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The Application Boundaries and Optimization of Emotional Design Theory in Products for the Elderly

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Abstract: At present, the number of individuals aged 60 and above in China has exceeded 310 million, with the silver-hair market size projected to surpass 8.8 trillion yuan by 2025.Elderly consumption is experiencing rapid growth, and emotional design, as a core theoretical pillar in the field of user experience, is crucial for the design of products tailored to the elderly. However, during implementation, issues such as the separation of functionality and emotion, and insufficient alignment with user needs often arise. Utilizing Donald Norman's hierarchical theory of emotional design and considering the physical and psychological characteristics of elderly users, this paper comprehensively examines current practices and fundamental limitations in the emotional design of products for the elderly. These limitations include boundary conditions of functional elements, boundary characteristics of user groups, ethical constraints, and cost-benefit relationships. Through analysis of diverse practical cases, a targeted improvement framework is constructed to establish an implementation framework and theoretical system that synergizes functional optimization and emotional empowerment in products for the elderly.

Keywords: Products for the Elderly; Emotional Design Theory; Elderly Consumption; Donald Norman's Hierarchical Theory.

1. Introduction

Countries worldwide are facing an irreversible trend of aging populations.

By 2024, the proportion of individuals aged 60 and above in China is expected to exceed 22%, with the market size for elderly-specific commodities surpassing 5 trillion yuan. However, the variety of available products remains limited at 2,000 types, significantly lower than the global average of 60,000 types, indicating a severe mismatch between supply and demand. Most elderly products focus on enhancing practical functionality while neglecting the emotional needs of the elderly. Research by Stanford University's Aging Research Team reveals that emotional care constitutes 2.4 times the demand for functional needs among the elderly.

Since Donald Norman laid the foundation for emotional design theory, it has expanded from UI design to product development across multiple fields.

It aims to evoke positive emotional responses in users through sensory stimulation, behavioral interaction, and psychological association, thereby fostering emotional recognition of the product. Applying this theory to the development of elderly products can alleviate concerns about product operation due to physical decline and satisfy psychological needs such as group belonging and individual efficacy. However, practical implementation often encounters issues like excessive decoration and misaligned emotional expression, highlighting the urgent need to define the scope of application and explore improvement strategies.

2. Verification of the Synergistic Framework for Emotional Design in Products for the Elderly

2.1. Core Connotations of Emotional Design Theory

Emotional design aims to evoke positive emotional feedback from users through design means, enhancing product attractiveness and user engagement.

Its theoretical basis lies in Norman's three-tier model of emotions.

Visceral Design: Meituan Dianping leverages spatial composition and color contrast in visual presentation to rapidly establish an emotional connection, with its orange-yellow visual identity evoking a warm emotional experience [1].

Behavioral Design: Focuses on the smoothness of interface operation and feedback timeliness, improving interaction by minimizing logical pathways and enhancing feedback information. For example, shopping cart animations provide immediate feedback, reducing the risk of operational errors.

Reflective Design: Concentrates on emotional accumulation and value alignment after user experience, fostering deep emotional bonds through varied experiences, similar to the emotional connection evoked by annual music reviews.

These three levels synergistically construct a progressive emotional connection: attracting customers, retaining them, and cultivating loyal customer bases.

This logic is equally effective in products for the elderly but requires reasonable refinement based on the unique characteristics of this user group.

2.2. Physiological and Psychological Characteristics and Emotional Needs of the Elderly

Elderly individuals, facing physiological deterioration and social role transitions, exhibit diverse physical and psychological attributes, shaping their unique emotional needs.

Physiological Characteristics: A survey by Peking University's Aging Research Center indicates that 75% of elderly individuals perceive device operation complexity as a major usage challenge. They experience reduced auditory discrimination, visual acuity, color perception, memory accuracy, concentration, reaction speed, and fine motor skills [2].

Psychological and Emotional Needs: The need for group belonging is acute, with 85% of solitary elderly individuals suffering from loneliness and thus having a strong demand for products that facilitate emotional communication. They also exhibit historical sentimentality, spontaneously identifying with traditional cultural symbols that evoke emotional memories. Safety concerns are heightened, with a strong expectation for product stability and reliability and increased sensitivity to potential hazards. Additionally, they reject being labeled with special tags or age-indicative product identifiers, valuing their dignity.

