Breaking through Fuzzy Positioning: Diverse Design Communication Strategies for Older Adults’ Healthcare Wearables

Chen Li, Chang-Franw Lee  
Graduate School of Design, National Yunlin University of Science and Technology
Wearable technology Design for Older Adults

Healthcare, life assistance, and independence
Healthcare
Self-management, Medical Care

Wearables
- Mind-reading Headgear
- Smart Glasses
- Wristband
- Smart Watch
- Smart Fabrics
- Smart Socks
Great gap between commercials and research

Start Point from commercials — Product Positioning

Older adults are in group with high diversity. Designers also need some consumer psychology knowledge on positioning to make our ethical idea of healthcare more attractive and reasonable.
A mental process of Categorization

A mental process during which individuals make their quantities of life experiences structured by classification construction and description.
It can be inferred that different positioning of recent healthcare wearables would be generated from the previous experiences among older adults, as far as conflicts between new medical sensors inherent in the devices and the corresponding acquainted appearances of personal items.
We regard the interaction between older adults and healthcare wearables as an indirect user-designer communication process. In the literature part, we also find the there are six important human considerations from the user part, which have the potential to impact wearables acceptability.

- **Perceived Usefulness (PU)**: PU means that older adults consider utilizing particular devices to improve degree of healthcare performances.
- **Perceived Ease of Use (PEU)**: PEU refers to mental and physical efforts taken by particular devices in the opinion of the elder users.
- **Personal Image (PI)**: PI means that a particular wearable to offer older adults with a self-identity feeling suitable for overall status of them, and improve the status of relevant older adults in social system.
- **Personal Privacy (PP)**: Evaluations between practical values and privacy risks.
- **Aesthetic Appearance (AA)**: Aesthetic experience is a critical part of healthcare wearables.
- **Physical Comfort (PC)**: Wearables are electronic technique or computers that can be put on comfortably and this is the uppermost feature of wearables.
Research Framework

Three questions:

- Do older adults have different perception toward the positioning of recent healthcare wearables?
- What influences does the perceptual positioning have on human considerations on acceptance behavior?
- Which communication strategy should be adopt by designers to address the diverse positioning.
Method and Procedure

We combined both quantitative and qualitative method to find our answer.

**Steps**

1. **Step1. Perceptual Product Positioning**

2. **Step2. Human Considerations to Accessibility**

3. **Step3. Adaptive Design Elements**

4. **Step4. Effective Design Communication Strategies**

**Methods**

- Two-Step Clustering
- Multiple Regression analysis
- Case Study
- Grounded Theory

**objectives**

- Exploring differences in older adults’ perceptions on product positioning
- Confirming influential human considerations from cognitive, social and physical aspects
- Analyzing human consideration related design elements in interactive contexts
- Finding adaptive communication strategies under different product positioning.

**Participants:** Chinese urban older adults over 60 who are interested in the healthcare wearables but can find a favor one for themselves.

- 60-70 Years Old
- with a middle education level
- Who earned 3,000 RMB and above
- Aging in place
Quantitative Phase

Six Categories of Stimulus Materials

- Smart Glasses
- Jins Meme
- ES Glasses
- Smart Necklaces
- Misfit Shine
- Smart Watch
- XianDaiYanYi
- Elderly Watch
- Smart Skin Patch
- BioMetrix
- Smart Garment
- Vigour

Positioning Perception (RP)
- RP1. I deem this product as a medical tracker.
- RP2. I deem this product as a fashion accessory.

Lifestyle Phase (LS)
- LS1: How is your physical condition?
- LS2: Do you exercise every day?
- LS3: What is the degree of social contact in your everyday life?
- LS4: I agree with fashion consumption.
- LS5: I agree with technology consumption.

Behavior Intention (BI)
- BI1. If this product were available to me, I would use it.
- BI2. If this product were launched on the market at an affordable price, I would likely purchase it.
- BI3. I would use this product without being forced.
- BI4. I would accept this product.

Perceived Usefulness (PU)
- PU1. This product is very practical for me.
- PU2. This product could improve the quality of my health.
- PU3. This product could help me attach importance to my health.
- PU4. This product could improve my performance of keeping healthy.

Perceived Ease of Use (PEU)
- PEU1. The operation of the product is clear and easy to understand.
- PEU2. I think this product is easy to use.
- PEU3. I think this product is not complicated to use.

