Visualization Of Female Public Toilet Information Service Design And Research Based On Queuing And Waiting Psychology

Jihong Yu, Zijie Xu, Yi Feng

Product Design, Donghua University, Shanghai City, 200050, China
Corresponding author’s e-mail: 18201855821@163.com

Abstract. In areas of high traffic, it is not uncommon for female public toilets to use queues. Even though the use of female public toilets has improved in recent years, this common dilemma has not been completely solved and optimized. In the context of significant data and the Internet era, through the optimization of female public toilet information prompts that look for ways to alleviate the queuing of female public toilets. From the perspective of users and based on the waiting psychology of queuing, analyzing the psychological and behavioral responses in the queuing process of female toilets, subsequently introducing the theory of visual information and exploring the service design for improving the public toilets for women, optimizing the user experience and effective improving the queuing of female public toilets.

1. Foreword
In recent years, the implementation and proposals of public toilet improvement policies and proposals in various provinces and cities have shown that increasing the number of public toilets, optimizing space utilization, and rationally improving the proportion of public toilets for men and women, in order to achieve a virtuous cycle of efficient use and rational management. And increasing urban civilization is becoming more and more important[1]. Due to the physiological structure of women, the need for toilet is longer and the proportion of space is higher than men. Therefore, the amount of space used is quite limited. The same number of people can be used normally in male toilets, but female public toilets have long queues. Large public places, women’s bathroom queues even frequently occur that the phenomenon of women occupy male toilets[2].

2. Psychological needs of users waiting in line
As a populous country, China is waiting in line to become a common phenomenon in public places. According to US statistics, the waiting time can be ranked in the top three in the time behaviors consumed in a person's life. While in the queue waiting, people's behavior is relatively simple, but psychological activities are complex and changeable. People behavior often changes from psychology Departure, thus waiting in line for psychology has become an important research of people's attention[3]. Queuing theory was first used in probability theory, belonging to the branch of operations research[4]. However queuing waiting psychology is relatively novelty and mainly from psychology. Queuing psychology believes that customers generally have three states when they wait in line: the unfairness of the queue leads to psychological imbalance; the generation of anxiety; the boredom when waiting[5]. The professor of the Massachusetts Institute of Technology, Diclason, proposed that,
the main problem of queuing is not the length of time from a human perspective, but is the perception and a series of negative emotions of customers[6].

The queuing wait is due to the limited supply capacity of the service and the different of the service requirements of each person[7]. From the user's point of view, when the psychology begins to meet the demand, it begins to meet the characteristics of service design, thus waiting in line is the first item or even the key item of service. Service design focuses on the user's complete experience while waiting in line for a psychological and physical experience as a consumer to crucial impact on overall service evaluation. Waiting can not to be treated differently from other processes in the service, should be as a link in the overall service[8]. The queuing psychological and user behavior analysis will help to find the root of the problem and improve the service experience. In order to meet the needs of users, the optimization service design of waiting in line is being widely used in hospitals, banks, stations, and restaurants. Although the waiting service facilities of public toilets are still shallow, small toilets is people's livelihood. And public health issues are related to the improvement of the working and living environment of the masses and related to the improvement of the quality of the people and the progress of social civilization.

3. Investigation and Analysis of Public Bathroom Users from the Perspective of Women

3.1. Public toilet improvement status

In 2015, General Secretary Xi emphasized that the “toilet revolution” should be promoted to improve urban civilization[9]. In 2016, Beijing proposed the construction of public toilets, that renovate public toilets with a number of men and women and useful area of 1:1.5. Despite the design standards for public toilets in China show that the ratio of the number of public toilets and usable areas for men and women is 2:3, but the number of public toilets that are actually implemented is extremely small. It was again proposed to improve the construction of public toilets for men and women and effectively promote the "toilet revolution" in the 2018 two sessions[10]. At present, the major difficulties in improvement are mainly concentrated on the use area and the number of toilets. However, the one-way method of limiting enlarge the use of female toilets is not effective in alleviating supply and demand.

3.2. Reasons of female public toilet queue

There are two external reasons for the queue of women's public toilets: one is that the environment is located with a large flow of people, who the demand is large; the second is that the plan for the use of the bathroom area. The practical area of female bathroom is relatively small due to the different bathroom structure when the same area situation of men and women[11].

The internal cause of women's public toilets is mainly due to the different physiological structure of men and women. Women's toilet time is 2.3 times that of men, the frequency is 1.5 times that of men [12], and there is a makeup behavior when they finish toilet, causing congestion and the queue of the later use person. Then there has the urgency, anxiety and fear feeling in the queue, caused the team to stay.

3.3. Scenario analysis of female public toilet use

The behaviors and psychology of users in different types of public toilets are different. According to the "Urban Public Toilet Planning and Design Standards", there are three types of public toilets in China[13]. The following will be based on the behavior of female users by behavioral observation and investigation to analyze their own needs.

