PROVIDING SUPPORT FOR OLDER PEOPLE WITH MOBILE APPLICATIONS: USABILITY & SOCIABILITY

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- Assistant Prof., Institute of Human Factors & Ergonomics, Tsinghua University
- Research interests
  - Universal design and IT Accessibility
  - Design of ubiquitous/mobile applications
  - Social computing
  - Cross-cultural comparisons
- Secretary of the China Chapter of Human Factors and Ergonomics Society
  - http://www.hfes.org/
INSTITUTE OF HUMAN FACTORS & ERGONOMICS (IHFE), TSINGHUA UNIVERSITY

- **Team**
  - 4 professors, 2 associate professors, and 2 assistant professors
  - about 20 PhD students and 20 master students

- **Research Areas**
  - Human-Computer Interaction
  - 3D Anthropometrical Measurement and Biomechanics
  - Organizational Psychology
  - Safety Engineering
  - Human Errors and Reliability
  - Virtual Reality and Driving Safety

- **Publications**
  - 140 journal papers and books/book chapters, 80+ on international journals (SCI/SSCI indexed)
  - 100+ international conference proceedings
COLLABORATIONS

We collaborate with following universities and research institutions

Industrial Partners
- International: Nokia, IBM, SAP, Liberty Mutual, P&G, NTT, Nissan, Mitsubishi, Samsung
- Domestic: Huawei, Lenovo, Midea, China Railway Construction Group, National Institute of Standardization

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HCI RESEARCH AT IHFE

Design for All
- User-centered design
- Aging people

Ubiquitous/mobile Computing
- Ambient intelligence
- Location-based services

Social computing
- Social Network Analysis
- Design of social web applications

Cultural Effects
- Technology acceptance
- Human-Robot Interaction
AGENDA

• Ageing in China: An Overview
• Usability Issues of Mobile Technology for Older Users
• Understanding and Supporting Sociability of Older People with Mobile Technology
CHALLENGES & OPPORTUNITIES

AGEING IN CHINA
AGEING IN CHINA

- China has the biggest grey population in the world.
  - 149 million 60+ by the end of 2006 (11.3%)
  - Will reach 248 million by 2020 (17.2%)
AGING POPULATION

 Decreased birth rate

 Increased life expectancy

Fast ageing China

- Annually incremental rate of the aged population reaches as high as 3.2% (2007)
  - nearly as 5 times as that of total population in China
- In 25 years, the proportion of 65+ Chinese increases from 7% to 14%
  - 60 years for America, 85 years for Switzerland, 115 years for France

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CHANGE OF FAMILY STRUCTURE

Family configuration

- The number of “empty nest family” is increasing
  - 49.7 % in the urban areas, 38.3 % in rural areas
- Strong willingness to live with their children
  - 37.2% in the urban areas, 54.5% in rural areas
- More than 70% of seniors are financially supported and looked after by their families
- Difficult to accept aged houses and rest homes for older people in China
ECONOMIC ASPECT
- “GROW OLD BEFORE GETTING RICH”

Income and expense of older people

- $11,963/10,028$ yuan/year in urban areas, $2722/750$ yuan/year in rural areas
- The income of $3.5\%$ older people in urban areas and $23.9\%$ in rural areas were below the local minimum living level in 2006

Source of living expense for older people

<table>
<thead>
<tr>
<th>Main source of livelihood</th>
<th>Urban areas</th>
<th></th>
<th>Rural areas</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Work</td>
<td>6.5</td>
<td>9.2</td>
<td>3.9</td>
<td>30.5</td>
</tr>
<tr>
<td>Pension</td>
<td>60.4</td>
<td>73.6</td>
<td>47.9</td>
<td>6.1</td>
</tr>
<tr>
<td>Family and relatives supply</td>
<td>28.5</td>
<td>14.3</td>
<td>42.0</td>
<td>59.6</td>
</tr>
<tr>
<td>Social doles</td>
<td>2.0</td>
<td>2.0</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Other</td>
<td>2.1</td>
<td>1.5</td>
<td>2.7</td>
<td>1.1</td>
</tr>
</tbody>
</table>

