

Research on Design of Wuhan Community Garbage Classification Service Based on Persuasion Theory

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Abstract:

Garbage source classification is the basis of 3R, which is not only conducive to comprehensive treatment of garbage, but also can turn “useless waste” into treasure. At present, the effectiveness of domestic waste classification in China is limited. One of the difficulties is how to guide residents to actively participate in garbage source classification. This paper systematically explains the relevant definitions, implementation carriers and applicable fields of persuasion theory, takes the behavior analysis grid and behavior model in persuasion theory as the basis of persuasion behavior, and analyzes relevant persuasion cases. On this basis, the author takes typical communities in Wuhan as an example to carry out a survey on the factors of residents' classified persuasion behavior, analyze the persuasion factors, and summarize the mechanism of residents' classified behavior persuasion from the source. Finally, under the guidance of persuasive design theory, this paper explores the practice of persuasive design for the current situation of Wuhan community residents' garbage classification behavior.

Keywords:

Persuasive Design, Garbage Classification, Community Service

1. Introduction

With the development of urbanization in China, domestic waste has become an important problem to be solved. In December 2016, the national development and Reform Commission issued the requirements of the 13th five year plan for the construction of harmless treatment facilities for urban domestic waste, which pointed out that more than 90% of the domestic waste in administrative villages in China should be effectively treated by 2020. Then, the municipal green city appearance Bureau issued the “implementation plan of compulsory classification of municipal solid waste”, which implemented the compulsory classification system of garbage in Shanghai. Subsequently, major cities followed suit, and China entered the era of compulsory waste classification.

The government of our country has long been concerned about the problem of waste classification. Since 2000, the national garbage classification system has been promoted, but the effect is not so good. The garbage classification system has been unable to be implemented in a large scale, and the citizens are familiar with and unfamiliar with “garbage classification”. The reasons can be summed up as personal factors, classification system problems, and imperfect supporting facilities. As early as the end of the 1990s, Wuhan municipal government began to try source classification, and has experienced four changes (Table 1). From the failure experience of classified facilities to terminal treatment and then to community classification, this paper explores a solution of socialized service that is responsible by the street, undertaken by the entrusted property, and purchased by the government. It shows that the community property classification service has a certain effect on the guiding measures of residents’ classification behavior. The purpose of this paper is to design a persuasive community garbage classification service design through the persuasive analysis of community property classification service, so as to contribute to the realization of garbage classification.

Table 1. Classification policies and implementation in Wuhan.

Time	Measures	How to implement it	Result
In 1996	Waste source classification through classification facilities	More than 100000 sorting bins have been put into operation so far	The recovery rate is less than 10%
In 2005	Through the end of the waste classification treatment	Private investors are introduced into erfishan waste dump to separate and recycle the waste, while waste collectors are ignored	It’s hard for the management to foresee the return on value, which only runs for one day
In 2006	Classified collection of community garbage	Community managers, volunteers and staff of environmental protection companies should educate and publicize the knowledge of classification for residents	It has achieved certain results, but it cannot guarantee the enthusiasm and accuracy of residents’ classification and recycling
In 2013	Street responsible, entrusted property to undertake, government purchase of social services	The implementation of intelligent system for garbage classification in property has achieved remarkable results	Residents’ participation increased by 30%

2. Persuasion Theory and Persuasion Design

2.1. Persuasion Theory

The 21st century belongs to the Internet, and Internet technology has derived new media and means of communication. Persuasion theory is a systematic theory for the research of persuasion technology products based on interactive computer system. Persuasive technology is its core. Professor Fogg, the founder of persuasion theory, defines it as interactive computing products used to change people's attitude and behavior. Chinese scholars define it as persuasive computer technology (computer persuasion), which is a branch of human-computer interaction (HCI). It focuses on the change of human behavior and attitude during human-computer interaction. At

present, persuasion technology is widely used in e-commerce, social networking and online games in China (Table 2)

Table 2. Research fields of persuasion theory.

