aesthetic is the largest among the secondary indicators. Therefore, when designing icons, it is necessary to improve the comprehensibility of icons to improve the recognizable features of icons, and at the same time improve the operability of icons, enhance the interactive experience, and make them have formal aesthetics, to make the icons of the navigation bar of mental health apps practical and aesthetically pleasing.

4.Mental Health App Navigation Bar Icon Design Element Extraction

4.1 Mental health app navigation bar icon information content classification

All the mental health app navigation bar icons in table 1 were categorized according to the textual explanations accompanying their icons and the information content of the page to which they belonged, there are 8 modules, but not all apps had these modules.

To ensure the accuracy of the recognition test, the study did not categorize them in a general way. Mental health apps have their own functional characteristics, and most of the information architecture is common, among which the heart, online answers, and community have social attributes in their page information content, and most of the apps in this part of the psychological course are categorized in the home page. Due to the different focuses of the apps, the elaboration is also different, which results in the display of icons in the navigation bar of the apps as well as the setting of content boards are all different.

4.2 Experimental design of navigation bar icons for mental health apps

The experiment is divided into two parts, the identification experiment, and the preference survey, where the identification experiment contains an accuracy experiment and a discrimination experiment.

4.2.1 Objective

The recognition experiment is to analyze the most recognizable navigation bar icon design features to provide reference for mental health app navigation bar icon design. The preference survey is to extract more design elements that meet the evaluation indexes and achieve design diversification.

4.2.2 Participants

A total of 20 (10 male and 10 female, all aged 20-30) smartphone users were invited to take part in the experiment, and each participant was proficient in operating a smartphone and had used more than five apps.

4.2.3 Implementation

The experiments were conducted in the PS software on the same computer, all on a white background, the size of the icon in each test in accordance with the current iOS system app navigation bar design specifications size unity in 44 * 44px, icon line width is maintained at about 15-17px, the icon color unity in black, which line surface icon unity of black and grey.

4.2.4 Process

Accuracy experiment, all the icons are disrupted and distributed irregularly in the upper half of the A4 white background page, the testers take turns to conduct the test, select the icons and drag them into the table below to classify them, in order to ensure the irregularity of the distribution of the icons, the distribution of the icons seen by each tester in a different location, at the same time the testers will be given the answers to the checking after the test, and answer the questions, Q1 the reason you classified them incorrectly is; Q2 the reason you classified it correctly is. As in figure 3 there is no time limit for this experiment until all the icons are classified.

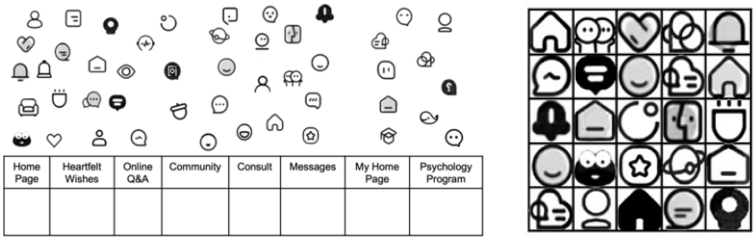


Figure 3. Accuracy experimental design (left) and discriminative experimental design(right).

Discriminative experiments, the icons with the correct rate below 40% were excluded through accuracy experiments, and the trials were reset. The same icon attributes and other interfering icons were arranged in a 5*5 arrangement in the page, as in fig 3 and the position of the icon arrangement as well as the interfering icons in the experimental diagram of the test looked at by each person was different, to ensure that the test icons were arranged in an irregular manner. The textual explanation of the icons was given before the experiment, and the experimental subjects were asked to select the category icons they belonged to from the experimental diagram, and to point their fingers until they reached the icons, and a person in charge of the experiment recorded the first selected icon of each tester.

The preference survey mainly set questions around the design image of mental health app icons, icon operation and interaction forms, icon colors and design opinions. The questionnaire was designed by Questionnaire Star and distributed to the testers to fill in.

4.2.5 Measurements

Data from three experiments were recorded and statistically analyzed.

- Accuracy Experiment- The correctness of the classification of each icon was derived from the results of each person's icon classification, while the responses to questions Q1 and Q2 were analyzed using word frequency software.
- Discriminative experiment- Sorting and analyzing the target icons according to the number of times they were selected in the experimental graph.
- Preference Survey- The questionnaire data was analyzed.