3.3.1. Freestanding public toilet: Generally, it is a small building that appears on the roadside and is widely distributed. It can be seen in the streets and in the park. The crowd around this type of public toilet is too fluid, that it is not concentrated around the surrounding area. The user of the bathroom is very purposeful, thus the location of the bathroom is also special important. If it is in the business
district or the flow of people is large in a centralized public area, the chances of women using queues will increase dramatically. Figure 1 is a scenario framework for the practical process of independent public toilets on the roadside. In an emergency, the user mainly searches for a bathroom by looking at the street sign indication and the mobile APP map. The way to ask the passerby is the most direct method, but it can pass the 50% probability of success of the independent public toilet on the roadside. And in the user's mind, that rarely use the way to ask people. If you can find it in normal use, it will go well. If you encounter queuing, you will choose to queue or continue to look for other nearby public toilets. There is less queue of female public toilets in this type of public area.

3.3.2. Built-in public toilet: It is attached to the public restrooms of other buildings and has separate exits that directly lead to the outdoors and management rooms. This type of female public toilets is frequently queued, large and crowded people will create highly concentrated public spaces especially in shopping malls, subway stations, airports, train stations, etc. It characteristic is what a few or even a dozen public restrooms in a building. Figure 2 is a scenario framework for the practical process of the attached public toilet. When the female user in the building or enters the building environment for finding a public toilet, it is mainly instinctively searching according to the signs in the building. If it is very urgent, they will ask staff to be faster and more accurate. The toilet is placed between the floors in the closed building. If users go to the female public toilet that situation is smooth in the floor, everything goes smoothly. If there is a large flow of people who need to queue up, most women will choose to queue up. Female users will choose to go to other floors to find a bathroom, and even use a male toilet when they are very urgent. If you are looking for a new floor bathroom, you will need to repeat all the processes.

As shown in Figure 3, the usage scenario contains the above two process phenomena, especially the commercial area (with freestanding public toilet and built-in public toilet).
Figure 3. Scenario framework for the use of public toilets in business districts.

3.3.3. **Movable public toilet**: Also known as a mobile toilet, it is widely used in vehicles. There is a public toilet between the carriage and the carriage, and it is shared by men and women. This type of bathroom is used very frequently, and the waiting problem involves both women and men.

3.4. **Research on the Psychology of Female Public Bathroom Users**

A questionnaire survey was conducted on the use of public toilets for women to wait in line for mental activities and needs. The questionnaire content is mainly investigation divided into the psychological activities and the demand of the users in finding the toilet and waiting in line. The questionnaire used an online sample survey of 50 women between the ages of 15 and 45, and a under the line sample survey of 50 women lined up in public toilets in different public areas. The questionnaire was recycled and data integrated, as shown in Figure 4.

Through the integrated data discovery and verification, the initial selection of the bathroom in the public place began, the user has begun to generate anxiety about the use of the bathroom, which mainly comes from the unknown state of the toilet and user traffic. In the stage that people has been queued, the data reflects that the users who care about the time required in the team to queue up only occupy the third place, while the first and second ones are unknown the surrounding toilets, which the unknown psychology produces hesitant feeling to stay or go away, it not like the hospital, supermarket, bank and other queuing services can know the situation of adjacent teams and windows. If the target object is unclear or even missing, the waiting person is missing waiting expectation[14], which causes anxiety and hesitation whose the purpose is that use the bathroom as soon as possible.
From the observation of the use process, it can be seen that before finding the public toilet, the user spends a long time in finding a way of the public toilet, which may increase the emergency situation of the user, and the mentality is more fidgety because of the subsequent queuing phenomenon. In particular, there are differences in the guidelines for public toilets in buildings. The role of signage information is extremely critical for users in unfamiliar environments. The amount of information in different buildings is also different. Take shopping malls as an example, the concealment of the bathroom is also troublesome for users looking for a bathroom even if the information is clear, because of the amount of information is too large in different shops.

In the queue, female users are not willing to line up in an emergency situation, but they are at a loss. If they go to find a new bathroom, they will look again, and they will not know the team time and the new toilet situation. Therefore it is rejected from the user's point of view.

4. Constructing User-oriented on Visualization Design Strategy Research of Female Public Toilet Information

In the process of finding public toilets, the location information of the nearby public toilets is the first choice for female users. From the perspective of user demand, it is most directly related to the anxiety of female users; In the process of queuing, the location, use status and the team time-consuming information of adjacent public toilets that meet the interactive nature of information visualization to make what female users can grasp the status of public toilets in real time and improve the efficiency of toilet use. The service that gets the demand in the shortest time is everyone's expectation and appeal, which is also the ultimate goal of increasing efficiency and reducing waiting. Waiting in line, as an important part of the service, is a necessary condition for improving service quality and user experience to achieve transparency, efficiency and interaction of information. Improving the information visualization system of female users from expectation to demand is an important strategy to enhance services, as shown in Figure 5.

Figure 5. Service strategy system for information visualization design.

