

Research on the Design of Security Products for Women Living Alone Based on Embodied Emotions

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Abstract. This study aims to explore design methods that enhance the experience of security products for women living alone through the research of embodied emotion theory. Methods: First, the characteristics and behavioral patterns of women living alone are analyzed. Next, the current development of security products for women living alone is reviewed, along with an analysis of the significance of embodied emotion in the design of these products. Lastly, an online survey is used to conduct new product satisfaction tests to verify product feasibility. Results: A design strategy for security products for women living alone based on embodied emotion is proposed, and a specific security product for women living alone is designed. Conclusion: Applying embodied emotion in the design of security products for women living alone enhances their psychological closeness to these products. For the security products, this approach results in a more comprehensive demonstration of their functionality and value.

Keywords. Theory of embodied emotions, women living alone, security product design, design methodology

1. Introduction

The 'New Solo Living Era Report' released by the Shell Research Institute mentions that, according to preliminary predictions based on data from the National Bureau of Statistics, by 2030, the number of people living alone in China may exceed 150 million, with the rate of single occupancy exceeding 30%. Due to physiological differences between women and men, women, especially those living alone, are more vulnerable to unlawful harm when encountering criminals[1]. With the continuous advancement of security technology, more and more security products aimed at women living alone have emerged in the market, such as door blockers, surveillance cameras, smart doorbells, and portable alarms. However, most of these products focus primarily on functionality and lack in-depth research into the lifestyles of women living alone, resulting in reluctance among users to actively purchase and use them. This paper introduces the theory of embodied emotion into the design process of security products for women living alone. By adopting a user-centered approach to research and design, it aims to create a safer living environment and experience for women living alone.

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2. Overview of Embodied Emotion Theory



2.1. Definition of the Concept of Embodied Emotion

The Embodied Emotion Theory, originating from the second generation of cognitive science, emphasizes the close connection between emotion understanding and the body. Ding Jun and others (2010) pointed out that the experience, perception, or recollection of emotions activates psychological processing, and that the control of facial expressions or body movements expressing emotions affects the perception and processing of emotions[2]. Yang Lihao and Xu Yuanli (2014) sorted out the concepts of embodied cognition and embodied emotion, summarizing the core concept of embodied emotion as processes closely related to the body, including the perception, experience, expression, evaluation, and regulation of emotions[3]. Nummenmaa and others (2018) examined embodied emotions from a neuroscience perspective, discussing functional magnetic resonance imaging (fMRI) studies and their applications in emotional cognition and mental health[4]. Gendron and others (2019) systematically reviewed this theory, emphasizing that emotional experience is influenced by bodily responses, postures, and perceptions, and explored individual differences and neural mechanisms[5].Huang Rong (2022) explored the impact of embodied emotion on the creative thinking of individuals prone to depression[6]. Overall, the Embodied Emotion Theory has received widespread attention both domestically and internationally, covering multiple fields including emotional experience, cognitive science, and neuroscience. These studies provide references for understanding the significance and applications of embodied emotion.

2.2. Application of Embodied Emotion in Design

The application of embodied emotion in design refers to the integration of emotions and feelings into the design process of products or experiences, allowing users to more deeply feel and understand the product. This design approach can help enhance the emotional engagement of users, increasing the attractiveness and usability of the product. Although the term 'embodied emotion theory' may not be widely mentioned in the current field of design, design related to embodied emotions has long been given significant attention. Below are some ways in which embodied emotion is applied in design.

Table 1. Application of embodied emotions in design

Application areas	Main characters	Classics	Introduction of the work
Emotional design	Donald Norman		Mercedes-Benz car seat button, the product through the way of mapping, reduce the cost of user learning.
Unconscious design	Naoto Fukasawa		Observe behavior in life and resonate with users.

Interface design

Steve Jobs



Reduce physical buttons, through gestures to operate the interface, in line with cognitive laws.

3. Analysis of Characteristics of Women Living Alone and Security Products

3.1 Analysis of Characteristics of Women Living Alone Group

- The group of women living alone discussed in this article specifically refers to those aged between 23-27 years who have graduated from university and have been living alone in first or second-tier cities in China for over a year. In analyzing the embodied emotional characteristics of urban women living alone, the research methods used are interviews and literature analysis.