Field	Example	Purpose of persuasion
business	Recommendation system on Taobao website, such as “guess what you like”	Persuading users to buy more products
Education, learning	CodeWarrior.comzhu	Focus on how to learn coding behavior
environment protection	Mobike	Persuading users to choose healthy travel mode
extension	Wechat grabs red packets	Make more users become users of wechat payment
Fitness	Nik Runing APP	Developing running
social connections	Renren.com	Encourage communication between students
Personal management and development	MyGoals.com	Set goals and achieve them step by step
security	Drunk driving simulation	Avoid drunk driving
medical care	Blood pressure management app	Guide users to a healthier lifestyle

Persuasion theory has two cores: one is Behavior Wizard, also known as Behavior Table; the other is Behavior Model. Professor Fogg pointed out that there is a difference between behavior and behavior. We can find the persuasive methods and Strategies of corresponding behavior types through the behavior analysis grid. Different behaviors are different according to the duration, familiarity and intensity of behaviors (Figure 1).

	Green behavior Do <u>new</u> behavior, one that is <u>unfamiliar</u>	Blue behavior Do <u>familiar</u> behavior	Purple behavior <u>Increase</u> behavior intensity or duration	Gray behavior <u>Decrease</u> behavior intensity or duration	Black behavior <u>Stop</u> doing a behavior
Dot behavior is done <u>one-time</u>	GreenDot Do new behavior one time <i>Install solar panels on house</i>	BlueDot Do familiar behavior one time <i>Tell a friend about eco-friendly soap</i>	PurpleDot Increase behavior one time <i>Plant more trees and local plants</i>	GrayDot Decrease behavior one time <i>Buy fewer boxes of bottled water</i>	BlackDot Stop doing a behavior one time <i>Turn off space heater for tonight</i>
Span behavior has <u>duration</u> , such as 40 days	GreenSpan Do new behavior for a period of time <i>Carpool to work for three weeks</i>	BlueSpan Do familiar behavior for a period of time <i>Bike to work for two months</i>	PurpleSpan Increase behavior for a period of time <i>Take public bus for one month</i>	GraySpan Decrease behavior for a period of time <i>Take shorter showers this week</i>	BlackSpan Stop a behavior for a period of time <i>Don't water lawn during summer</i>
Path behavior is done from now on, a <u>permanent change</u>	GreenPath Do new behavior from now on <i>Start growing own vegetables</i>	BluePath Do familiar behavior from now on <i>Turn off lights when leaving room</i>	PurplePath Increase behavior from now on <i>Purchase more local produce</i>	GrayPath Decrease behavior from now on <i>Eat less meat from now on</i>	BlackPath Stop a behavior from now on <i>Never litter again</i>

Figure 1. Behavior analysis grid.

Each behavior can find its corresponding type and solution between horizontal and vertical interlacing. Generally speaking, point behavior only needs one persuasion trigger, while segmental behavior and path behavior need long-term persuasion. It is worth pointing out that the green behavior and the black behavior have relativity. Taking the source classification behavior as an example, if the purpose of persuasion is to make the residents not to mix collection, it belongs to the black path behavior; if the purpose of persuasion is to make the residents form the classified collection (start

a new behavior), it belongs to the green path behavior. The behavior model points out that people's behavior is generated only when the three elements of motivation, ability and triggers are satisfied at the same time, which is expressed by an equation, that is, $B = MAT$ [5]. The behavior model is qualitative and can be used to analyze the persuasive power of products and guide the design of persuasion. The model points out that the generation of behavior requires the user to have enough motivation, the ability to implement the behavior and trigger the user behavior. As shown in Figure 2, the vertical axis indicates the motivation of users to implement behaviors; the horizontal axis indicates the ability of users to implement behaviors; the curve represents the critical line of behavior actions, the trigger success area is above the action line, and the trigger failure area is below the action line.

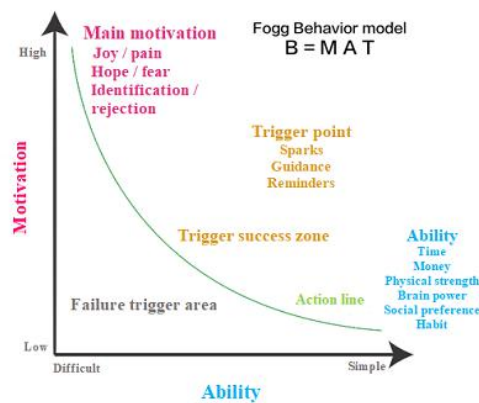


Figure 2. Behavior model.