4.3 Analysis of results and discussion

4.3.1 Accuracy experiments

As shown in table 5 combined with the quadrant diagram (figure 1), it was found that most of the icons with more than 80 per cent correctness were in quadrants one and two, and the icons were highly figurative, i.e., they had concrete figurative semantics. Most of the icons with less than 20 percent correct are in quadrants two and three, where the icons are abstract, i.e., they do not have concrete image semantics.

Table 5. Results of the accuracy experiment analysis (left) and discriminatory experimental analyses (right).

Accuracy Experiments	
Correct Rate	Icon
80%-100%	
60%-80%	
40%-60%	
20%-40%	
0%-20%	

Discriminatory Experiment	
Icon Glyphs	Icon Selection Rate Sorting
Home Page	
Heartfelt Wishes	\
Online Q&A	
Community	
Consult	
Messages	
My Home Page	
Psychology Program	\

According to the results of word frequency analysis, the reasons for wrongly classifying icons can be roughly categorized into these points: abstract icons, which do not match the meaning of the words; similar meanings expressed by the icon images, multiple meanings of one picture, and confusion in classification; unfamiliarity with the icons, which is not understood; conflict with one's own understanding, and ambiguity in the meaning of the words. The reasons for correctly classifying icons can be categorized as follows: the icon is easier to understand than the image; the icon is familiar and often used; it matches the meaning of the word and has a high degree of similarity.

4.3.2 Discriminatory tests

As shown in table 5 combined with the results of the accuracy experiments, the icons in the categories of heartfelt and psychological courses were excluded because the lexical images were too close to each other resulting in a low accuracy rate of the icons belonging to these two categories. The analysis results show that the icons with high selection rate are in quadrant 1 and 3 respectively, with high icon image and more specific semantics, and at the same time, it is found that the one with more complex icon structure in the same category of icons is easier to identify.

4.3.3 Preference survey test

From the survey results show that 60% of the people prefer to use the face icon, 100% of the people choose to click as the operation method, 80% of the people prefer the dynamic form of interaction, the icon color is more inclined to the blue, green, most of the people in the design opinion hope that the mental health app icon design image is vivid and warm healing.

4.4 Discussion

It can be proved through the experiment that the higher the image degree, the easier it is to identify the icon, and the complexity of the icon composition has less impact on the recognition of icons, generally the more specific the icon is, the more complex the composition is and the easier it is to recognize it. At the same time, the experiment indirectly clarifies the classification of the information content board of mental health apps, which can be divided into homepage, community, counselling, news, and my, and these categories of icons have a small error rate and a high degree of familiarity. The preference survey provides a more comprehensive design reference for mental health navigation bar icons.

5 Mental Health App Navigation Bar Icon Design Options and Evaluation

5.1 Mental health app navigation bar icon design solution

According to the experimental results, the icon design of the mental health app is expressed in the form of face-shaped icons, the color is blue-green, and the interaction form of the icon has a dynamic effect, and the operation method is clicking. Home page, community, consult, messages, personal homepage as the icon text meaning, through the transformation of the icon form with high recognition rate in the experiment to establish the navigation bar icon image with the exclusive characteristics of mental health apps, modelling the use of the heart shape in the original icon form on the basis of the fusion of innovation, the overall design of the unity and aesthetics, specific as follows.

Table 6. Design proposal.

Mental Health App Icon Design Solution		
Icon Glyphs	Operating Method	Operation Expression (before -- after clicking)
Home page	Click	
Community	Click	
Consult	Click	
Messages	Click	
Personal homepage	Click	

5.2 Mental health app navigation bar icon design solution recognition test

The design icon was unified in black and gray, with the same specification as the test icon in the recognition experiment, and 10 people (5 men, 5 women, who had not participated in the recognition experiment before) were arranged to perform the design icon recognition test according to the same steps of the recognition experiment in the

previous section. The results showed that in the accuracy experiment, the correct rate of the design icons of this group were all above 90%, and in the discrimination experiment, the rate of the design icons of this group being selected were all above 80%. The results of the recognition test proved that the recognizability of the navigation bar icons of this group of mental health apps is high, and the design solutions have achieved the expected effect in terms of application guidance.