The Main Source of living expense in China’s urban and rural areas (2004)

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HEALTHCARE
- “DARE NOT BE ILL”

Healthcare insurance
- Low coverage of healthcare insurance for older people
  - 51.7% in urban areas and 44.7% in rural areas, including Cooperative Medical Systems

High healthcare cost
- Example: average cost for one hospitalization treatment of diabetes B without complication in Guangdong province is 9181.01 Yuan

“Keeping good health is a responsibility of older people”
- Actively learning knowledge about healthy diet and lifestyles, doing regular exercises
Opportunities

• The huge aged population and the need for supporting their independent living at home
• Diversified economic status, but abundant demand for new technology in urban areas
• A willingness to pay for older people’s well-beings in general
• High penetration rate of mobile devices in China
  • 786 million mobile phones by April, 2010
• Mobile applications can help older people by providing
  • Access to information, daily life services and entertainments
  • Care for physical and mental health
  • Opportunities to facilitate social and emotional supports exchange
  • Support for mobility
USABILITY ISSUES FOR OLDER USERS
CHALLENGES FOR SUPPORTING OLDER PEOPLE WITH MOBILE APPLICATIONS

Usability challenges

• Reduced physical and psychological capabilities
• Low computer literacy and confidence
• High privacy and security concerns
USABILITY CHALLENGES ASSOCIATED WITH VISUAL IMPAIRMENTS DUE TO AGEING

Older people have
• Lower level of visual acuity
• Problematic visual accommodation
• Poorer color discrimination ability
• Lower contrast sensitivity
• Reduced peripheral visual field
• Poorer adaptation to changing light levels
• Slower motion perception
VISUAL IMPAIRMENTS ASSOCIATED WITH AGEING

Text design

Visual impairments

Targets

Color

Graphics

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COGNITIVE & MOTOR IMPAIRMENTS ASSOCIATED WITH AGEING

Older people have

• Poorer focused attention
• Reduced selective attention
• Diminished divided attention
• More limited working memory
• Poorer perception and memory of spatial and graphic information
• Joint stiffening and arthritis
• Reduced ability to reduce interference from neutral noise
IMPLICATIONS OF COGNITIVE & MOTOR IMPAIRMENTS ASSOCIATED WITH AGEING
GUIDELINES FOR WEB/MOBILE WEB DESIGN FOR OLDER PEOPLE

Jointly with NTT Cyber Solution Laboratory, Japan

• 3 year project (2005~2008)
• Understand the difficulties of older people in using web and mobile web
• Obtain qualitative and quantitative information about perception, performance, and preference of older users
• Develop guidelines based on empirical results
• 16 laboratory experiments, 10+ focus groups, and 1 longitude study with older participants

Working closely with
• Center for the Study of Gerontology at Tsinghua University (http://www.tsinghua.edu.cn/docsns/shxx/site/old/)
• Two universities for aged citizens at Beijing
## A SERIES OF EXPERIMENTS ON MOBILE WEB USABILITY ISSUES

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Category</th>
<th>Focus</th>
<th>Independent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Display</td>
<td>Text design</td>
<td>- Size&lt;br&gt;- Text margin</td>
</tr>
<tr>
<td>2</td>
<td>Display</td>
<td>Information presentation</td>
<td>- Size of images&lt;br&gt;- Cross-page lines</td>
</tr>
<tr>
<td>3</td>
<td>Banners &amp; logo</td>
<td>Banners &amp; logo</td>
<td>- Location&lt;br&gt;- Number of banners</td>
</tr>
<tr>
<td>4</td>
<td>Navigation</td>
<td>Interaction</td>
<td>- Means to purchase&lt;br&gt;- Number of input items in one screen</td>
</tr>
<tr>
<td>5</td>
<td>Navigation</td>
<td>Navigation across pages</td>
<td>- Bread crumb list&lt;br&gt;- Presentation of purchase flow</td>
</tr>
<tr>
<td>6</td>
<td>Arrangement</td>
<td>Arrangement</td>
<td>- Alignment of selective objects&lt;br&gt;- Location of links to a top page</td>
</tr>
<tr>
<td>7</td>
<td>Search</td>
<td>Search</td>
<td>- Presentation of the number of results&lt;br&gt;- Total number of search results</td>
</tr>
<tr>
<td><strong>Focus group</strong></td>
<td></td>
<td>-</td>
<td>- Margin around logos&lt;br&gt;- Size of banners and logos&lt;br&gt;- Design of search results</td>
</tr>
</tbody>
</table>
TEXT SPACING DESIGN OF MOBILE WEB FOR OLDER PEOPLE

