

PAPER

Survey of VR Products to Treat Social Phobia among College Students Based on Logistic Regression and K-Means Clustering Analysis

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ABSTRACT

Social phobia or social anxiety disorder, is characterized by a fear of embarrassing situations in front of others, leading to long-term chronic anxiety disorders. The purpose of our study is to examine the market prospects of using virtual reality (VR) technology for the treatment of social phobia. Specifically, we aim to investigate the current prevalence of social phobia among college students in eight universities in Guilin and explore their willingness to adopt VR technology as a treatment option. To achieve this, we utilized various data collection methods, including questionnaire surveys, literature surveys, and field interviews. Through descriptive statistical analysis we gained insights into the respondents' demographics and their perceptions of social phobia and its treatment. Subsequently, we constructed a binary logistic regression model to identify the influencing factors contributing to social phobia among college students. Additionally, we conducted factor analysis, which revealed that the aspects of service quality, safety, and environmental quality were of utmost concern. Finally, we employed K-Means cluster analysis to differentiate the distinctive characteristics of potential users and develop effective strategies for the advancement of VR technology in social phobia treatment.

KEYWORDS

social phobia, VR technology, binary logistic regression model, K-Means clustering analysis

1 INTRODUCTION

As society continues to evolve, it is inevitable that people will participate in various social activities. Renowned social psychologist Maslow emphasized the significance of social interaction in his hierarchy of needs theory, reinforcing the notion that social activities contribute significantly to human development. However, for some people, showing themselves in public, even for daily social activities, is like a “disaster.”

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They may experience nervousness and trembling, blushing and palpitations, and stuttering, which is what psychology calls “social anxiety” or “social fear” [1].

According to the survey results, the search rate of the term “social fear” has continued to rise since 2016. Notably, the Douban App has witnessed a substantial number of searches related to social fear, with over 10 related groups dedicated to the topic. Furthermore, on Weibo, a popular social media platform, hundreds of topics centered on “social fear” have emerged. These discussions encompass various aspects, such as “the nightmare of social fear people,” “how much social fear affects people,” etc. Many of these topics have garnered extensive attention, with discussions surpassing 100 million interactions [2].

Some studies have indicated that the college years represents a peak period of social anxiety, and approximately 80% of social anxiety occurs before the age of 20 [3]. A report entitled “Social Phobia in China,” was published by the South China Morning Post on April 5, 2022. According to the report, approximately 32% of individuals’ aged of 16 and 29 in China met the medical criteria for social phobia. It is crucial to address social phobia promptly, as if left untreated, its symptoms can persist throughout an individual’s lifespan, negatively impacting their academic pursuits and interpersonal relationships etc. [4].

In this context, conducting an in-depth study of social phobia has become crucial, particularly in the development of accessible, convenient and effective treatment options for individuals suffering from this condition. Based on this, our team conducted a comprehensive survey to explore ways to alleviate the symptoms of social phobia among college students. Additionally, we sought to determine their willingness to adopt VR technology as a potential treatment modality for social phobia. The findings from our study have yielded valuable insights and provided useful recommendations for addressing this issue effectively.

2 STATUS OF RESEARCH

2.1 The development status of VR technology at home and abroad

The development status of foreign VR technology. The United States of America is the birthplace of VR technology. The “National Information Infrastructure (NII)” plan announced by the US government in 1993 laid the foundation for the development and application of distributed virtual reality [5]. It took the lead in applying VR in military applications, which subsequently facilitated the expansion of VR technology into various other domains, including medical education and entertainment. As a result, VR technology has found broad applications across multiple sectors, creating ample opportunities for its implementation [6].

European countries also attach great importance to VR technology. Spain hosts the multi-user Virtual Olympics. Germany has a virtual environment testing platform, and the TNO Institute in the Hague, Netherlands, developed a physical training system using VR.