There are three main principles in the process of information visualization design: one is informatization, which allows users to intuitively understand the information content; the second is identifiability, which easy and detailed and fast identification of information to enhance life efficiency; third is interactive, which let users grasp the information in real time and take appropriate action[15]. From the female users encounter the queuing situations, selecting public toilets, there is a lack of understanding of the demand target information. The design strategy of public toilet information visualization service based on female user's point of view can be constructed from the following aspects.
4.1. Transparent location information of public toilets in public areas
Information services for public toilets can be quickly obtained when female users have a need. Nowadays, the information channel has been fully evolved into the Internet, such as APPs of maps can also search for nearby public toilets. At present, the original icon information is too scattered in street shopping malls, which a comprehensive public toilet information system needs to be constructed for use to improve the quality of information acquisition and reduce the time for self-search and hesitation.

4.2. Efficient use of traffic information
The queuing phenomenon is inevitable, and the retention of a single team can be adjusted through efficient transmitting information. The queuing phenomenon of public toilets is different from other multi-teams. There are always toilets with “peak” and “low peak” usage in a certain area. The visual information service needs to efficiently transmit the location information and specific usage information of the adjacent toilets to the users, eliminating the queue waiting’s fear, anxiety, and hesitation for unknown expectations, deploying spread people, improving efficiency, and avoiding single detention.

4.3. Interactive user behavior adjustment
The user does not make substantial feedback on the use of the bathroom, but it will react differently due to the unpredictability of the behavior. The visual service system of public toilet information generates real-time data according to the flow of people, and allows users to obtain information transparently and efficiently to take the initiative of selection, thereby interactively improving the efficiency of women's toilets and improving the use experience.

5. Conclusion
The issue of queues for women's public toilets has always been regarded as a matter of supply and demand to discussing and improving. It is undeniable that the necessity of adjusting the space ratio of men and women in public toilets. Starting from the psychological waiting needs of users, it is novel and effective to start study with the information visualization design as the service solution of this problem. Visual design for the improvement of public toilets, through the supervision of the Internet of Things big data to achieve the visualization of a single use bathroom. And the location of the surrounding public toilets and the use of the situation to form a system to show with efficient and simple information, which it satisfies the user's fears, worries and hesitations in a certain extent, and allows users to make autonomous choices through simple information to ease the waiting congestion problem of single channels and flow of people to achieve fast, limited and scattered effect.

References
[1] Yu, J. D. (2018) Suggestions on Improving the Present Situation of Public Toilets in Our City. In: Zigong City Planning Administration.
[2] Yan, Q.Y., Yang, J. (2014) Talking About the Improvement of Female Public Toilet. Journal of Green Science and Technology., 8: 281-281.
[3] Yin, J.M., Yao, J., Cao, M.M. (2014) Analysis of Services Design in Queuing and Waiting Psychology. Packaging Engineering., 35: 37-41.
[4] Wang, X.G., Jiao, Z.C. (2008) Research on Bank Queuing Problem Based on Queuing Theory. Journal of Xiangtan Normal University(Social Science Edition), 30(1): 58-60.
[5] Seth Stevenso.(2012) What You Hate Most About Waiting in Line. https://slate.com/business/2012/06/queueing-theory-what-people-hate-most-about-waiting-in-line.html.
[6] Zhao, X.Y., Cao, Z.P. (2009) Review and Prospect of Research on Customer Perception in Service Waiting. Journal of Northeastern University (Social Science Edition), 11: 508-514.
[7] Yu, Y. (2006) Psychological Analysis of Queuing Service Management. Journal of Zhengzhou College Animal Husbandry Engineering., 26: 51-53.
[8] Deng, J.H. (2015) The Application Research of Waiting in the Public Service and Facilities Design——Taking the Waiting Facilities of Public Bus as Example. Beijing Institute of Technology., 16-17.

[9] Yang, L.N., Cheng, H.Y. (2017) People's Daily Commentator: Grab the "toilet revolution". People's Daily., 11(1).

[10] SI Ma-tong. (2018) Two Sessions· Reforming A New Journey - Improving The Proportion of Male and Female Toilets, Effectively Promoting The "Toilet Revolution". http://www.sohu.com/a/225534660_162758.

[11] Sun, X., You, H.Y., Huang, Z.X., Wang, H.Y. (2017) Study On The Proportion of Public Bathroom Toilets in Staff-intensive Areas and Countermeasures. Anhui Architecture., (11): 52-54.

[12] Zhang, Q., Song, H.S. (2018) Analysis on the Queue of Female Toilets in the Status Quo of Urban Public Measurement. Shanxi Architecture., 44: 22-23.

[13] Urban Public Toilet Planning and Design Standards. (2016) Ministry of Housing and Urban-Rural Development of the People's Republic of China.,: 4-6.

[14] Sun, Y.B., Song, Z., Zhu, C.C., Ji, M.Y. (2017) Information Visualization Design of Vehicle Management Services Platform. Packaging Engineering., 20: 13-18.

[15] Zhang, G.C., Sun, C.C. (2016) Visual Design of Urban Public Space Information Under the Era of Big Data. China Building Materials Technology., 1: 34-36.