Questions:
• 1. Is the text spacing commonly used suitable for elders?
• 2. Does text spacing influence legibility or readability of texts for older adults?
• 3. Does text spacing influence older adults’ reading performance, visual fatigue, and their text preference?
• 4. Is inter-line spacing correlated with inter-character spacing?
INDEPENDENT VARIABLES

- A: Space between characters
- B: Space between lines

3*4 Latin Square Design
EXPERIMENTAL STUDY ON MOBILE TEXT DESIGN

Participants
- 12 60+ participants (M=66, STD=11.2) with mobile phone experience (M=4.2, STD=1.8)

Apparatus
- NEC N6305

Two types of tasks
- Visual search for specific characters in random texts
- Reading and answering questions
EXPERIMENTAL STUDY ON MOBILE TEXT DESIGN

Dependent variables
- Time and errors of visual search tasks
- Time and errors of reading tasks
- Readability, fatigue, satisfaction

Procedure

Introduction of the purpose of experiment → Consent form → Demographic information collection → Practical session → Experiment session → Post-experiment questionnaires → Thanks and gifts
RESULTS

Significant differences

- The larger the space between lines, the better the readability and the higher preference

<table>
<thead>
<tr>
<th>Variables</th>
<th>a=0px</th>
<th>a=2px</th>
<th>a=4px</th>
<th>F(2)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>STD</td>
<td>Mean</td>
<td>STD</td>
<td></td>
</tr>
<tr>
<td>Time of reading task(s)</td>
<td>39.70</td>
<td>16.65</td>
<td>40.41</td>
<td>19.22</td>
<td>40.86</td>
</tr>
<tr>
<td>Time of visual search task(s)</td>
<td>30.50</td>
<td>12.04</td>
<td>29.33</td>
<td>10.53</td>
<td>28.85</td>
</tr>
<tr>
<td>Error of reading task</td>
<td>0.13</td>
<td>0.32</td>
<td>0.13</td>
<td>0.17</td>
<td>0.09</td>
</tr>
<tr>
<td>Error of visual search task</td>
<td>0.04</td>
<td>0.08</td>
<td>0.11</td>
<td>0.18</td>
<td>0.06</td>
</tr>
<tr>
<td>Readability</td>
<td>4.50</td>
<td>1.56</td>
<td>5.21</td>
<td>0.95</td>
<td>5.94</td>
</tr>
<tr>
<td>Fatigue</td>
<td>3.91</td>
<td>1.41</td>
<td>3.59</td>
<td>1.51</td>
<td>2.86</td>
</tr>
<tr>
<td>Preference</td>
<td>3.92</td>
<td>1.53</td>
<td>4.58</td>
<td>0.98</td>
<td>5.31</td>
</tr>
</tbody>
</table>
RESULTS

Significant findings:

• The larger the space between characters, the better the readability and the higher preference