The development status of domestic VR technology. China has demonstrated a strong commitment to the research and development of VR technology. In the “National Medium- and Long-Term Science and Technology Development Plan (2006–2020),” VR technology is listed as one of key technologies to be developed [7]. In addition, the national Science and Technology Support Plan for the “11th Five-Year Plan” also supports the development of VR technology. In the “13th Five-Year Plan”, the state proposes to develop innovation and industrialization in emerging frontier fields such as VR and interactive film and television.

2.2 Application of VR technology in the treatment of social anxiety disorder

In the treatment of social anxiety disorder, VR technology is used to create simulated social situations. The virtual social scenarios require the creation of avatars with certain “perceptual” and appropriate “expressive responses” to enable social interaction with the patient [8].

The latest advancements in VR technology have indeed paved the way for such capabilities. Roy and others have made notable contributions in utilizing VR technology for the treatment of social anxiety. They used VR technology to create four different virtual social scenarios: speaking to a virtual audience in a virtual conference room, chatting with a virtual friend, receiving attention from virtual customers, and waiters in a virtual coffee shop, and subjects’ own interests being violated by an avatar [9]. Through a period of treatment utilizing these VR scenarios, patients exhibited significant improvements in their social anxiety levels.

Oxford Virtual Reality (OVR) has officially launched a set of VR-based social therapies to help people overcome their social phobias. Through its social therapy, OVR uses simulated environments to help individuals deal with situations they might encounter in the real world, such as traveling by bus, buying food and groceries, ordering alcohol in a bar, or going to the hospital to see a doctor.

3 DATA FORECAST

According to the latest foreign research reports, the market size of AR/VR applications in the medical field is approximately 2.7 billion dollars at present, and is expected to reach 10 billion dollars by 2027. Simultaneously, the global healthcare VR market is expected to grow at a compound growth rate of 30.62% from 2022 to 2030. This implies that VR technology has significant development potential in the market for the treating social phobia, and presents a substantial new opportunity for the medical industry. It has the potential to enhance the patient experience, improve medical efficiency, and reduce medical risks, thereby providing greater development benefits to society.

4 DATA ANALYSIS

4.1 Data processing

To ensure accurate data representation and minimize incorrect responses, the survey team several measures during the questionnaire survey process. Real-time background data is collected to gain insights into the respondents and maintain the authenticity of their responses. In cases where the questionnaires are incomplete, display inconsistencies between previous and subsequent responses, have IP address that does not match, or have a duration of less than a minute, respondents are guided to refill the questionnaire as required. If a satisfactory questionnaire is not available after multiple requests, it will be treated as invalid. After the survey is completed, the collected data is subjected to a cleaning process, excluding any responses on the questionnaire network. The questionnaire data is then exported and imported into the data analysis software for further analysis and processing.

4.2 Data testing

The reliability and validity test primarily focused on the scale section of the questionnaire. The information obtained from the pre-survey analysis was utilized to make slight adjustments to the questionnaire, resulting in the creation of the official version. During the formal survey, a total of 650 questionnaires were distributed, and all the 650 were retrieved, resulting in a 100% response rate. Out of these, 602 questionnaires were deemed valid, indicating a valid response rate of 92.62%. The data collected from 602 valid questionnaires are subjected to reliability and validity analysis using SPSS, and the results are presented in the table below.

Table 1. Reliability test of the total scale

| Cronbach's Alpha Coefficient | Standardized Cronbach's Alpha Coefficient | Number of Items |
|------------------------------|---|-----------------|
| 0.946 | 0.947 | 31 |

According to Table 1, the Cronbach's Alpha coefficients of the scales are all greater than 0.8. This indicates that the questionnaire exhibits high reliability.

Table 2. Formal survey validity test

| | | |
|------------------------------------|------------------------|-----------|
| Kaiser-Meyer-Olkin numerical value | | 0.945 |
| Bartlett's test of sphericity | Approximate chi-square | 12551.619 |
| | df | 465 |
| | p | 0.000 |

Based on the information presented in Table 2, the KMO value for the validity analysis is greater than 0.9 and the P-value of Bartlett's sphericity test is less than 0.5. These results suggest that the questionnaire design is valid and suitable for factor analysis.