2.3. Adaptation Logic of Emotional Design and Products for the Elderly

The needs of elderly users organically connect with the three-tier architecture of emotional design.

Behavioral design minimizes cognitive pressure and enhances operational confidence through simplified operations and timely feedback. Visceral design significantly improves visual comfort for the elderly through clear color contrasts and minimalist structures. Reflective design effectively fulfills the emotional belonging needs of the elderly through retro styles and social interactions. Case studies in elderly care communities demonstrate that devices incorporating emotional design can reduce depression symptom scores by 1.8 levels and increase user adoption rates to 92%, confirming the practical value of this adaptation logic.

3. Current Application Status and Analysis of Typical Cases: Emotional Design in Products for the Elderly

3.1. Current Application Status

Emotional design in elderly products exhibits a pronounced bipolar phenomenon.

Some products remain at the functional priority stage, such as traditional walking aids that focus solely on mechanical without considering visual experience or emotional transmission. Conversely, tech-assisted elderly products are exploring avenues for emotional care, exemplified by smart bracelets with video calling capabilities and elderly clothing featuring traditional textures [3].

Consumer surveys and empirical research reveal that 23% of elderly-specific products successfully integrate emotional elements.

However, significant shortcomings persist:

Technical Implementation vs. Emotional Experience Disconnection: The complexity of technical interactions dilutes the impact of emotional design.

Stereotypical Design Dilemma: Emotional expression overly relies on superficial aesthetic modifications.

Inadequate Need Exploration: A health supplement marketed for "disease prevention" repels 68% of elderly consumers.

3.2. Typical Application Cases

Visceral Design Case: The Palace Museum launched a clothing line tailored for middle-aged and elderly individuals, combining traditional classic patterns with flattering silhouettes for the elderly physique.

Vibrant yet soft color palettes evoke positive emotional responses, achieving 12 million yuan in sales upon launch. This design transmits cultural identity through graphic symbols, aligning with the elderly's aesthetic and self-esteem psychological needs, and challenging stereotypes about elderly clothing.

Behavioral Design Case: A monitoring bracelet, co-developed by a hospital expert team, simplifies necessary operations to within three steps and replaces complex waveform displays with "red-yellow-green" color-coded light indicators.

This enhances the accuracy of malignant arrhythmia warnings to 82% and significantly reduces the initial failure rate by 63%.

Reflective Design Case: Based on lifestyle data from 3,000 elderly users, Sofa Living launched a concealed support armrest that addresses fall prevention concerns through seamless design, eliminating user apprehension.

The product achieved 860 million yuan in sales in its first year, with 29% of customers making repeat purchases. It effectively caters to both safety and dignity needs, fostering deep emotional engagement.

4. Exploring the Implementation Boundaries of Emotional Design in Products for the Elderly

4.1. Functional Essence Boundary: Emotion as an Auxiliary Element, not a Substitute for Functionality

Two typical transgressions of boundaries are observed:

Emotional Design Encroaching on Practical Space: Some elderly terminals prioritize aesthetic trends at the expense of functionality, such as thin designs that compromise battery life, conflicting with the elderly's need for prolonged usage. A smart cane with excessive decorative elements reduces grip comfort and increases safety risks.

Redundant Design Deviating from Functional Purpose: A smart mattress integrates a "emotional companionship" module with a chat function, escalating costs and complicating operations, resulting in core monitoring functionality utilization below 30%.

Within the functional realm, emotional design should adhere to the principle of "necessity and moderation":

Visceral Level: Visual elements should not hinder the identification of core information, with font legibility as the foundation for decoration.

Reflective Level: Design should align with key product functionalities. Annual health reports should emphasize tangible health indicator improvements rather than solely

emotional presentations.

Behavioral Level: Emotional interaction design should maintain operational efficiency, with loading animations ideally under 3 seconds.