2.2. Persuasion Design Based on Persuasion Theory

Persuasive Design / Persuasion Design, also known as persuasive design, is a design with persuasive intention, which is the practice and application of persuasive theory and persuasion technology. Traditional design tends to start directly from the product level, while persuasive design is designed from the desired results of the product. Persuasive design is to influence the user's behavior through the intervention measures designed into the product. The intervention measures are divided into information type and structural type. This paper focuses on the information-based intervention measures.

At the beginning of persuasive design, a clear design goal must be set according to the product vision, that is, what kind of behavior or attitude changes the implementer is expected to have. When defining design objectives, we should not set them blindly, but should be specific and implementable. Professor Fogg pointed out that fuzzy goals are difficult to sustain. When the product vision is difficult to be realized immediately, we can start with small goals and gradually progress until the final design goals are achieved. Having a clear design goal doesn't mean omnipotence. On the contrary, it's just a reference point. When problems arise, the actual situation of measurement target results can examine whether the persuasive design is effective or not; or, if the design goal is not correct, the design goal can be redefined in time. The criteria for examining goals are based on the reasons why the target behavior can't be completed and judged according to the behavior model: the result of the survey is "the behavior will not produce", which needs to be redefined back to the starting point; the result is "the behavior will not produce", which needs to be supplemented or redefined back to the starting point; the result is "the behavior may not produce" and "the behavior may

not produce”. It is necessary to guide the generation of behavior through the design of corresponding influencing factors; the result of examination is “behavior generation”, and the purpose does not need to be designed.

The design goal is to expect the system to accomplish what kind of things, in order to complete this thing, we need to consider the conditions of user behavior in the actual situation. However, the behavior model can well explain the conditions of behavior occurrence and the relationship among the conditions, as shown in Figure 3: motivation and ability are the preconditions of conscious behavior, which must be possessed at the same time and can compensate each other, and the trigger condition must be to activate the user's behavior with the assistance of motivation and ability conditions. For example, when the user’s demand for a product (motivation) is not urgent, enough preferential treatment may cause behavior; when the user has the purchasing power, improving the user’s demand for the product can promote the behavior; when the user has both the demand for a product and the purchasing power, he only needs to provide the purchase information to generate the purchase behavior.

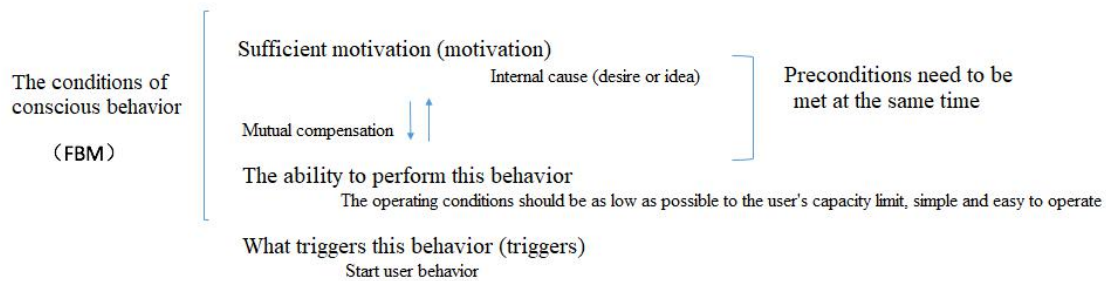


Figure 3. *The conditions of conscious behavior.*

To sum up, three tasks must be completed through persuasive information technology to achieve the design goal, even if the user has enough behavioral motivation (motivation factor), simplify the target behavior (ability factor), and set up effective trigger (trigger factor) for the target behavior, and in the process of design, the thinking order of persuasive factors should be followed, and the design of motivation factors should be given priority.

The selection of persuasion carrier has a certain influence on the effect of persuasion design based on information. Usually, the carrier can be personal computer, computer electronic equipment (based on man-made or environment-based system) and mobile intelligent equipment. There are three different roles in the interaction between information products of different carriers and users, namely, tool, media and social role. As shown in Table 3, this paper mainly studies the persuasion design of mobile intelligent devices.

