Effect of Perspective on Eye Movement of Aesthetic Preference Research on Wai Shape of New Chinese Style Arhat Bed

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Abstract

The new chinese style Arhat bed is taken as the research objective to explore the effect of people's view on people's aesthetic preferences for Wai shape of new chinese Arhat bed, using the eye movement analysis method through comprehensive analysis on eye movement data from volunteers. Eye movements characteristics of 20 volunteers in watching pictures of different new chinese Arhat bed Wai shape are recorded by SR research Eyelink head mounted eye tracker. Experimental results show that eye movement data of men and women are in the same trend, but there are few data in instability and the male and female have a significant correlation with the time and the number of fixation points, with a obvious regression effect, under two different presented Perspective of products. In all 16 samples selected, samples 12 has the most fixation and fixation times, while samples 15 and samples 13 has the least. Visual fatigue and the difference between 3D model and the real Arhat bed products have some effects on the experimental data. It makes no difference for people to choose products from different perspectives in where the products are placed, and people prefer the Wai shape which contains column and is simple.

Keywords: Perspective; new chinese style Arhatbed; Wai shape; aesthetic preference; eye movement

1. Introduction

Arhat bed, a bed with back and panel, but without the column roof rack is called as" Arhat couch" by Beijing craftsmen. It is a furniture for people to rest and hospitality furnishings in ancient China. The Couch is gradually evolved from the Han Dynasty, and the origin of the name is inconclusive, probably because the monks commonly lecture sitting on it. Its shape is same to the bed. Usually, the furniture with large size for above use is "bed", while the smaller is called "couch"; additionally, it is also said that the use in the bedroom for lying is named "bed", while the little one for passenger hospitality is called " couch"[1]. According to the mainstream opinion, Arhat bed is a very exquisite furniture mostly used in the department to entertain guest and is very exquisite furniture. It is a typical Chinese classical furniture, with a high aesthetic value. Products can be presented in a variety of Perspective, especially in online shopping. New Chinese style Arhat bed refers to Arhat bed can be massively manufactured in industry with application of modern technology, equipment, materials and process in line with the modern aesthetic and environmental requirements on living space, reflecting the spirit of the times, and with a strong Chinese traditional culture and national characteristics [2]. Wai shape of new chinese

style Arhat bed is the first part visually presented to the people and as a visual center, playing an important role in the popularity of the product [3].Meanwhile, the different angles of products placed offers different visual effect. Different Wai shape presentations represent different psychological feelings, including the reflection of hidden emotional needs of a user for new chinese style Arhat bed. This demand is often not reflected intuitively, while generally can be quantitatively analyzed by use of psychological measure eye movement research method[4,5].To dig deeper user's emotional demand for new Chinese style Arhat bed appearance, this experiment was carried out to study the impact of different perspectives selection of products to the public, which could help enterprise and designer for their business development and design improvement.

2. Methodology

2.1 Experiment methods

2.1.1 Experiment object

The subjects are randomly recruited college students and graduate students, with age of 20-30 years old, in good health, have vision or corrected visual acuity of not less than 1.0. Test capacity is of 20 people, including 10 male, 10 female, 10 of them are majored furniture design, and another 10 are not.

2.1.2Experiment device

Experiment use SR Research EyelinkIIhelmet desktop eye tracker, which comprises of a Host PC, a Display PC and to record the objects during the test, which comprising of a Host PC, a Display PC and a testing Headband Cable and necessary software, to record the objects during the test. The Display PC has a maximum resolution of 1024 x 768 pixels, and the eye tracker is employed for pupil sampling at frequency of 250Hz. Presentation of test material and data recording, interpretation, analysis are completed by dedicated software of DataViewer for eye tracker.

2.1.3 Test sample

The samples for the experiment are the new chinese style Arhat bed. 40 pictures for representative Arhat beds are collected for internet and furniture market. These pictures are then appropriately categorized and 16 types of Wai shapeare extracted and constructed into model sample pictures using software of 3Dmax (shown in table 1 as 1-16 in a perspective view and 01-016 in a front view). Each Wai shape has different visual experience. To minimize the subjective influence of the subjects on the subject, all shapes are not specifically described prior to the test, and there is no any presentation in any text form relating to the shape.

Table 1. The samples of new Chinese style Arhat bed.