Personal Image (PI)
- PI1. I think this product would be suitable for me.
- PI2. I think this product would accord with my identity.
- PI3. I think wearing this product would be a good experience.

Personal Privacy (PP)
- PP1. I’m worried about the product couldn’t be properly protect my personal health information.
- PP2. I think the product would threaten my privacy.
- PP3. I think the product can spill my personal information.

Perceived Comfort (PC)
- PC1. I think this product would be comfortable.
- PC2. I would feel at ease when wearing this product.
- PC3. I think this would be well suited to my body.

Aesthetics appeal (AA)
- AA1. I think the product is beautiful.
- AA2. I think using this product can bring good aesthetic experience.
- AA3. I like the appearance of this product.
Quantitative Phase

In quantitative phase, relevant data are collected here by questionnaires that should use scales with good reliability and validity in references as bases to the greatest extent. Questionnaire surveys are also carried out to gather data and SPSS 24.0 is adopted to perform data analysis. The Crobanch’s α value of 248 effective questionnaires as a whole is 0.90 (>0.70), and relevant results indicate that the KMO value is 0.87, sphericity test of Barttlett exhibits significant results (p<0.001), which proves that the questionnaires surveys have preferable reliability and validity.
## Quantitative Phase

### Means of Positioning Perception Items

<table>
<thead>
<tr>
<th>Items</th>
<th>(Cluster 1) Tech-Aid Type</th>
<th>(Cluster 2) Fash-Acc Type</th>
<th>(Cluster 3) Fash-Tech Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Technology</td>
<td>4.30</td>
<td>1.73</td>
<td>4.46</td>
</tr>
<tr>
<td>Fashion Accessory</td>
<td>2.51</td>
<td>4.47</td>
<td>4.28</td>
</tr>
</tbody>
</table>

### Means of Lifestyle Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Poor</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Condition</td>
<td>3.31</td>
<td>3.94</td>
<td>4.00</td>
</tr>
<tr>
<td>Daily Exercise</td>
<td>2.71</td>
<td>3.06</td>
<td>2.72</td>
</tr>
<tr>
<td>Social Contact</td>
<td>2.43</td>
<td>3.74</td>
<td>3.66</td>
</tr>
<tr>
<td>Fashion Consumption</td>
<td>2.41</td>
<td>4.02</td>
<td>3.75</td>
</tr>
<tr>
<td>Technology Consumption</td>
<td>3.74</td>
<td>2.83</td>
<td>3.58</td>
</tr>
</tbody>
</table>

### Quality of Two-step Cluster Analysis

- **Cluster 1, 35.10%**
- **Cluster 2, 21.40%**
- **Cluster 3, 43.50%**

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**Clusters of Product Positioning**
Quantitative Phase

In multiple regression analysis, this study pays much more attention to the potential influence relations between six human considerations.

<table>
<thead>
<tr>
<th>Type</th>
<th>Tech-Aid (TA)</th>
<th>Fash-Acc (FA)</th>
<th>Fash-Tech (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>35.1% (n=87)</td>
<td>21.4% (n=53)</td>
<td>43.5% (n=108)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.522</td>
<td>0.630</td>
<td>0.652</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>0.668***</td>
<td>-0.129</td>
<td>0.207**</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEU)</td>
<td>0.260**</td>
<td>0.297*</td>
<td>0.379***</td>
</tr>
<tr>
<td>Personal Image (PI)</td>
<td>0.010</td>
<td>0.334**</td>
<td>0.199**</td>
</tr>
<tr>
<td>Personal Privacy (PP)</td>
<td>0.265**</td>
<td>-0.092</td>
<td>0.161*</td>
</tr>
<tr>
<td>Physical Comfort (PC)</td>
<td>-0.156</td>
<td>0.115</td>
<td>0.215*</td>
</tr>
<tr>
<td>Aesthetic Appearance (AA)</td>
<td>-0.160</td>
<td>0.418***</td>
<td>0.228**</td>
</tr>
</tbody>
</table>

The coefficients of three regression equations are all greater than 0.50. Which signified a good quality. For Tech-aid type, PU, PEU and PP are significantly related to acceptance behaviors. For Fash-Acc type, factors significantly related to acceptance behaviors are PEU, PI and AA. For Fash-Tech type positioning, all the six factors are significantly associated with acceptance behaviors of older adults.
We speculate that older adults have different human consideration as far as different positioning perception are considered.
Qualitative phase

Case study was used in qualitative phase base on grounded theory, which means we deconstruct data into open coding, axial coding and at last selective coding, we also call it storyline analysis of interactive contexts.