5.3 Evaluation of mental health app navigation bar icon design program

The design scheme is evaluated by comprehensive fuzzy evaluation method, and the evaluation set V= {unsatisfied, generally, satisfied} is established for the mental health app icon design scheme, and assigned the values of 0, 0.5 and 1 to form a quantitative evaluation set: V= {0, 0.5, 1}. The questionnaire is set up and data are collected based on "Questionnaire Star", which is published on WeChat, with real-name login and each respondent is allowed to answer only once. The sample consisted of designers with UI design experience, design students who are skilled in using various apps, and a random sample of people who have used psychological apps. The survey was conducted from 5th August 2023 to 7th August 2023, and a total of 96 valid questionnaires were returned, and the data of the questionnaire on the satisfaction with the design scheme are shown in table 7.

Table 7. Data from the questionnaire on satisfaction with the design program.

Title	Option	Options (unit: votes)		
		Unsatisfied	Generally	Satisfied
Identifiability A	Icons easy to understand a1	4(4.17%)	12(12.5%)	80(83.33%)
	Icons are recognizable a2	7(7.29%)	26(27.08%)	63(65.63%)
	Icons are graphic and concrete a3	7(7.29%)	20(20.83%)	69(71.88%)
Interactivity B	Icon manipulation presentation interesting b1	3(3.13%)	7(7.29%)	86(89.58%)
	Icons are easy to manipulate b2	4(4.17%)	27(28.13%)	65(67.71%)
	Icon information is clearly expressed b3	4(4.17%)	16(16.67%)	76(79.17%)
Aesthetics C	Icons have formal beauty c1	4(4.17%)	17(17.71%)	75(78.13%)
	Icons have aesthetic appealc2	5(5.21%)	19(19.79%)	72(75%)
	Icons are imaginative c3	5(5.21%)	18(18.75%)	73(76.04%)

Using online SPSS analysis software, the fuzzy comprehensive evaluation is carried out for 9 indicators and 3 comment sets, and the M (., +) operator for the study. Calculate the affiliation function of the design solution M (. , +), i.e:

First, establish the evaluation index weight vector matrix A, and construct the 9x3 weight judgment matrix R, and finally analyze the weight value of 3 comment sets, respectively: 0.048, 0.188, 0.764. From table 8, we can see that the weight value of satisfaction is the highest in the 3 comment sets (0.764), and combined with the law of maximum subordination, we can see that the result of the comprehensive evaluation is "satisfied".

Table 8. Results of weighting calculations.

Results of Weighting Calculations			
	Unsatisfied	Generally	Satisfied
Degree of Affiliation (Statistics)	0.048	0.188	0.764
Normalized Degree of Affiliation [Weight]	0.048	0.188	0.764

Online SPSS analysis software in the fuzzy comprehensive evaluation, will be based on the calculation of the weight value, as well as the score of each indicator item, to get the comprehensive score value, the principle of its calculation is the indicator item score and the weight value multiplied by the cumulative. The comprehensive score is shown in Table 9, and the overall satisfaction of the design solution is 85.8%, Illustrates that the design solution establishes a good human-application interaction while realizing the

functional basis of recognizability of the mental health app navigation bar icons, at the same time, to meet the aesthetics of the design of the navigation bar icons.

Table 9. Overall evaluation of the design program.

Objective	Aggregate Score	Criterion	Aggregate Score	Indicator	Aggregate Score
Overall Evaluation of The Design Program Z	0.858	Identifiability A	0.84	Icons easy to understand a1	0.9
				Icons easy to understand a1	0.79
				Icons are graphic and concrete a3	0.82
		Interactivity B	0.88	Icon manipulation presentation interesting b1	0.93
				Icons are easy to manipulate b2	0.82
				Icons are easy to manipulate b2	0.88
		Aesthetics C	0.86	Icons have formal beauty c1	0.87
				Icons have aesthetic appeal c2	0.85
				Icons are imaginative c3	0.85

6. Conclusion

To make the navigation bar icon of mental health app really play the role of navigation and improve the efficiency of application use. The design method of mental health app navigation bar icon based on fuzzy hierarchical analysis, analyses domestic and international app icon design methods, summarizes the design law of mental health app navigation bar icon, proposes the design process of mental health app navigation bar icon based on fuzzy hierarchical analysis, and designs a complete set of mental health app navigation bar icon. The evaluation results show that the scheme better reflects the identifiability, interactivity, and aesthetics of mental health apps, verifies the reasonableness and feasibility of the fuzzy hierarchical analysis-based mental health app navigation bar icon design method, it is of great practical significance to improve the user experience of mental health apps and increase the willingness of users to continue to use the app. This design scheme can provide methodological reference for future mental health app navigation bar icon design.

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