4.3 Binary logistic regression analysis

a. Model selection. Since the study aims to examine the correlation between "whether there is social phobia" and various factors, a binary logistic regression model is suitable for this analysis. This model is chosen because "whether there is social phobia" is a binary discrete variable, and the goal is to identify the influencing factors of social phobia among college students in Guilin.

b. Variable setting and model building. The dependent variable in this study is whether or not an individual has social phobia. It represents the current market situation of social phobia. The binary choice behavior of each individual, indicating whether they have social phobia or not, is expressed as the dependent variable. When an individual chooses "yes," the corresponding value is 1, and when they choose "no," the value is 0.

The independent variables in the study include basic personal information and family factors. These variables are divided into five categories: "gender," "grade," "household registration," "family monthly income," and "understanding of social phobia." In the questionnaire design, all five variables under personal information were qualitative variables. As a result, they were converted into dummy variables.

According to the purpose of the study and the generalization of the questionnaire data, the variable names and variable settings of the model were obtained as shown in Tables 3 and 4.

Table 3. Table of independent variables for binary logistic regression models

| Independent Variable | Variable Symbol | Variable Definition |
|--------------------------|-----------------|---|
| Gender | Gender | $gender = \begin{cases} 1 & \text{male} \\ 0 & \text{female} \end{cases}$ |
| Grade | Grade | $grade_1 = \begin{cases} 1 & \text{freshman year} \\ 0 & \text{postgraduate and above} \end{cases}$ $grade_2 = \begin{cases} 1 & \text{sophomore year} \\ 0 & \text{postgraduate and above} \end{cases}$ $grade_3 = \begin{cases} 1 & \text{junior year} \\ 0 & \text{postgraduate and above} \end{cases}$ $grade_4 = \begin{cases} 1 & \text{senior year} \\ 0 & \text{postgraduate and above} \end{cases}$ |
| Household Registration | urban | $urban = \begin{cases} 1 & \text{urban areas} \\ 0 & \text{rural areas} \end{cases}$ |
| Monthly household income | Income | $income_1 = \begin{cases} 1 & \text{under 4000 RMB} \\ 0 & \text{over 12000 RMB} \end{cases}$ $income_2 = \begin{cases} 1 & 4000-8000 \text{ RMB} \\ 0 & \text{over 12000 RMB} \end{cases}$ $income_3 = \begin{cases} 1 & 8000-12000 \text{ RMB} \\ 0 & \text{over 12000 RMB} \end{cases}$ |
| Understanding | Understand | $understand_1 = \begin{cases} 1 & \text{a serious mental illness} \\ 0 & \text{general introversion} \end{cases}$ $understand_2 = \begin{cases} 1 & \text{a kind state} \\ 0 & \text{general introversion} \end{cases}$ |

Table 4. Table of dependent variables for binary logistic regression models

| Dependent Variable | Variable Symbol | Variable Definition |
|---------------------------|-----------------|---|
| whether has social phobia | y | $y = \begin{cases} 1 & \text{yes} \\ 0 & \text{no} \end{cases}$ |

Table 5 shows the parameter estimates in the logistic regression model, highlighting significant differences in the dependent variables. The results indicate that several factors significantly influence whether the respondents have social phobia. These factors include gender, grade-1, grade-4, urban, income-1, income-2, and understand-1.