Perspective view		Front view	
1	2	01	02
3	4	03	04
5	6	05	06
7	8	07	08
9	10	09	010
11	12	011	012
13	14	013	014
15	16	015	016

The experiment is a multivariate one, comprising two variables. one is the showing angle and another one is the Wai shape of beds. To ensure the accuracy of test, the impacts of color, texture, seat and leg shape variable on the test results are minimized as much as possible. By reference to the color and texture of most popular bed in market, all 3D model are given with same texture and rendered in the same rendering environment. All the pictures are processed by Photoshop software to unify other elements from the perspective and geometric modeling.

2.2 Experiment design and procedures

2.2.1 Experiment content

The experiment was an eye movement experiment consists two groups of perspective view and front view. Each group comprises 25 pictures of sample, which are presented orderly and allow a 8s of observation time.A rest time of 10minutes is specified for switch from a group to another one. The data will be saved immediately after collection, and then reviewed. If any missing or error, supplemental tests are conducted.

2.2.2 Eye movement experimentindexs

The purpose of the experiment is to check the influence of different perspectives on people's selection of product. The key points for the experiment are recording of quantitative data and interpretation of the connection between the data and defined purpose. In this paper, the eye movement indexes of AOI area of interest which can be recorded via eye tracker are defined as original data. The following two eye movements are selected:

Fixation duration: refers to the residence time of the subject's line of sight on a designated area, the longer the viewing time, the more difficult to obtain information or more attention on the sample is.

The number of fixations: refers to the number of the fixation point of the subject's line of sight in the designated area , the more the number of fixations, the more difficult to obtain information or more attention on the sample is [6,7].

2.3Experiment data handling

AOI areas of interest are divided into different areas based on the Wai shape , one AOI area for one shape. Before the analysis, the extreme data of a fixation duration greater than 1500ms or less than 50ms of the data are excluded[8].

3. Methodology

Eye movement data analysis

3.1 Perspective view of fixation duration

As shown in Figure 1, in all 16 samples of perspective view, sample 12 has the longest fixation time, followed by 11,10, 1/2,5/7,3/4,9,6,8,14,13/16,15. The sample15 has the least time. After regression analysis on the male and female groups, it is found that the linear regression equation is y=0.97x+0.02 and a quite high R^2=0.9524, indicating that 95.24% of all the data is in line with the equation, which suggests a very good simulation by the regression. For a given significance level α (0.05), the critical value of the correlation coefficient R is 0.950, however the R of the regression is 0.997, which is higher than the critical value of 0.950 (critical value), indicating that the correction of fixation time of male and female groups are significant.

3.2 Perspective view of the number of fixation point

As shown in Figure 2, in all 16 samples of perspective view, samples 12 has the largest number of fixation point, followed by 2,11,10 / 1,5,3 , 4,9,8,16,15 / 7,14 / 6,13. The sample 13 has the smallest number of fixation point. This order is slightly different from that of the fixation time. Similarly, after regression analysis on the male and female groups, it is found that the linear regression equation is y=0.9739 x + 0.0519 and a quite high R^2 = 0.9937, indicating that 99.37% of all the data is in line with the equation, which suggests a very good simulation by the regression. For a given significance level α (0.05), the critical value of the correlation coefficient R is 0.950, however the R of the regression is 0.993, which is higher than the critical value of 0.950 (critical value), indicating that the correction of fixation point of male and female groups

are significant.

Figure 1. Perspective average fixation time statistics/s

ordinal value	average fixation time	average fixation time of male	average fixation time of female
12	0.60	0.59	0.61
11	0.54	0.52	0.54
10	0.51	0.51	0.51
1	0.50	0.50	0.51
2	0.50	0.50	0.50
5	0.49	0.49	0.49
7	0.49	0.49	0.49
3	0.47	0.48	0.46
4	0.47	0.47	0.47
9	0.44	0.44	0.44
6	0.43	0.42	0.43
8	0.42	0.41	0.42
14	0.41	0.40	0.41
13	0.39	0.39	0.38
16	0.39	0.38	0.39
15	0.38	0.36	0.40

Figure 2. Perspective average number of fixation point statistics/per

ordinal value	average fixation time	average fixation time of male	average fixation time of female
12	0.60	0.59	0.61
11	0.54	0.52	0.54
10	0.51	0.51	0.51
1	0.50	0.50	0.51
2	0.50	0.50	0.50
5	0.49	0.49	0.49
7	0.49	0.49	0.49
3	0.47	0.48	0.46
4	0.47	0.47	0.47
9	0.44	0.44	0.44
6	0.43	0.42	0.43
8	0.42	0.41	0.42
14	0.41	0.40	0.41
13	0.39	0.39	0.38
16	0.39	0.38	0.39
15	0.38	0.36	0.40