Table 3. *Analysis of persuasion carrier.*

	personal computer	Electronic equipment	Mobile smart devices
advantage	Large scalability and user base	Portable, mobile and persuasive in different situations	Large user base, mobile and portable
disadvantage	Limit place and time	High cost	Fast update

3. Research Methods

The source classification of domestic waste belongs to environmental behavior. Environmental behavior can be divided into individual behavior and collective behavior. The first step of the whole management process is to take the source

individual or family as the first link of the whole management process. The behavior of each family (individual) to classify and collect the garbage generated by it according to the specified categories and put the classified garbage into the designated place belongs to the individual behavior. But in fact, this kind of individual behavior is affected by the environment, so this paper puts forward the research mode of family community combination.

3.1. Research Plan

The author selected typical “community families” from the pilot community and non-pilot community. Through the behavior observation and recording method, the real garbage disposal behavior of residents was observed through video equipment (camera and mobile phone). The advantage of this research method is that it can extract behavior data that can be used for design research from user perspective and actual situation. There are two reasons for using the equipment to observe the records. First, to prevent the respondents from being influenced by researchers and lead to behavior deviation; second, we can get more details about garbage disposal. If there are problems in the research process, we can repeatedly study the recorded images.

3.2. Basic Information of Research Objects

3.2.1. Non Pilot Communities

The non-pilot community is located in Tianxing Garden community, Jiangnan District, Hankou. The community property service mainly involves the environmental sanitation and greening management service in the public area of the community area, and the specific service items are the sanitation and cleaning of the public places in the building, and the garbage removal and transportation, etc. there is no service related to the classification, and the community property presents a mixed state of garbage management in the region.

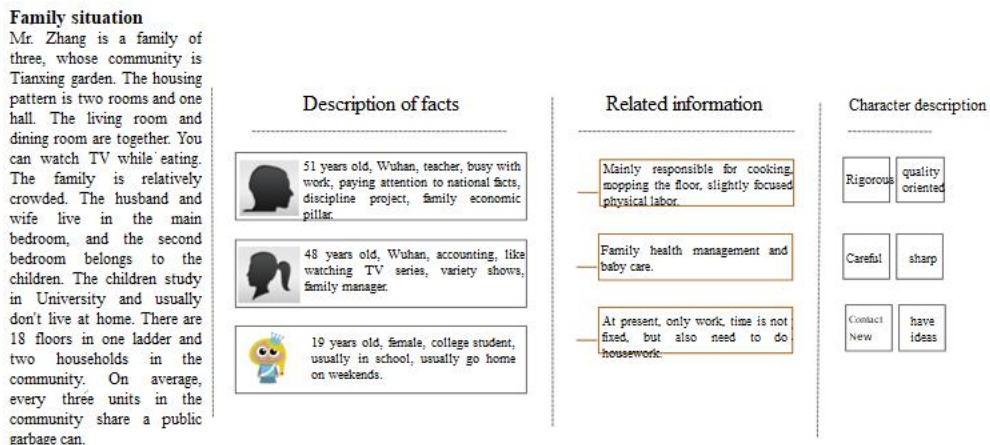


Figure 4. Portrait of family members in non-pilot community.

Ms. Li is responsible for the cleaning management of non-pilot families. Ms. Li usually collects the garbage from her home and puts it into the public dustbin between the buildings in the community (Figure 4). The non-pilot community and its household waste treatment forms are in a mixed state, which is the same as that of most communities and families in Wuhan City, which basically reflects the garbage treatment status of most communities and families in Wuhan city.

3.2.2. Pilot Community

The pilot community is located in Wanke golf community in Dongxihu District, Hankou. Since Wuhan implemented the pilot project in Dongxihu District, the community has become the first batch of pilot communities.

In 2014, Vanke golf community officially launched classified services. At the initial stage of the pilot project, volunteer, intelligent garbage sorting system and classified publicity sea were carried out. The property staff compiles the information of residents and makes them into unique QR code and integral card, which are distributed to the community residents. The residents only need to collect the recyclable garbage and paste the QR code into the community recyclable garbage can. The property cleaning personnel clean the garbage in the dustbin at regular intervals every day. The main work is to scan the two-dimensional code on the garbage bag. The intelligent system will carry out clearing and give the residents corresponding points. Residents can exchange items at the community service station by using the scorecard. For the inconvenient people, they can call or make an appointment with the community staff to collect or deliver the exchange products. The kitchen waste collected in the community will generate organic fertilizer through the kitchen waste treatment equipment of the property, part of which will be used for community garden cultivation, and part will be given to the community owners for family flower cultivation. The collected recyclable garbage is sent to the corresponding recycling agency for resource recycling; the hazardous waste is collected and sent to the qualified enterprise for harmless treatment.