Table 5. Binary logistic regression model results

| | | B | Standard Error | Wald | Degree of Freedom | Prominence | Exp(B) |
|--------|--------------|--------|----------------|--------|-------------------|------------|--------|
| Step 1 | gender | -0.506 | 0.225 | 5.047 | 1 | 0.025 | 0.603 |
| | grade_1 | 2.571 | 0.497 | 23.344 | 1 | 0.000 | 8.080 |
| | grade_4 | 1.837 | 0.403 | 9.465 | 1 | 0.002 | 1.948 |
| | urban | -0.485 | 0.237 | 4.182 | 1 | 0.041 | 0.616 |
| | income_1 | 1.444 | 0.386 | 13.976 | 1 | 0.000 | 4.237 |
| | income_2 | 1.278 | 0.348 | 13.482 | 1 | 0.006 | 3.590 |
| | understand_1 | 0.649 | 0.261 | 6.159 | 1 | 0.013 | 1.913 |
| | constants | -1.993 | 0.652 | 9.333 | 1 | 0.002 | 0.136 |

c. Summary of binary logistic analysis

Gender. The P value of gender is 0.025, which is less than the significance level of 0.005, indicating a significant impact of gender on whether the interviewees have social phobia. The probability of boys suffering from social phobia is 0.603 times that of girls, indicating that girls are more prone to social phobia than boys.

Grade. In different grades, the P values for freshmen and seniors were 0.000 and 0.002, respectively, both below the significant level of 0.005. This indicates a significant polarization within the group suffering from social phobia. Freshmen and seniors were more likely to suffer from social phobia than the group with post-graduates and above. Among individuals with or without social phobia, the number of freshmen was 8.080 times higher than that of other grades, and the number of seniors was 1.948 times higher than that of other grades.

Household registration. Household registration also demonstrated a significant effect on whether respondents suffered from social phobia. Individuals with an urban household registration were found to be less likely to experience social phobia compared to those with a rural household registration.

Monthly household income. In the regression results, the regression coefficients for family monthly income below 4000 RMB and 4000–8000 RMB were 1.444 and 1.278, respectively. The corresponding P values were 0.000 and 0.006, indicating a significant impact of family monthly income on the likelihood of the family experiencing social phobia. Specifically, as family monthly income decreases, the probability of having social phobia increases.

Understanding of social phobia. In terms of social understanding, respondents who considered social phobia as a serious mental illness were 1.913 times more likely to experience social phobia compared to those who viewed social phobia as a general introversion.

4.4 Factor analysis

Factor analysis is a multivariate statistical analysis method that aims to condense a large number of variables into a smaller set of independent common factors. It focuses on studying the interdependencies within the correlation matrix of indicators. In this survey, the scale was tested and analyzed, and the common factor was extracted based on correlation. The analysis aimed to reduce the 21 most representative questions in the scale questions to obtain meaningful results.

a. KMO and Bartlett's test. Table 6 displays the results of the KMO and Bartlett test results. A higher KMO value indicates a greater suitability for factor analysis, as it suggests a higher degree of common factors among variables. As for the Bartlett test, if the significance value is less than 0.05 or 0.01, it indicates that factor analysis can be conducted.

Table 6. KMO and Bartlett's test

| | | |
|---|------------------------|----------|
| Kaiser-Meyer-Olkin measure of sampling adequacy | | 0.939 |
| Bartlett's test of sphericity | Approximate chi-square | 8003.223 |
| | df | 210 |
| | Sig | 0.000 |

Based on the Table 6 shown, the KMO value for the statistical analysis is 0.939, which is greater than the recommended threshold of 0.5. This indicates that the questionnaire has good reliability, suggesting it is suitable for factor analysis. Furthermore, the sphericity test result of 0.000 indicates a significant difference, further supporting the appropriateness of conducting factor analysis.

b. Factor analysis. The table below presents the summary plot of the factor analysis. In this case, the component coefficients indicate the degree of correlation between each variable and the common factor. A coefficient with an absolute value closer to 1 signifies a higher degree of correlation, as illustrated in Table 7.