• Psychological Characteristics of Women Living Alone

Independence and Autonomy. Many women living alone are often independent, as they have to take responsibility for all aspects of their life, including financial management, household chores, and social relationships[7]; **Loneliness.** Long-term solo living can also lead to a strong sense of loneliness[8]. Therefore, women living alone may alleviate this by purchasing dolls, smart speakers capable of intelligent conversation, or by caring for plants and pets; **Desire for Social Interaction.** Despite living alone, the need for social interaction still exists. They actively seek social interactions, maintaining contact with friends, family, or social groups to fulfill emotional and social needs.

• Physical Characteristics of Women Living Alone

Less Strength. The School of Journalism and Communication at Nanjing University once conducted a statistical analysis of solitary victimization cases: in 94 valid cases, male victims whose gender was disclosed only accounted for 15.6%, while the number of female victims was 3.37 times that of males, accounting for 52.6%; **Petite Stature.** The average size of a woman's body is relatively smaller compared to that of a man's. Therefore, when designing products for women, attention should be paid to the body size of female users, and designs should be made from a perspective that aligns with female ergonomics[9]; **Focus on Health.** Women living alone, due to their concern for beauty, are very keen on weight loss, and an increasing number of women realize the importance of exercise and health in maintaining physical and mental well-being. Therefore, a considerable number of women living alone have the habit or need to diet and exercise.







3.2 Analysis of Security Products for Women Living Alone

• Current State of Security Products

Security products refer to those that can provide safety protection or early warnings for individuals or families. Common security products mainly include surveillance cameras, smart locks, video doorbells, alarms, door blockers, etc. (see Figure 1). With the continuous development of smart technology, high-tech security products are emerging in increasing numbers. Technologies such as artificial intelligence and machine learning, cloud computing and storage, wireless technology, environmental sensing, and biometric technologies are widely applied in security products. These

technologies help in identifying potential security threats, reducing false alarm rates, and providing more precise security protection[10].

Table 2 .Analysis of common security products

Name	door blocker	surveillance camera	portable alarm	smart lock	video doorbell	door and window alarm
Image						
illustrat	Prevent external forces from opening the door	Monitor indoor or outdoor status in real time	Encounter bad guys, sound the alarm, get attention	Open door records, no key	Intelligent cat's eye to observe and record visitors in real time	Open door alarm to prevent forgetting to close doors and windows.

• Analysis of Security Products for Women Living Alone

Security products for women living alone refer to those specifically designed for women living alone, intended to prevent harm from criminals either at home or during commutes. These products are used for alerting or defense purposes. Due to their simplicity, practicality, and cost-effectiveness, door blockers are the most commonly used among women living alone. Door blockers can mainly be categorized into home door blockers and portable door blockers, as shown in Figure 1.

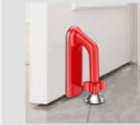




Household door stopper				Portable door stopper	
Applicable groups	All groups of people			People who go out a lot	
Structure type	arched	Foldable	"Ladder" type	"Ladder" type	"H" type
How to use it	Place in the gap under the door, and tighten the rotary screw	Stick to the door, straighten when used and stow away when not in use	Take it out and place it directly in the gap under the door	Place it in the gap under the door, and it will sound an alarm when touched	After assembly, it is installed at the door seam
Pros and cons	Good protection, but bulky size	It is simple to install and easy to use, but it is easy to be destroyed	Easy to store and easy to destroy	Combined with the alarm function, it is easy to be broken	Easy to carry, easy to install, easy to break by force
Exterior display					

Figure 1. Analysis of the current situation of security products for women living alone.

4. Design Strategy for Security Products for Women Living Alone Based on Embodied Emotion

4.1 Design Elements

Functionality. The product must first meet the safety protection needs of women living alone against unauthorized intrusion by strangers during their time alone.

- Structure

The structure should not be overly complex, with simple operation, user-friendliness, and compatibility with female ergonomics.

- Shape

- The design should use fewer straight lines and more curved elements, as curves generally convey an impression of extension and roundness, thus appearing more gentle and subtle, and are more suitable as design elements for a feminine preference.

- Material

Considering women living alone's love for fashion and desire to share, product materials should use safer, more stylish materials such as wood, metal, and glass.

- Color

Warm colors should be the primary choice for the product; selecting warm and soft colors can enhance the sense of safety for women living alone."