3.3 Front view of fixation duration

As shown in Figure 3, in all 16 samples of front view, samples 012 has the longest time, followed by 011/05 / 04,01,03,02 / 010,09 , 06,08,016 / 07,014,013 / 015, and the sample 015 has the least viewing time. This order is basically agree with that of perspective view. Therefore, conclusion of that perspective have no effect on the people's choice of products can be preliminarily drawn. The results of regression analysis is y = 1.0746x-0.0255 with a very high R^2 = 0.9778, means 97.78% of the data in line with the equation, which suggests that the simulation by regression is very good. For a given significance level α (0.05), the R of 0.989 is greater than the critical value, indicating that the correction of fixation time of male and female groups are significant.

Figure 3. Front average fixation time statistics/s

ordinal value	average number of fixation point	average number of fixation point of male	average number of fixation point of female
012	2.72	2.71	2.72
03	2.09	2.08	2.10
01	2.06	2.05	2.06
011	2.05	2.04	2.05
02	1.96	1.97	1.95
05	1.96	1.96	1.96
04	1.93	1.93	1.92
06	1.88	1.86	1.90
07	1.82	1.82	1.82
016	1.82	1.81	1.82
09	1.77	1.77	1.77
010	1.69	1.68	1.70
08	1.64	1.63	1.65
015	1.58	1.58	1.58
014	1.56	1.55	1.57
013	1.55	1.53	1.54

3.4 Front view of the number of fixation point

As shown in Figure 4, in all 16 samples of front view, samples 012 has the largest number of fixation points, followed by 03,01,011,02 / 05,04,06, 07 / 016,09,010,08,015,014,013. The sample 013 possesses the smallest number of fixation point. Therefore, preliminary conclusion of that the Perspective have no effect on the people's choice of products can be drawn. After regression analysis, it is found that the linear regression equation is y = 0.9949x + 0.0183 with a quite high R^2 = 0.9976, indicating 99.76% of the data are consistent with equation, which suggests simulation by regression is very good. The R of 0.998 is greater than the critical value, indicating that the correction of fixation time of male and female groups are significant.

Figure 4. Front average number of fixation point statistics/per

ordinal value	average number of fixation point	average number of fixation point of male	average number of fixation point of female
012	2.72	2.71	2.72
03	2.09	2.08	2.10
01	2.06	2.05	2.06
011	2.05	2.04	2.05
02	1.96	1.97	1.95
05	1.96	1.96	1.96
04	1.93	1.93	1.92
06	1.88	1.86	1.90
07	1.82	1.82	1.82
016	1.82	1.81	1.82
09	1.77	1.77	1.77
010	1.69	1.68	1.70
08	1.64	1.63	1.65
015	1.58	1.58	1.58
014	1.56	1.55	1.57
013	1.55	1.53	1.54

3.5 Different view of fixation duration

As shown in Figure 5 , after regression analysis on different perspectives average fixation time groups, it is found that linear regression equation is y = 1.2513x-0.1409 with a R^2 = 0.7689, indicating that 76.89% of the data are consistent with equation, which means the simulation by regression is general for average fixation time. For a given significance level α (0.10), R = 0.877 is less than the critical value of 0.900, however it is very close to the threshold R, indicating that

the correlation is significant in some degree. Then the F test is conducted, and found that F = 46.581, which is higher than F0.9 (1,14) = 3.10, indicating that the overall effect of regression is significant with given significance, i.e. a significant linear relation exists between perspectives and average fixation time index. This further reflect that different perspectives have no significant impact on aesthetic preference People's choice of products.

Figure 5. Different perspectives average fixation time regression analysis
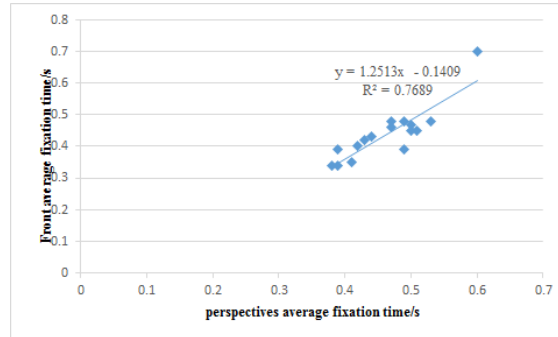
3.6 Different view of the number of fixation point