Table 7. Summary table of factor analysis

| | Title Item | Percentage of Variance | Weights | Ingredients | | | |
|-----------------|-------------------------------------|------------------------|---------|-------------|-------|---|---|
| | | | | 1 | 2 | 3 | 4 |
| Service Factors | Price | 21.572 | 0.046 | | 0.653 | | |
| | Effect | | 0.055 | | 0.722 | | |
| | Security | | 0.053 | | 0.751 | | |
| | Treatment Environment | | 0.049 | | 0.763 | | |
| | Convenience | | 0.045 | | 0.744 | | |
| | Service Quality | | 0.054 | | 0.753 | | |
| Scene Factors | Social occasions such as gatherings | 19.793 | 0.054 | 0.728 | | | |
| | Crowded streets | | 0.048 | 0.777 | | | |
| | Restaurants and other public places | | 0.048 | 0.715 | | | |
| | Face up and down the hierarchy | | 0.049 | 0.765 | | | |
| | Face the opposite sex | | 0.051 | 0.744 | | | |
| | Large lecture | | 0.045 | 0.754 | | | |
| | Face-to-face communication and chat | | 0.054 | 0.664 | | | |

(Continued)

Table 7. Summary table of factor analysis (Continued)

| | Title Item | Percentage of Variance | Weights | Ingredients | | | |
|-----------------------|--------------------------------|------------------------|---------|-------------|---|-------|-------|
| | | | | 1 | 2 | 3 | 4 |
| Hazard Factors | Addictive | 13.458 | 0.045 | | | 0.645 | |
| | Causes eye strain | | 0.046 | | | 0.792 | |
| | Causes myopia | | 0.048 | | | 0.737 | |
| | Causes dependency | | 0.051 | | | 0.680 | |
| Effectiveness Factors | Poor treatment results | 12.727 | 0.052 | | | | 0.759 |
| | Poor security | | 0.053 | | | | 0.734 |
| | Lack of technological maturity | | 0.054 | | | | 0.723 |

From the table it is evident that four factors have been extracted: service factor, scene factor, hazard factor, and utility factor. The variance percentage represents the contribution rate each factor in the factor analysis. Analyzing the effect degree of each factor based on the contribution rate, we observe that the factors rank as follows, from high to low: service factor, scene factor, hazard factor, and utility factor.

c. Summary of factor analysis. Based on the data presented, it is evident that the service factor has the highest contribution rate among all the factors. This indicates that the service factor holds high importance among the four factors. Specifically, respondents' highly value the treatment environment. Therefore, when utilizing VR technology for the treatment of social phobia, it is crucial to focus on creating a comfortable and user-friendly treatment environment. Additionally efforts should be made to enhance service quality with a customer—centered approach. Ensuring the safety throughout the treatment process is also important. In addition, considering the objective reality, providing convenience and cost-effectiveness should be prioritized to give customers the maximum benefits and discounts.

The second factor identified is the scene factor, which represents the respondent's expectation of virtualized scenes using VR technology. Among all the selected scenes, the most desired scene by respondents is being in a crowded street, followed by facing the company's superiors and subordinates (such as teachers and classmates), and then giving a large speech. These three scenes hold significant importance, indicating that VR treatment for social phobia should primarily focus on these three scenarios. Furthermore, the treatment approach can gradually expand to include social occasions such as parties and events, and public places such as restaurants and bars.

The third factor is the harm factor, which involves the potential harm associated with the application of VR technology. Similar to drug therapy, the use of VR technology may have certain negative effects on the human body. According to the survey data, respondents express the highest concern regarding eye fatigue or myopia resulting from the treatment process. This concern arises due to the virtual nature of the 3D world and the non-adaptive nature of the treatment equipment. Customers may experience a feeling of dizziness or vertigo, and prolonged close contact with virtual reality equipment can potentially contribute to the development of myopia.