Marginal significance on fatigue

Table 8: Data for Testing the Effects of Space between lines

<table>
<thead>
<tr>
<th>Variables</th>
<th>b=2</th>
<th>b=4</th>
<th>b=6</th>
<th>b=8</th>
<th>F(3)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>STD</td>
<td>Mean</td>
<td>STD</td>
<td>Mean</td>
<td>STD</td>
</tr>
<tr>
<td>Readability</td>
<td>4.25</td>
<td>1.39</td>
<td>4.94</td>
<td>1.12</td>
<td>5.58</td>
<td>0.84</td>
</tr>
<tr>
<td>Fatigue</td>
<td>4.24</td>
<td>1.25</td>
<td>3.73</td>
<td>1.36</td>
<td>3.03</td>
<td>1.59</td>
</tr>
<tr>
<td>Preference</td>
<td>3.72</td>
<td>1.12</td>
<td>4.44</td>
<td>1.04</td>
<td>4.94</td>
<td>0.99</td>
</tr>
</tbody>
</table>
GUIDELINE DEVELOPED

• When the font size is 15*15 pixels (8 points), the recommended inter-line spacing is 6-8 pixels and the inter-character spacing is 2-4 pixels for higher text readability, lower visual fatigue, and higher user preference.

• Note: the spacing should not be used excessively since it will lead to extra scrolling operations.
SUMMARY OF USABILITY STUDIES FOR OLDER PEOPLE

• 21 guidelines for general web design and 13 guidelines for mobile web design were developed based on empirical results.

• Guidelines were applied in design of a travel community website for older people, and the website was evaluated by 12 older people through their 2 months of use.

• More problems related to actual use and long-term use were founded.

• Results provided a rich pool of investigation data on Chinese older web users’ behaviors.
PUBLICATIONS


UNDERSTANDING AND SUPPORTING SOCIABILITY OF OLDER PEOPLE WITH MOBILE TECHNOLOGY
EXPANDING SOCIABILITY OF OLDER PEOPLE WITH NEW TECHNOLOGY

Growing number of empty nest family and older people living along is likely to lead to

- Loneliness
- Social isolation
- Negative influences on psychological or even physical well-beings

Attempts to use mobile technology to support older people’s social life.

- It is difficult to design such technology from a purely technical perspective, since use of such technology is inherently embedded in social and cultural contexts.
- Related factors includes: living alone, social class, income, health/diseases, retirement, bereavement, and etc.
A SURVEY OF SOCIAL LIFE OF OLDER PEOPLE

• 100 older participants were interviewed
  • 50 from the University for the Aged at Tsinghua (Group 1), 50 from Chang’an XinCheng community in Beijing (Group 2)
INTERVIEW QUESTIONS

Demographic information and living status
- age, gender, household size, marriage status, number of children, kin, friends, level of education experience, income

Use of computers and mobile phones
- time of first use, computer type, place of use, frequency of use, frequently used functions, problems ever confronted with, people to turn to when have problems

Health conditions and requirements for health care information
- self-assessed health conditions, chronic disease, percentage covered by medical insurance, concerned health care information, methods to obtain information, actions taken to keep healthy, periodic physical examination, attitude toward activity coach and diet recommendations

Social activities
- Interaction with family members and friends
- Leisure time activities, frequency, number of partners, method of organizing
- Level of loneliness

Introduction of social community platform and nutrition advisor
- willingness to use, expected use scenarios and functions, attitude toward such applications
AGE AND GENDER

- 56 females, 44 males
- Aged averagely 65.35
INCOME PER MONTH

1. <1K  2. 1K~2K  3. 2K~3K  4. 3K~4K  5. 4K~5K  6. 5K~6K  7. 6K~7K  8. 7K~8K
## EDUCATION BACKGROUND

<table>
<thead>
<tr>
<th>Level</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 no school</td>
<td>6.6%</td>
<td>4.08%</td>
</tr>
<tr>
<td>1 pupil school</td>
<td>16.0%</td>
<td>16.0%</td>
</tr>
<tr>
<td>2 middle school</td>
<td>16.0%</td>
<td>16.0%</td>
</tr>
<tr>
<td>3 technical school</td>
<td>9.00%</td>
<td>14.07%</td>
</tr>
<tr>
<td>4 high school</td>
<td>10.0%</td>
<td>2.08%</td>
</tr>
<tr>
<td>5 junior college</td>
<td>2.08%</td>
<td>54.08%</td>
</tr>
<tr>
<td>6 bachelor</td>
<td>2.08%</td>
<td>0.35%</td>
</tr>
<tr>
<td>7 master</td>
<td>0.35%</td>
<td>0.00%</td>
</tr>
<tr>
<td>8 doctor</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