4.2. Group Diversity Boundary: Moving Beyond a One-Size-Fits-All Approach to Cater to Diverse Needs

The elderly population exhibits significant diversity. From a health perspective, they can be categorized into three groups: 40% semi-disabled, 35% severely disabled and elderly, and 25% active and healthy.

Each group has varying emotional care needs and operational capabilities, creating a watershed for emotional design. However, design practices often rely on a "generic elderly sample," leading to mismatches.

Active and Healthy Elderly: They demonstrate strong social belonging and achievement motivation. Yet, most products revolve around the "elderly care" concept, with excessive health and wellness content pre-installed on some smart devices for the elderly, neglecting their latent expectations for leisure and social interaction, resulting in user engagement below 15%.

Disabled Elderly: Only 8% of disabled users can operate devices independently, yet many still employ touch-screen interfaces. Autonomous operational capabilities are weak, necessitating simplified interaction logic to prevent emotional design from becoming superficial.

Regional Cultural Differences: The utilization rate of social adaptation products for the elderly varies by 40 percentage points across regions due to differing social preferences between northern and southern elderly groups. Northern elderly individuals lean towards familial interactions, while southern elderly individuals prefer community-based socializing.

Given these disparities, a "stratified and categorized" design approach is warranted. For active elderly users, reflective layer interaction experiences can be enhanced, such as establishing hobby-based matching mechanisms.

Northern products should emphasize familial reunion concepts, adjusting emotional expressions based on regional cultural backgrounds. For disabled elderly individuals, visceral and behavioral layers should be optimized for simplicity, employing a combination of voice announcements and tactile vibrations.

4.3. Ethical and Safety Boundary: Psychological Preventive Intervention and Data Security Crisis Defense

Emotionally oriented design faces three ethical challenges, necessitating resistance to emotional exploitation and privacy violations and the establishment of ethical defenses.

Given the cognitive decline in the elderly population, they are susceptible to emotional manipulation.

Emotional Blackmail Design: Some health supplements use familial marketing rhetoric for emotional packaging, exaggerating product efficacy and using health as bait to deceive elderly consumers, undermining market trust.

Privacy Infringement Risks: A smart monitoring system, intended for "emotional companionship," excessively collects data on the elderly's living habits, including meal times and sleep durations, without encrypting sensitive information.

Dignity-Compromising Design: Some schemes use overt age-related attributes to evoke empathy, such as assistive devices labeled "suitable for the elderly," which instead cause psychological discomfort, contradicting the of emotional soothing.

The foundation of ethical safety protection lies in the principles of "respect and protection." This involves formulating ethical guidelines for emotional communication to prevent the use of emotional for false promotion.

It also necessitates implementing HIPAA-level data protection encryption to securely store health data and behavioral records. Additionally, employing invisible design, such as embedding "invisible handrails," safeguards user dignity.

4.4. Cost-Benefit Boundary: Balancing Emotional Utility and Popularity Potential

Currently, two types of imbalances can be observed. Given that elderly consumers tend to be more conservative and prioritize cost-effectiveness when selecting products, it is essential to reasonably constrain the costs of emotional design to avoid price escalations due to excessive emphasis on emotional value, thereby delineating the boundaries of income and expenditure.

High-End Tendency: Smartwatches equipped with AI emotional analysis modules, priced at over 3,000 yuan, are significantly out of sync with the purchasing power of the elderly, with an actual user base of less than 5%.

Cost Wastage: A mid-to-old age model, aiming to showcase the emotional value embedded in its casing design, adopted specialized casing processing techniques, increasing manufacturing costs by 40%.

However, the level of appreciation among end-users for this design only increased by 8%, highlighting a substantial gap between investment and return.

Influenced by cost-benefit boundaries, it is imperative to establish a cost-control system based on core needs, prioritizing 80% of the emotional budget for core user experience aspects such as operational improvements [4].

Implementing flexible module combinations, allowing personalization of emotional modules through a tick-box mechanism, and streamlining base prices are crucial. Adopting cost-effective emotional expression methods, such as using color schemes instead of high-quality materials to convey warmth, is recommended. Sophia Home Furnishings' "Memory Armrest," utilizing modular craftsmanship, significantly reduced cost inputs while achieving emotional empowerment, raising the user repurchase rate to 41%, demonstrating the rationality of this decision.