Finally, the effectiveness factor. According to the survey data, respondents express the highest level of concern regarding poor treatment effectiveness. Safety and technological maturity are subsequent concerns. Regarding therapeutic effectiveness, as VR technology for the treatment of mental illness progresses, new methods are

being developed. Currently, VR technology is already being used to treat various phobias and diseases. As the field advances and incorporates technologies such as 5G, artificial intelligence, and flexible displays safety and technical maturity will likely improve significantly.

4.5 K-Means clustering analysis

K-Means cluster analysis, also known as the K-Means clustering algorithm, utilizes distance as a measure of similarity. The algorithm aims to group objects together based on their proximity, considering objects closer in distance as more similar. In order to understand the characteristics of VR technology in the treatment of social phobia, cluster analysis can be employed. The survey respondents, who are potential users with social phobia, can be analyzed through cluster analysis to identify distinct user profiles and understand their basic characteristics. This information can then be utilized to tailor and diversify services and marketing strategies accurately for different user groups.

a. Definition of potential users. Potential users in this context are individuals who have social phobia, but have not yet been exposed to or treated with VR technology. By identifying and mining potential users, the VR technology treatment industry can implement focused and targeted publicity and promotion efforts to attract and engage a larger user base. Specifically, in Question 6 of the survey, respondents who have answered “yes” to the question, “Do you think you are socially afraid?”, were selected and categorized as potential users. The total number such respondents was identified as 463 individuals.

b. Model application and analysis

1) Clustering factor selection and model solving

Based on the previous study results, seven factors were selected from the questionnaire as indicators for cluster analysis. These factors include grade level, household registration, monthly household income, understanding of social phobia, whether it affects academic life, single time acceptance of treatment, and single price acceptance of treatment. In order to perform cluster analysis, these indicators can be assigned numerical value to represent their respective attributes or levels of each sample in the analysis. Assigned values to these indicators allows for the measurement of proximity between samples, enabling the clustered algorithm to group them based on their similarity.

The seven indicators of potential users were organized and entered into SPSS for analysis. K-means clustering was performed using SPSS, and the clustering results were obtained by clustering running the algorithm with different number of clusters, specifically 3, 4, 5, and 6. The result of these clustering iterations are presented in Table 8.

Table 8. Clustering frequency table

| Number of Categories | Category 1 | Category 2 | Category 3 | Category 4 | Category 5 | Category 6 |
|----------------------|------------|------------|------------|------------|------------|------------|
| Frequency (6) | 105 | 65 | 60 | 42 | 121 | 71 |
| Frequency (5) | 68 | 128 | 51 | 91 | 127 | |
| Frequency (4) | 201 | 127 | 78 | 58 | | |
| Frequency (3) | 215 | 146 | 103 | | | |

From the analysis presented in Table 8, it is observed that with too few category divisions (e.g., categories 3 and 4), it becomes challenging to examine the specific differences between the categories. On the other hand, when there are more category divisions (e.g., category 6), some categories may contain insufficient data, leading to reduced specificity. To strike a balance between reflecting differences between categories and ensuring category homogeneity, the data was ultimately divided into 5 categories.

2) Potential user value model based on clustering results

When the number of clusters was taken as 5, the results were processed and analyzed by SPSS, as illustrated in Table 9.

Table 9. Clustering center coordinates

| Clustering Type | A | B | C | D | E | F | G |
|-----------------|--------|--------|--------|--------|--------|--------|--------|
| Category 1 | 3.5441 | 1.5000 | 3.3676 | 2.9121 | 2.0315 | 2.0441 | 1.7500 |
| Category 2 | 2.9400 | 1.4400 | 2.8400 | 2.4766 | 1.5934 | 3.0600 | 2.6600 |
| Category 3 | 3.7422 | 1.6563 | 1.5937 | 2.3529 | 1.4400 | 1.9453 | 1.6953 |
| Category 4 | 1.7473 | 1.7253 | 1.5604 | 2.3000 | 1.4063 | 2.0000 | 1.6703 |
| Category 5 | 1.8661 | 1.7244 | 1.9213 | 1.5386 | 1.3676 | 1.7638 | 1.3543 |

Upon converting the clustering centers to the original data type the results obtained are presented in Table 10.