4.2 Design Principles

- Principle of Psychological Perception of Safety

Human embodied emotions are a composite result of instinctive reactions and psychological cognition, and so is the sense of safety. The design of security products for women living alone, while considering the product's inherent safety, must also integrate the psychological characteristics of women living alone, ensuring that the product design aligns with factors related to their sense of safety.

- Principle of Emotional Experience of Safety

The emotions of women living alone are particularly susceptible to external factors. Safe product design should create positive psychological suggestions for the embodied emotions of women living alone, aiding in forming a secure emotional response.

- Principle of Functional Interaction Safety

People are often fearful of the unknown or what they cannot control. Therefore, in developing new products, the sense of safety in functional interaction is reflected in the safety and rationality of product functions, as well as the controllability of the product.

5. Design of a Smart Door Blocker for Women Living Alone Based on Embodied Emotion

5.1. Design Analysis

- HMY Questioning Method

How can we create a product for women living alone that enhances their sense of security when they are out, addressing the privacy concerns about whether landlords might enter their rooms in their absence, thereby creating a sense of emotional value and safety for women living alone?

- 5W2H

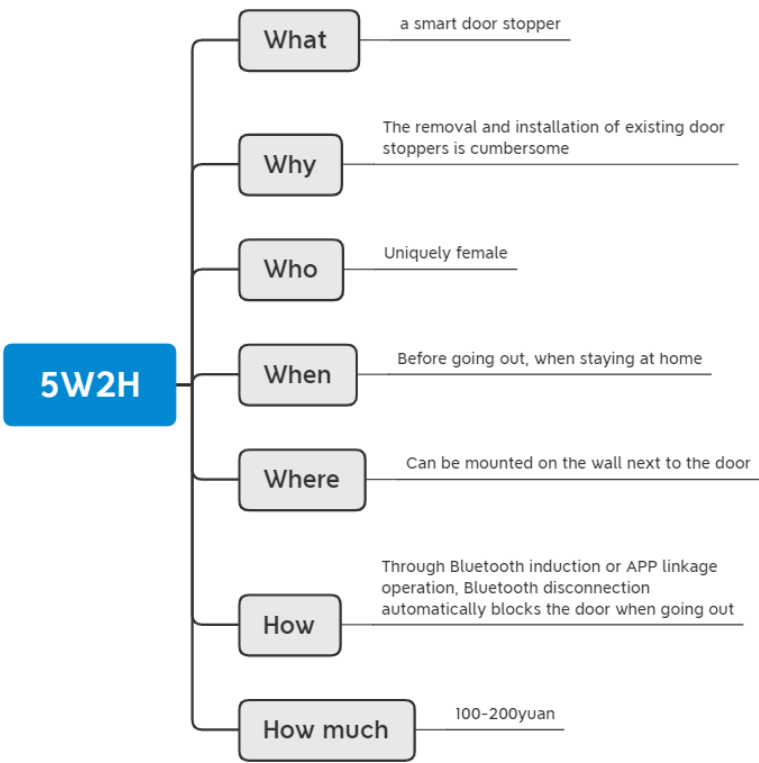


Figure 2 .5W2H analysis diagram.

5.2. Exhibition and Explanation of the Work



Figure 3. Renderings of design works.

