Function Analysis of Anti-haze Products Based on User Requirements

Jiaqi Wang\textsuperscript{1,a} and Qinghua Sun\textsuperscript{2,b}

\textsuperscript{1}Harbin Institute of Technology, Harbin, China
\textsuperscript{2}Harbin Institute of Technology, Harbin, China
\textsuperscript{a}568278500@qq.com, \textsuperscript{b}sqh7@foxmail.com

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Abstract. In recent years, due to the influence of environmental factors and human factors (transportation, heating, etc.), the frequency of haze in China is increasing day by day. And people's protective measures for haze are not in place. This paper uses the method of questionnaire and data analysis to determine people's demand for haze prevention products. 70.13\% of the people living in haze areas are willing to buy anti-haze products. In haze weather, 38.7\% of the people prefer to use anti-haze masks, 27.3\% of the people prefer to use air purifiers, and 16.1\% of the people prefer to choose anti-haze hangers. The two most important aspects that people focus on are haze prevention effect and wearing comfort. Gender differences influence the intention to buy anti-haze products. People's basic functional requirements for wearing anti-haze products are anti-haze effect. Other requirements include wearing comfort, appearance, price and others, and others include sustainability and quality.

1 Introduction

In recent years, the frequency of haze weather in China is increasing day by day, which has caused great harm to the national health. Living in this kind of environment for a long time will damage the respiratory system, cardio cerebrovascular system, nervous system and reproductive system \cite{1}, which will increase the probability of people's disease and even the mortality. At present, there are many anti-haze products in the domestic market, such as various anti-haze masks, anti-haze pendant \cite{2}, anti-haze baby carriage \cite{3}, etc. The main principle of the filter is to make the air containing harmful substances filtered and purified by the filter material before being inhaled by people. The filter material includes the filter cotton used for dust prevention and the chemical filter box used for poison prevention. Due to different anti-haze standards followed by different manufacturers, the anti-haze products on the market now have their own advantages and disadvantages. At present, there is a lack of anti-haze products for domestic PM2.5 phenomenon in China, which not only has good protection effect, but also does not make people feel exaggerated, suitable for wearing in daily life, and has better air permeability.

2 A method of obtaining user requirements based on frequency analysis

Basic statistical analysis often starts with frequency analysis. Frequency analysis method can help us to understand the status of variable value, and it is very useful to grasp the distribution characteristics of data. Through these analyses, it can reflect to a certain extent whether the sample has the overall representativeness and whether there is systematic deviation in the sampling. Frequency analysis is the most widely used analysis technique in all questionnaires. Frequency analysis is divided into single variable frequency analysis, multi response variable analysis and cross contingency table analysis.

2.1 Research status of single variable frequency analysis and multi response variable analysis

The main contents of single variable frequency analysis and multi response variable analysis include data statistics, one-dimensional frequency analysis, frequency distribution table and
statistical chart as well as sorting frequency. Data statistics are the basis. For the data to be analyzed, common statistical contents include: average value, median, mode, percentile, sample variance, sample standard deviation, etc. Where the calculation formula of sample average is as follow:

\[
\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n} = \frac{\sum_{i=1}^{n} x_i}{n}
\]  

(1)

Sample variance calculation formula is as follow:

\[
Var = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2
\]  

(2)

Calculation formula of sample standard deviation is as follow:

\[
S = \sqrt{Var}
\]  

(3)

Common statistical tables of single variable frequency analysis include frequency distribution table, cumulative frequency table and cumulative percentage table. Common statistical charts include bar chart, pie chart, histogram (normal curve), line chart, etc.

The main difference between single variable frequency analysis and multi response variable analysis is that single variable frequency analysis is mainly aimed at the data analysis of single choice questions and blank filling questions in the questionnaire survey, and multi response variable analysis is mainly aimed at the data analysis of multi topics.

2.2 Institutions Optimization Design

The analysis of cross contingency table is mainly the cross analysis of two single choice questions. It is an analysis method based on the vertical analysis method and the horizontal analysis method, from the perspective of cross and three-dimensional, from shallow to deep, from low to high. Although this method is complex, it makes up for the deviation brought by the analysis method of "do one's own thing".

The analysis of cross contingency table can reflect the data distribution of multiple variables under different values, further analyze the mutual influence and relationship between variables, better reflect the relevance between the two factors, and the correlation between the two factors and the observed phenomenon. The specific steps are to generate two-dimensional or multi-dimensional cross contingency table through SPSS software according to the collected sample data. The value of P is less than 0.05, reject zero hypothesis, correlation; The value of P is greater than 0.05, cannot reject zero hypothesis, there is no statistical significance.

3 Research on users’ requirements of haze prevention products

In order to determine the needs of users, this paper adopts the method of questionnaire survey. This questionnaire survey has a total of 462 people, mainly for people living in the haze environment, accounting for 70% of the total number. The target population is reasonable. At the same time, the majority of people who fill in the questionnaire are 20-40 years old. These people have formed perfect values and purchasing power. The content of the questionnaire has reference.