Adaptive Communication Strategies

**Tech-Aid Type**
- Perceived Usefulness;
- Perceived Ease of Use;
- Personal Privacy

**Fash-Acc Type**
- Perceived Ease of Use;
- Personal Image;
- Aesthetic Appearance

**Fash-Tech Type**
- Perceived Usefulness;
- Perceived Ease of Use;
- Personal Image;
- Personal Privacy;
- Aesthetic Appearance;
- Physical Comfort

Design Elements

Grounded theory

- Selective Coding (Storyline Analysis)
- Axial Coding
- Open Coding
Case Study

We trace back to 15 older participants with different positioning recognition in the questionnaire test, then let them experience the sample healthcare wearable sample. Then three coders reconstruct the full picture of possible design communication. And QSR Nvivo 11 was used as a tool for data processing.

<table>
<thead>
<tr>
<th>No.</th>
<th>Question phases and implementation procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Living habits and customs, daily routine, and interest or hobby.</td>
</tr>
<tr>
<td>02</td>
<td>How to take care of their health? What kind of products do they use.</td>
</tr>
<tr>
<td>03</td>
<td>Which sorts of health data do they pay attention to, and how to use them?</td>
</tr>
<tr>
<td>04</td>
<td>Researchers introduce the wearable health product (stimulus materials) and demonstrate the operation procedure of the relevant service.</td>
</tr>
<tr>
<td>05</td>
<td>Older Adults experience stimulus materials practically.</td>
</tr>
<tr>
<td>06</td>
<td>Older adults talk about the overall feeling of using the product.</td>
</tr>
<tr>
<td>07</td>
<td>Older adults talk about the reasons that can affect the human factors for evaluation</td>
</tr>
<tr>
<td>08</td>
<td>Opinions and Suggestions for the healthcare wearables.</td>
</tr>
</tbody>
</table>
Interactive Context between influential human considerations and design elements

Encoding came from five interviewees. In total, 95 free nodes were sorted out and then used as the open codes converged into 21 axial codes.
Interactive Context between influential human considerations and design elements

<table>
<thead>
<tr>
<th>Factor</th>
<th>Verifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance</td>
<td></td>
</tr>
<tr>
<td>Perceived Ease of Use (PEU)</td>
<td></td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td></td>
</tr>
<tr>
<td>Control Power</td>
<td></td>
</tr>
<tr>
<td>Functional Collocation</td>
<td></td>
</tr>
<tr>
<td>Visualizing Data</td>
<td></td>
</tr>
<tr>
<td>Readability</td>
<td></td>
</tr>
<tr>
<td>Interoperability</td>
<td></td>
</tr>
<tr>
<td>Process of Wearing</td>
<td></td>
</tr>
<tr>
<td>Scale</td>
<td></td>
</tr>
<tr>
<td>Health Tips</td>
<td></td>
</tr>
<tr>
<td>Location for Wearing</td>
<td></td>
</tr>
<tr>
<td>Style</td>
<td></td>
</tr>
<tr>
<td>体验</td>
<td></td>
</tr>
<tr>
<td>Experience Exchange</td>
<td></td>
</tr>
<tr>
<td>Personal Data Connection</td>
<td></td>
</tr>
<tr>
<td>Data Connection</td>
<td></td>
</tr>
<tr>
<td>Experienced People</td>
<td></td>
</tr>
<tr>
<td>Personal Privacy (PP)</td>
<td></td>
</tr>
</tbody>
</table>

Factors verified in quantitative research:
- Blood pressure
- Blood sugar
- High cholesterol

Storyline Analysis in Tech-Aid Type

Interactive Context between influential human considerations and design elements

Priority to control power;
Fit symptoms

Factors verified in quantitative research:
- Blood pressure
- Blood sugar
- High cholesterol

Storyline Analysis in Tech-Aid Type

Interactive Context between influential human considerations and design elements

Priority to control power;
Fit symptoms

Factors verified in quantitative research:
- Blood pressure
- Blood sugar
- High cholesterol
Interactive Context between influential human considerations and design elements