As Shown in Figure 6, the average number of fixation point of different perspectives are processed by regression analysis, and results are linear regression equation: y = 1.1589x-0.4538, R^2 = 0.6753, indicating that 67.53% of the data are consistent with equation, which suggests a general simulation by regression. R = 0.822 of the regression analysis is less than, however very close to the critical value of 0.900 for a given significance level α (0.10), indicating that the correlation is significant to some extent. Then the F test is conducted, and found that F = 29.116, which is higher than F0.9 (1,14) = 3.10, indicating that the overall effect of regression is significant with given significance, i.e. a significant linear relation exists between perspectives and average fixation time index. This further reflect that different perspectives have no significant impact on aesthetic preference People's Choice of products.
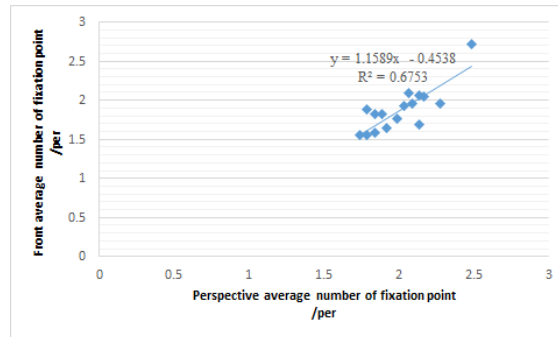
Figure 6. Different perspectives average number of fixation point regression analysis

4. Discussion

In summary, it is found that eye movement data from both groups for male and female share a same trend, but few unstable data also exist due to following reasons:

Visual fatigue: by the subject's behavior observation and communication with the subject, it is found that due to the relative massive pictures, careful observation on all samples usually completed after 3-5 group of picture . After review on 5-18 group of picture, it is found that behaviors of visual fatigue blinking, drifting, increasing number of saccade and etc. occurred during the 18-20 group picture After then, the sight mostly stay on the preferable pictures or even on just one picture, the fixation point is more concentrated. In addition, since the long duration of experiment and the male more attentive, the data from male is more stable then that from female which is slightly fluctuant.

Difference between 3D model and the real Arhat bed product: after communication with the subjects, it is found that the match degree between Wai and the seat surface and the legs and other incongruous mix is not so excellent which due to the difference between experimental sample by 3D model and real products, and also due to ability level of the authors, resulting in influence on the choice of subject in term of overall visual. For instances, incongruous samples of 14, 8,5 (or 014,08,05) are generally with low popularity in a subject.

To address the instability issue caused by visual fatigue and gender data, we recommend the following solutions:

1.Doing preliminary experiment or allowing the experimenter to watch the colorized paper documents of experiment picture before the implementation of experiment to enable the experimenter a initial impression of the observation of all the objects in the mind.

2.Increasing the viewing time and reducing the number of images, such as time increase from 8 seconds to 10 seconds, and reducing the number of Wai shapewas from 16 to 12 and number of experimental picture from 25 to 20. By increasing the attention of experimenter on their preferable Wai shape and reducing the overall experimental time as much as possible, the influence caused by visual fatigue and gender is appropriately minimized.

For the difference between 3D models and the real Arhat bed products which may lead to unstable data, we proposed following solutions: Designing the most typical shape of seat surface and leg by collecting data from the market or removing the Arhat bed seat surface and legs with the Wai shape remained as part of the experimental observation in the object.

5. Conclusion

Two sets of experimental data, the male and female eye movement data share a same trend, but few disordered data also exist. The causes of this may due to visual fatigue, materials difference between model and real products, and so on.

Different perspectives of products placed do not greatly affected on the People's choice of products aesthetic preferences, indicating that the different perspectives are not significantly correlated with fixation duration, fixation times, average fixation time. In two different perspective, eye movement data from both show the most popular wai shape of new chinese style

Arhat bed is samples 12 (or 012), while the most unpopular Wai shape is samples 13 and 15 (or 013,015).people concern and love the Wai shape which contains column and is simple such as sample 1,2,3,4,11,12 (or 01,02,03,04,011,012)and less like the Wai shapes which is complex and contains too traditional elements, such as 5,6,7, 8(or 05,06,07,08).

The study still has following drawbacks: 16 kinds of model chart are selected as representatives of all new Chinese style Arhat bed wai shape in market, however the representativeness is limited; there are nonneligible difference between sample and real product in size , as well as the different perspectives and observation environment from their actual use; only the perspective and front view were covered by the experiment, which may leads to experiment error. More study on this requires to be conducted.

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