Ms. ye and her mother are responsible for the cleaning management of the pilot families. Ms. ye and her mother usually separate and collect the garbage generated at home and put them into the public dustbin between the buildings in the community (Figure 5). The experimental community and its domestic waste treatment forms are in the classification state, which can reflect the overall classification and treatment status of the pilot community.

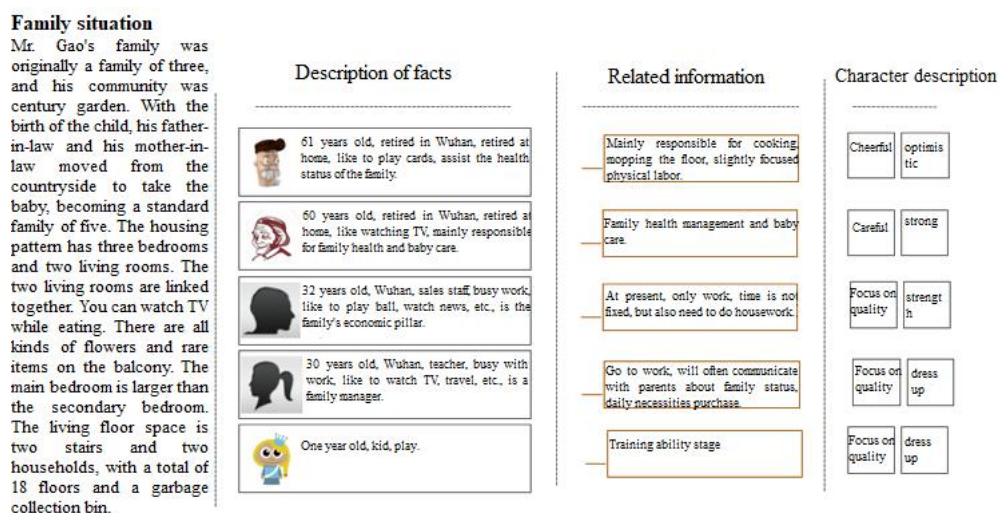


Figure 5. Portrait of family members in pilot community.

3.3. Research Results

3.3.1. Garbage Disposal Personnel

The executors of household waste management and treatment in both pilot and non-pilot communities were women.

3.3.2. Family Scene Classification Facilities

Classification facilities are the carrier of garbage and the material basis for the realization of garbage classification and collection, which is of great significance to the study of source classification behavior. Through observation, it is found that the equipment for household garbage storage in both pilot and non-pilot communities are ordinary garbage cans, and there are no classified garbage cans, and they are used to putting garbage bags on the garbage cans. The main source of garbage bags is the garbage bags purchased in the market, or shopping (shopping, supermarkets, express delivery, etc.) packaging bags, whose material composition is complex, and mainly difficult to decompose materials. The position of garbage can is roughly the same, that is, the kitchen, living room, toilet each have a garbage can.

3.3.3. Community Scene Classification Facilities

The pilot community property will be equipped with 2-4 garbage collection bins according to the situation of each building's residents and the total amount of garbage, and the cards with classification marks will be pasted on the surface of the garbage collection bins to achieve the sorting effect. The non-pilot community property is equipped with two public dustbins between each two units, and there is no classification identification.

3.3.4. Garbage Disposal Behavior in Different Scenes of the Family

In the family kitchen scene of non-pilot community, Ms. Li cooks most of the scenes. Usually, Ms. Li throws the garbage directly into the dustbin, and after dinner, she packs the garbage bags filled with garbage at the door of her home. The garbage in the garbage bag is mainly fruits and vegetables, leftovers, seasoning bottles and cans. In the family kitchen scene of the pilot community, Ms. Ye's parents cook most of the scenes. Usually, Ms. Ye's parents only throw the garbage such as fruits and vegetables, leftovers and leftovers directly into the garbage can, and the non-recyclable garbage is thrown into the garbage bin in the living room, and the recyclable garbage is collected separately.

In the scene of family living room in the pilot community, the garbage cans beside the tea table in the living room are mainly placed in the non-recyclable garbage in daily life, and the recyclable garbage is separately placed under the balcony flower rack outside the living room. The summary is to complete the garbage classification through different regional functions.