Friendly learning; Straightforward

Factors verified in quantitative research
- Axial coding with single direction
- Axial coding with double direction
- Storyline repeated once
- Storyline repeated twice
- Storyline repeated 3 times
- Storyline repeated 4 times
- Storyline repeated 5 times
- Relationship verified in quantitative research

(a) (b)
Acceptance

Perceived Ease of Use (PEU)

Perceived Usefulness (PU)

Visualizing Data

Control Power

Physical Conditions

Readability

Interoperability

Learnability

Process of Wearing

Scale

Location for Wearing

Style

Experience Exchange

Personal Data Connection

Data Connection

Experience

Experienced People

Context Support

Interactive Context between influential human considerations and design elements

Information hierarchy; Cautious interconnection

Factors verified in quantitative research
- Axial coding with single direction
- Axial coding with double direction
- Storyline repeated once
- Storyline repeated twice
- Storyline repeated 3 times
- Storyline repeated 4 times
- Storyline repeated 5 times
- Relationship verified in quantitative research

Personal data
Measurement data
Personal experience
Interactive Context between influential human considerations and design elements

Encoding came from six interviewees. In total, 219 free nodes were sorted out and then used as the open codes converged into 26 axial codes.
Interactive Context between influential human considerations and design elements

Thinking about modeling; Concealing stigma.

Factors verified in quantitative research
- Axial coding with single direction
- Axial coding with double direction
- Storyline repeated once
- Storyline repeated twice
- Storyline repeated 3 times
- Storyline repeated 4 times
- Relationship verified in quantitative research
Interactive Context between influential human considerations and design elements

Modeling style, Agreeing with aesthetic appreciation.
Interactive Context between influential human considerations and design elements

Simplified operation; Popping on and off at will.
Interactive Context between influential human considerations and design elements

Encoding four interviewees. In total, 170 free nodes were sorted out and then used as the open codes converged into 25 axial codes.
Interactive Context between influential human considerations and design elements

Data insights; Entertainment complementary.
Storyline Analysis in Fach-Tech Type

Interactive Context between influential human considerations and design elements

Visual data to reduce interferences.

Factors verified in quantitative research
Axial coding with single direction
Axial coding with double direction
Storyline repeated once
Storyline repeated twice
Storyline repeated 3 times
Storyline repeated 4 times
Storyline repeated 5 times
Storyline repeated over 6 times
Relationship verified in quantitative research
Storyline Analysis in Fach-Tech Type

Interactive Context between influential human considerations and design elements

Style modality; Appropriate display.
Interactive Context between influential human considerations and design elements

Appropriate size; Proper style.
Interactive Context between influential human considerations and design elements

Factors verified in quantitative research:
- Axial coding with single direction
- Axial coding with double direction
- Storyline repeated once
- Storyline repeated twice
- Storyline repeated 3 times
- Storyline repeated 4 times
- Storyline repeated 5 times
- Storyline repeated over 6 times
- Relationship verified in quantitative research
Interactive Context between influential human considerations and design elements

Context fusion; Contact comfort.
### Discussion —— Design Communication Strategies and their guidelines

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<td></td>
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</tr>
<tr>
<td><strong>Calm Communication Strategy</strong></td>
<td></td>
<td>Active Communication Strategy</td>
</tr>
</tbody>
</table>

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**Key Terms:**
- **Data insights**: Information gathered through observation or analysis.
- **Entertainment complementary**: Enhancing the overall experience through additional content or displays.
- **Visual data**: Visual representations linked with specific use cases.
- **Style modality**: Aesthetic integration within the product design.
- **Context fusion**: Integration of context-specific applications.
- **Professional people**: Professionals involved in the design and development process.
- **Appropriate size**: Ensuring the right scale for optimal use.
- **Proper style**: Maintaining a consistent and suitable design style.
- **Persuasive Communication**: Influencing users' attitudes and behaviors through communication strategies.
• First, older adults’ perceptions on product positioning of devices are classified into three types, including Tech-Aid type, Fash-Acc type and Fash-Tech type. In addition, these diverse types of product positioning correspond to older adults with various lifestyles.

• Second, older adults have different human consideration as far as different positioning perception are considered so as the corresponding communication strategy. Product positioning developed for older adults in a particular lifestyle should be definitely judged to adopt an suitable design communication strategy.
Thank you for your attention!