Table 10. Converted clustering centers

| Category | Grade | Registration | Income | Understanding | Impact | Time | Price |
|----------|---------------|--------------|------------------|---------------------------|----------------|-------------|--------------|
| 1 | Junior | Cities | 12000RMB or more | Serious diseases | Severe Impact | Within 2h | 300–450RMB |
| 2 | Sophomore | Cities | 8000–12000RMB | Serious diseases | Severe Impact | Within 3h | 450–600RMB |
| 3 | Senior year | Rural | Under 4000RMB | Serious diseases | General Impact | Within 1h | 150–300RMB |
| 4 | Freshman year | Rural | Under 4000RMB | A state | General Impact | Within 2h | 150–300RMB |
| 5 | Freshman year | Rural | 4000–8000RMB | Just general introversion | No effect | Within 0.5h | Under 150RMB |

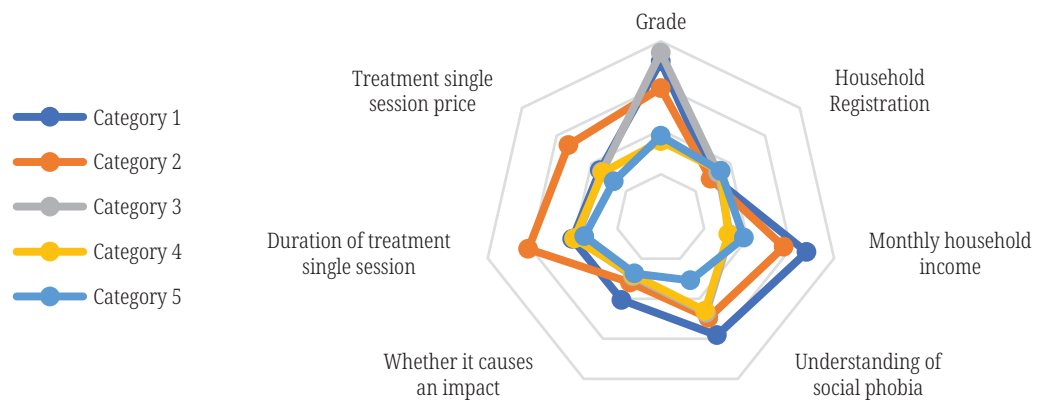


Fig. 1. Radar plot of each cluster

3) User differentiation

According to Table 10 and Figure 1. Radar plot of each cluster, it is evident that each category exhibits distinct characteristics. Based on this characteristic phenomenon, users can be classified into four categories: important potential users, secondary potential users, general potential users, and low-value potential users. The characteristics of each of their user categories are as follows:

Important potential users. The first and second categories of users are important potential users. These users consists of juniors and seniors residing in urban areas, with a monthly household income ranging from 8,000–12,000RMB. They perceive social phobia as a serious mental illness that significantly impacts on their daily study life. Moreover, they are willing to invest more time and money in receiving treatment. For this particular, the virtual technology treatment industry can offer a treatment system with diverse modalities, catering to their specific needs.

Secondary potential users. The third category comprises secondary potential users, predominantly senior students hailing from rural areas with a monthly income of less than 4000RMB. They acknowledge social phobia as a significant psychological disease that affects their daily studies and life in general. These users are willing to undergo treatment with reduced time commitments and lower costs. For such users, the virtual technology treatment industry should offer greater preferential support to cater their needs. Additionally, it is essential to design shorter treatment courses for this group, ensuring they do not invest excessive time in the treatment process.

General potential users. The fourth category consists of general potential users, primarily composed of freshmen from rural areas with a family income of less than 4000 RMB per month. They perceive social phobia as a condition that significantly affects their daily studies and overall life. These users are willing to invest in treatment for a moderate duration and cost. In order to cater to this group, the VR technology treatment industry should offer appropriate discounts, effectively communicate through advertisement that social phobia is a psychological disease, and actively encourage them to seek treatment.