3.3.5. Garbage Disposal Path

Due to the different treatment methods of household members in pilot community and non-pilot community, the treatment path is also different. The garbage treatment method of family members in non-pilot community is to throw the garbage in the nearest garbage can, which is called the principle of proximity. The behavior path of "proximity principle" is shown in Figure 6, which is relatively simple. The garbage treatment method of family members in pilot community is to throw the garbage into the garbage bin with the same property, which is called functional principle. The

behavior path of “functional principle” is shown in Figure 7, which is relatively complex.

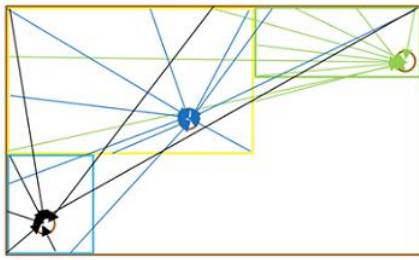


Figure 6. Path of principle of proximity.

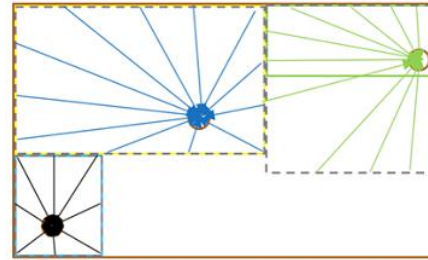


Figure 7. Path of principle of function

3.4. Analysis and Summary

The non-pilot community is in the state of mixed collection and mixed investment; the pilot community is in the state of classified collection and classified investment. According to the data of the pilot community property supply, the participation of residents in classified investment is 30% higher than before, and the correct rate of investment is 20% higher, and the source classification work has achieved initial results. Through the investigation of families in pilot and non-pilot communities, the author summarizes the following points:

3.4.1. Community Service Has a Persuasive Effect on Residents' Classified Behavior

From the above analysis data, the biggest difference between the pilot community and the non-pilot community is whether the property provides guidance and classification related services, in other words, property services can affect the behavior and attitude of residents. The pilot community classification service guides residents to form classification behavior, and its influence is shown in the following aspects:

- a. pilot community “neighborhood Convention” conference leads residents to pay attention to classified services by arousing residents' curiosity;
- b. pilot community through the points exchange, free lottery, double points and other incentives to affect the enthusiasm of residents to participate in the classification behavior;
- c. the pilot community distributed the Classification Manual to the residents, and put up the classified posters in the obvious position of the community for classified publicity, and used visual information and text information to influence the residents' garbage disposal behavior;
- d. pilot communities organize activities related to classification, which affect residents' understanding of classified collection through residents' experience in the process of participating in activities;
- e. pilot community can effectively simplify the classification behavior and reduce the threshold of classification behavior by means of guiding volunteers by classification and booking door-to-door recycling

To sum up, the effect of community classification service is reflected in two aspects: making residents willing to implement classification behavior and simplifying

classification behavior, and has a persuasive effect on residents to form classification behavior.

3.4.2. The Intervention Stage of Residents' Classified Behavior

According to the behavior model, the author further explores the persuasive analysis of the pilot community property service in guiding the community residents to change the old mixed collection, the formation of classified collection of investment behavior, and the service delivery behavior (Table 4). Through the above analysis, it is concluded that the intervention stage of property service persuasion is before, during and after the behavior (continuous behavior).

Table 4. Persuasive analysis of property services in pilot communities.

Persuasion dimension	Forms of persuasion	Purpose of persuasion	persuasion	Persuasive intervention stage
motivation	“Neighborhood Convention” press conference	Arousing interest	expect	Before behavior
ability	Waste classification Brochure	Cultivate classification consciousness and knowledge	Lowering the threshold of classification behavior	Before, during and after behavior
	Guidance manual for waste classification	Classification knowledge and guidance classification	Lowering the threshold of classification behavior	Before and during behavior
	Category guidance volunteers	Guide classification	Guide, reduce the threshold of classification behavior	Before and during behavior
	Make an appointment to collect	Optimize service	Simplify behavior and reduce the threshold of classification behavior	During and after behavior
trigger	Points exchange	Enthusiasm, fun	Spark type	Before and after behavior
	Publicity poster of waste classification	Cultivate classification consciousness and remind classification	signal	Before, during and after behavior
	Community classification activities	Enthusiasm, fun	Spark type	Before, during and after behavior
	Vanke property exclusive app	Community concern		Before, during and after behavior