3.1 Single variable frequency analysis of user demand for haze prevention products

From the results of frequency analysis, people tend to eat more fruits and vegetables, strengthen exercise and the application of anti-haze products, among which the most inclined is the application of anti-haze products. As shown in Table 1, 70.1% of the people will choose to buy anti haze products for their families, and only 29.9% of the people are not willing to buy anti haze products, that is to say, there is still a market for anti-haze products at present. With the improvement of people's consumption level, people have the ability and willingness to buy anti haze products to protect the health of their families.
Table 1. Single variable frequency analysis of whether there is any intention to buy anti-haze products.

| Q6: will you buy anti-haze products for yourself or your family? | Frequency | Percentage | Valid Percent | Cumulative percentage |
|---------------------------------------------------------------|-----------|------------|---------------|-----------------------|
| Effective Yes                                                 | 326       | 70.1       | 70.1          | 70.1                  |
| No                                                            | 139       | 29.9       | 29.9          | 100.0                 |
| Total                                                         | 465       | 100.0      | 100.0         |                       |

According to the table 2, 38.7% of people prefer to use anti haze masks in haze weather, which is much higher than other anti-haze products, 27.3% prefer to use air purifiers, 16.1% prefer to choose anti haze hangers. Among all anti haze products, people are most inclined to choose anti haze masks to reduce the harm of haze to themselves. Only a few people prefer to buy some uncommon anti-haze products, such as anti-haze hula hoop.

Table 2. Single variable frequency analysis of purchase intentions of anti-haze products.

| Q8: Which anti haze products do you prefer to use in haze weather | Frequency | Percentage | Valid Percent | Cumulative percentage |
|-----------------------------------------------------------------|-----------|------------|---------------|-----------------------|
| Effective Anti-haze Pendant                                     | 75        | 16.1       | 16.1          | 16.1                  |
| Air-cleaner                                                     | 127       | 27.3       | 27.3          | 43.4                  |
| Anti-haze mask                                                  | 220       | 47.3       | 47.3          | 91.8                  |
| Anti-haze hula hoop                                             | 43        | 9.2        | 9.2           | 100.0                 |
| Total                                                           | 465       | 100.0      | 100.0         |                       |

3.2 Multi response variable analysis of user demand for haze prevention products

As can be seen from the table 3, for haze prevention products, the two aspects that people attach most importance to are haze prevention effect and wearing comfort, with 193 and 184 people selected, which are far higher than other options. The main demands for mask type haze prevention products are haze prevention effect and wearing comfort, and other demands include appearance, price and others, including sustainability and quality. Ranking by importance: haze prevention effect > wearing comfort > appearance > price > others.

Table 3. Multi response variable analysis of selection factors for anti-haze products.

| Aspects of haze prevention products that people pay attention to | Number of response cases | Percentage | Percentage of cases |
|----------------------------------------------------------------|--------------------------|------------|---------------------|
| Wear comfort                                                   | 184                      | 27.9%      | 39.6%               |
| Appearance                                                     | 115                      | 17.5%      | 24.7%               |
| Anti-haze effect                                               | 193                      | 29.3%      | 41.5%               |
| Price                                                          | 116                      | 17.6%      | 24.9%               |
| Sustainability, endurance, etc.                                | 51                       | 7.7%       | 11.0%               |
| Total                                                          | 659                      | 100.0%     | 141.7%              |

a. The value 1 is used to tabulate the two groups.

3.3 Analysis of cross contingency table of users’ requirements for haze prevention products

By cross analysis and chi square test, we can see that the value of P is less than 0.05, which indicates that gender is related to the intention to buy anti haze products. Compared with men,
women are more inclined to buy anti haze products. Women are a more sensitive and careful group, and they care about their own and their family's health.

Table 4. Chi-Square Test of Gender and Willingness to Buy.

| Chi-square test                | Value  | Free degree | Progressive significance (bilateral) |
|-------------------------------|--------|-------------|-------------------------------------|
| Pearson square                | 3.835a | 1           | .039                                |
| Continuity correction B       | 3.447  | 1           | .043                                |
| Likelihood ratio              | 3.826  | 1           | .037                                |
| Linear association            | 3.827  | 1           | .045                                |
| Number of valid cases         | 465    |             |                                     |

a. Expected count of 0 cells (0.0%) is less than 5. The minimum expected count is 63.37.

4 Function analysis of haze prevention products based on user requirements

According to the results of user demand, people tend to wear anti haze products for anti-haze products, while for the existing anti haze products on the market, the main pain points of users are inconvenient use, poor anti haze effect and unsightly shape, so these aspects should be considered in the functional analysis. As shown in Figure 1, for haze prevention products, the essential function is haze prevention, with good haze prevention effect, which mainly depends on the selection of filter element material. In addition, there are some auxiliary functions, such as comfortable wearing, aesthetic function, high cost performance, and sustainable environmental development.

Figure 1. Functional diagram of haze prevention products.

5 Conclusion

In this study, we collect data by issuing questionnaires to residents living in haze areas, and analyze the data frequency, including single variable frequency analysis, multi response variable analysis and cross contingency table analysis, to get residents' demand for haze prevention products, and then list the functional analysis for haze prevention products according to the user demand, and to get the conclusion that people have the same demand for haze prevention products. The basic functional requirements of wearing anti haze products are anti haze effect, other requirements...
include wearing comfort, appearance, price and others, others include sustainability, quality, etc. This research method is a common method to obtain the needs in industrial design, which can get more accurate user needs, but its limitation is that it needs a large number of survey samples. In the follow-up study, the haze prevention product can be designed according to the functional analysis diagram obtained at this time.

References

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