Low value potential users. The fifth category comprises low-value potential users, characterized by low academic performance and a monthly family income ranging from 4000–8000 RMB. They believe that social phobia has minimal impact on daily school life. The prevalence of social phobia within this user category is relatively low. For these users, the virtual reality industry should primarily focus on providing traditional psychotherapy, while incorporating VR technology treatment to a certain extent.

c. Summary of K-Means analysis. Based on the analysis using the K Means clustering model, it is evident that among respondents with social phobia, those with higher grades exhibit significant potential to become users of VR therap. Additionally, there is a notable correlation between the user's family income, their understanding of the club, and the impact of social phobia on their learning life. According to the analysis, 42% of users are identified as important potential users of VR technology treatment, and these users demonstrate a high likelihood of seeking social phobia treatment through VR technology.

5 CONCLUSION

Based on the research conducted on the current situation of social phobia among college students in eight universities in Guilin and the market situation of VR technology in the treatment of social phobia, the following important conclusions can be drawn.

5.1 The current situation of social phobia among college students in Guilin

According to the survey, 77.08% of the respondents reported experiencing social phobia, with 75.68% attributing their social phobia to self-perception evaluation. These findings suggest that a majority of students with social phobia lack self-awareness. In addition, the survey data also reveals that 47.84% of parents and 56.98% of the respondents have limited knowledge about social phobia, indicating a lack of sufficient scientific dissemination of information about the condition by relevant departments. Therefore, it is recommended that the relevant departments increase their efforts in promoting public awareness and understanding of social phobia. This can be achieved through various means, such as utilizing social media platforms like television and Weibo to conduct online publicity campaigns. Offline activities, such as academic lectures and knowledge sharing meetings, should also be organized to facilitate greater recognition and understanding of social phobia among the general population. By increasing awareness, individuals suffering from social phobia can identify their condition in a timely manner, leading to better treatment outcomes through early detection and treatment.

Therefore, in the process of treatment, we combine psychotherapy to actively guide students in establishing self-confidence psychology, improving self-cognitive evaluation, and cultivating college students' abilities in independent thinking and independent participation. This integration of VR technology and psychotherapy aims to enhance the diversified competitive advantage of the VR technology industry.

5.2 College student respondents' willingness to consume VR technology for social phobia in Guilin

According to the survey, 80.23% of college students expressed their willingness to use VR technology for the treatment of social phobia. Among them, the respondents specifically emphasized the importance of safety and efficacy, considering the maturity of the technology as a significant factor in their decision to undergo treatment using this method. Therefore, it is crucial to prioritize these aspects when developing the VR industry for social phobia treatment. By improving the maturity of the technology and enhancing the treatment environment, we can deliver better treatment outcomes to consumers and expand the consumer market.

5.3 Consumption demand for social phobia treatment places among college students interviewed in Guilin

The study primarily focuses on consumer demand for treatment places. It indicates that hospitals and specialized institutions are the most significant treatment locations for consumers seeking treatment for social phobia. However, emerging places include campuses, suggesting that college students are potential customer groups for VR technology-based social phobia treatment. Therefore, the government should strengthen the cooperation with major universities to promote the technology into the campus setting.

5.4 Prospects of VR technology in the treatment of social phobia

The survey findings indicate that VR technology as a new industry, is well-known among college students, with half of the college students aware of its potential in treating social phobia. Furthermore, an impressive 80.23% of the college students expressed their willingness to undergo social phobia treatment using VR technology. This high level of recognition and market acceptance demonstrates the promising prospects for the development of VR technology in this field. To effectively promote and publicize VR technology, a combination of online and offline strategies can be employed. Such efforts can help enhance the overall public awareness and acceptance of the technology, thereby establishing a solid social mass base of support.

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7 DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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