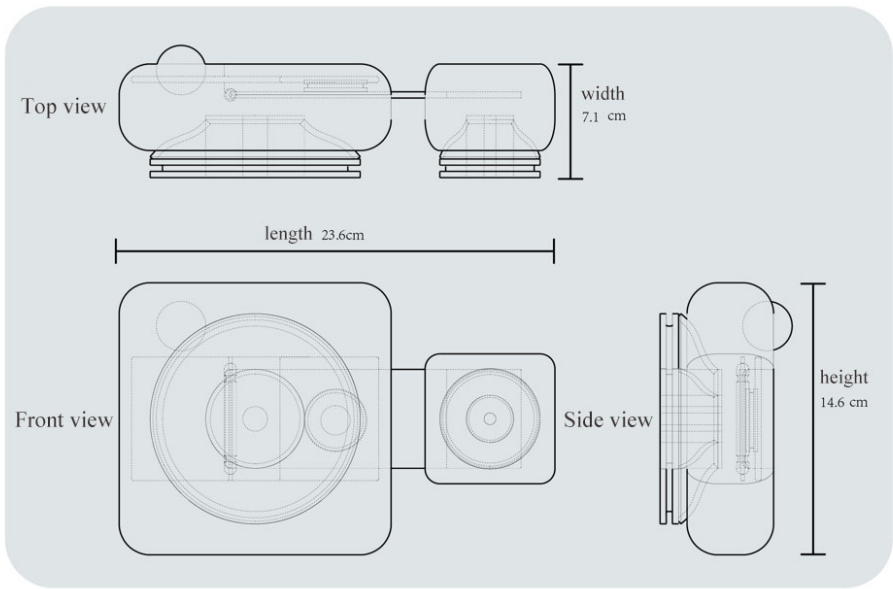


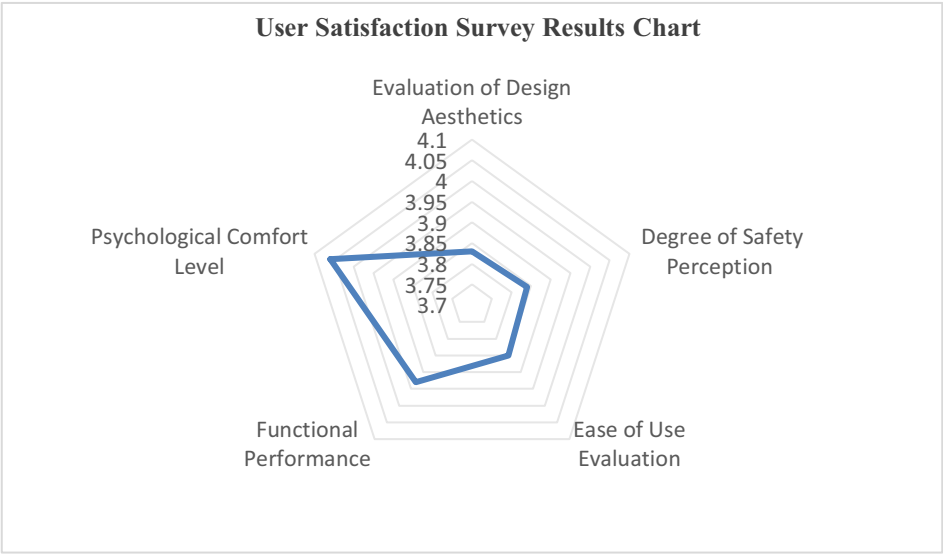
Figure 4 .Three views of the work.

This is a door-blocking product designed for the personal safety of women living alone indoors. It operates via Bluetooth sensing or app linkage, enabling automatic door blocking when the Bluetooth disconnects or after a set time when leaving home, and also automatic door blocking at a set time when at home. This ensures that whether women living alone are out or at home, others cannot easily enter the room.

6. Product Testing

To verify the feasibility of the design, an online survey was conducted to assess the overall design, sense of safety, ease of use, functionality, and emotional impact of the product across five dimensions. The usability test used a Likert 5-point scale, with scores ranging from 'very dissatisfied = 1' to 'very satisfied = 5'. Higher scores indicate greater user approval of the product[11]. A total of 100 questionnaires were collected in this survey, with 95 being valid. The average score for psychological comfort was 4.06, the highest among all items, indicating the product's excellent performance in providing psychological comfort. The average score for the design was only 3.83, suggesting users have certain expectations for the product's design. Overall, the average score was 3.91, indicating a generally high evaluation of the new security product by users, especially in terms of psychological comfort and functionality.

Table 3. User Satisfaction Survey Results Chart



7. Conclusion and Outlook

This study focuses on a global issue—women's safety, particularly the challenges faced by women living alone in the face of potential security threats. It analyzed the shortcomings of existing security products for women living alone and, based on the theory of embodied emotion, proposed new design solutions aimed at reducing the risk of harm to women living alone. The limitation of this study is that the research subjects do not fully cover diverse needs. Moreover, the new design solutions rely heavily on existing technology and lack extensive field testing. In the future, the study will expand to include women of different ages and cultural backgrounds. It will explore emerging technologies to enhance product intelligence and adaptability. Emphasizing user

participation ensures that design solutions meet real needs. Promoting multidisciplinary collaboration seeks comprehensive solutions.

8. Acknowledgements

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