3.4.3. Limitations of Pilot Community Service

The pilot community persuasive service has achieved certain results, but it also shows its limitations. The specific performance is as follows:

- a. the time of persuasion is limited, and continuous persuasion cannot be formed;

b. the scale of persuasion is limited and cannot form a larger scale due to the influence of human and material resources;

c. is to be able to obtain classified information of residents, and cannot form personalized classification service;

d. the place of persuasion is limited and can only be conducted in the public environment of the community, which fails to penetrate into the residents' homes;

e. persuasion forms are limited, and its effect on Residents' classification motivation and ability is limited;

To sum up, we should deepen the exploration of community classified persuasive services to form more effective, more personalized, and more sustainable and larger-scale persuasion.

4. Persuasive Design of Community Garbage Classification Service

4.1. Concept

The goal of persuasive community garbage classification service design is to change the residents' mixed collection behavior and form classification behavior. Through the mobile terminal design of community service platform, it can stimulate residents' willingness to classify and reduce the threshold of classification behavior, so as to improve the enthusiasm of residents to participate in source classification work. The inspiration of product logo comes from the understanding of source classification and persuasion design: the goal intention of source classification design is to persuade green path behavior. One trigger cannot achieve the intention of green path behavior, but need repeated persuasion to achieve the design intention; the realization of source classification behavior needs the joint efforts of community property and community owners; source classification design is human and environment, the solution of environmental relationship is to maintain the relationship between them and realize sustainable development.

4.2. User Research

The ideal target object of source classification persuasion design is the whole community residents. Based on the ethical consideration of persuasion, the user object is targeted at individuals aged 20-68 years old with independent behavior ability. The author understands that the channels for Japanese residents to master the source classification knowledge come from the propaganda of the government and the community and from the family's teaching by example. Generally, parents will teach their children how to separate and collect garbage. Children can learn how to carry out sorting behavior by observing their parents' garbage sorting methods. Similarly, if the source classification persuasion design can effectively persuade the target population to carry out classification behavior, then the target population classification behavior can have an impact on residents under 20 years old, and achieve the ideal goal of product impact on the whole community residents.

4.3. Garbage Exchange Device

The design of garbage exchange device is based on the research process. The author found that the collection of express paper box exceeding the capacity of garbage bin will occupy the family space, the recyclable garbage collection status such as

beverage bottles will be scattered and occupy the family space, the limited working hours of points exchange, more manpower and material resources are needed for excessive scattered appointment collection, and the quality of garbage bags is uneven. The garbage exchange device can exchange integral for scattered recyclable paper boxes, beverage bottles, newspapers and so on, which need to occupy the family space. It can also exchange the points for degradable garbage bags, and test the usability in the actual scene through the garbage exchange device simulation test.

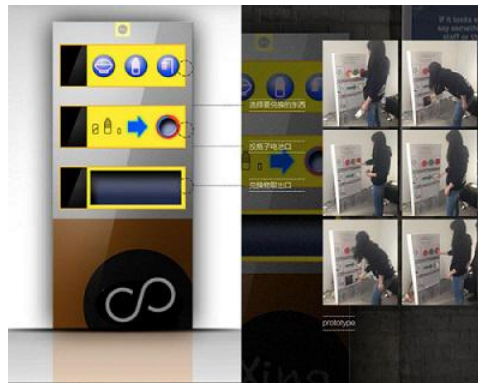


Figure 9. Garbage exchange device.

4.4. Persuasion Mechanism

Based on the source classification of persuasive strategies, the function of persuasive mechanism is sorted out (Figure 10).



Figure 10. Function with persuasive mechanism,

5. Conclusions

This paper focuses on how to effectively guide the community residents to separate and collect garbage at home and put it into the designated dustbin in the community as the core. Its innovation lies in jumping out of the field of design, trying to solve the problem of guiding classification by improving the design of garbage sorting facilities (garbage cans), but taking Professor Fogg's persuasive theory of behavior change as the guidance, exploring the behavior persuasion way to solve the problem. The author believes that garbage classification is not an overnight, paper-based enterprise, which requires researchers to settle down and take advantage of the wave of Internet technology.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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