5. Optimization Paths for Emotional Design in Elderly Products

5.1. Establishing a "Functionality-Emotion" Synergistic Design Philosophy

Emotional design should be developed based on the realization of reliable functionality. For instance, intelligent emergency devices should aim to control call response times within 3 minutes, followed by enhancing the emotional expressiveness of voice responses. Clinical practice has shown that when functionality meets standards and is subsequently enhanced with emotional elements, user approval ratings significantly increase by 62%.

Using open-ended interviews combined with behavioral log analysis as a means, an association model linking elderly

needs, emotional factors, and functional blocks can be created. By aligning "loneliness" needs with "video communication" functions and "warm color palette" emotional elements, emotional design can be precisely targeted.

5.2. Adopting "Participatory + Contextual" Design Methods

Participatory Design: By collecting data on the living habits of 12,000 elderly individuals, a certain elderly care institution guided seniors with varying health conditions to deeply participate in the design process, from need exploration to prototype evaluation. This approach raised the adoption rate of customized products among elderly users to 89% [5].

Contextual Design: Developing emotional interaction plans based on typical behavioral patterns of the elderly, such as introducing a "gradual awakening paired with health news" heartwarming wake-up strategy and setting up a "real-time monitoring + emergency contact" system in nighttime scenarios to enhance psychological security. After a pilot implementation of contextual facilities in a Shanghai nursing home, user retention rates increased by 37 percentage points.

5.3. Utilizing "Aging-Adaptive + Intelligent" Technological Support

Simplified Technological Emotional Expression: Transforming complex technologies into elderly-friendly emotional interactions, such as reshaping AI emotional analysis technology to automatically play recordings from children during negative emotions, thereby downplaying technical expertise. According to MIT Media Lab data, proactive care-type intelligent devices are projected to dominate the market by 2030.

Combining the sensory characteristics of the elderly, multimodal interaction combinations of voice prompts, visual signals, and tactile feedback can be implemented. Achieving triple feedback of voice, visual flicker, and tactile vibration during button interactions alleviates cognitive burdens, raising the task completion rate among the elderly by 29%.

5.4. Constructing a "Full-Chain + Multi-Stakeholder" Support Ecosystem

Establishing a Hierarchical Evaluation System: Utilizing four indicators—heart rate variability, task interruption frequency, satisfaction scores, and data collaboration level—to comprehensively measure the impact of emotional design and prevent design overreach. After implementing this system, device iteration cycles can be shortened by 58%, and user complaint rates reduced by 71 percentage points.

Forming a Multi-Stakeholder Collaboration Mechanism: Communities can collaborate on environmental testing, universities provide academic support for elderly psychological research, enterprises lead product development, and the government promotes ethical review mechanisms and standard upgrades. Leveraging standardized systems to clarify ethical boundaries in emotional design and prevent unauthorized privacy collection and emotional deception.

6. Conclusion and Prospects

6.1. Research Conclusion

Incorporating emotional design theory into the development of elderly products holds significant theoretical importance. However, achieving progress in four key dimensions is essential. The product functionality boundary requires emotional design to revolve around basic product functions. The boundary for different user groups necessitates classified design approaches for diverse populations. Ethical safety demands the prevention of manipulative behaviors and privacy breaches. Cost control requires simultaneous consideration of value output. Employing a synergistic mindset, implementing participatory processes, embedding aging-adaptive technological modules, and constructing an ecological support network can effectively address issues of design similarity and lack of depth, facilitating a transition of elderly products from meeting needs to enhancing experiences and ultimately fostering user dependency.

6.2. Research Prospects

Future research can be deepened in three aspects: As technology advances and cognitive iterations continue, elderly products can leverage emotional design to achieve dual optimization of functionality and emotion. Firstly, exploring tailored emotional support design approaches for elderly groups with cognitive impairments. Secondly, integrating cutting-edge technologies such as brain-computer interfaces to construct precise emotional need capture and response systems.

Thirdly, establishing a cost-benefit analysis model for emotional design to assist enterprises in making quantitative decisions and promoting the formation of a warmer smart elderly care model.

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