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HOUSEHOLD SIZE
USE OF COMPUTERS

**Computer Experience**

- **Never:** 21%
- **Less than 1 year:** 2%
- **1~2 years:** 5%
- **3~5 years:** 18%
- **6~10 years:** 17%
- **> 10 years:** 37%

**Major Uses of Computers**

- Online chatting/IM
- BBS/forum
- Downloading software
- Banking
- e-Commerce
- Listening music
- Watching Movie/Video
- Sending/receiving Email
- Other
- Stock
- Reading News
- Image/Video editing
- Searching for information
- Playing game

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PROBLEMS WITH COMPUTER USAGE: PRELIMINARY ANALYSIS

Major issues

• Fear of frauds (24)
• Difficulty in inputting with Pinyin (14)
• Not reliable or convenient service (12)
• Too much learning needed, not enough learning capability (12)
• Slow speed of networks or computers (10)
• Afraid to “destroy” data or system (9)
• Software updates too fast (8)
• Vulnerable to virus attack (6)
• English and jargons (5)
USE OF MOBILE PHONES

Mobile Phone Experience

- More than 10 years: 38%
- 6~10 years: 32%
- 3~5 years: 18%
- 1~2 years: 5%
- Less than 1 year: 1%
- Never: 6%

Major Use of Mobile Phone

- Call: 50%
- SMS: 65%
- Taking photos: 25%
- Other: 5%
- Game: 5%
- Music/Radio: 5%
- Timer: 1%
PROBLEMS WITH MOBILE PHONE USAGE: PRELIMINARY ANALYSIS

Major issues

• Difficulty with inputs
  • Pinyin (14)
  • Awkward keypads (3)
  • Strong preference with touch screens (11)
• English and jargons (17)
• Low motivation to learn more functions other than basic functions (13)
  • Other functions are “not so useful for us”
• Small texts/displays (8)
• Too complex functions (5)
  • Too much to learn, and easy to forget
• Fear for bad influence on health (3)
• Fear of being stolen (3)
• Cost (2)
LEISURE TIME ACTIVITIES

Leisure time activities

- Other
- Waist drum
- Fishing
- Kite flying
- Photography
- Pokers/Chess
- Chorus/Singing
- Reading
- Drawing/Caligraphy
- University for Aged
- Travel
- Swimming
- Pingpong
- Taichi soft power ball
- Walking/Jogging
- Taichi
- Dancing

More activities include doing volunteer work, watching performance, religious activities, playing music instruments, and etc.

FREQUENCY

<table>
<thead>
<tr>
<th>Frequency ( /month )</th>
<th>No. of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>43</td>
</tr>
<tr>
<td>21-40</td>
<td>36</td>
</tr>
<tr>
<td>41-60</td>
<td>14</td>
</tr>
<tr>
<td>61-80</td>
<td>4</td>
</tr>
<tr>
<td>81-100</td>
<td>2</td>
</tr>
<tr>
<td>100以上</td>
<td>1</td>
</tr>
</tbody>
</table>

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# THE WAY TO ORGANIZE ACTIVITIES

<table>
<thead>
<tr>
<th>Organizer</th>
<th>Method</th>
<th>Typical Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self</strong></td>
<td>FtF, phone, SMS, and Email</td>
<td>Dancing, hiking, Taichi, poker and chess, Pingpong, watching performance</td>
</tr>
<tr>
<td><strong>Residents’ committee</strong></td>
<td>FtF, phone, website, and announcement board</td>
<td>Dancing, chorus, hiking, Taichi, volunteer work</td>
</tr>
<tr>
<td><strong>Prior organization</strong></td>
<td>FtF, phone, website, Email, and announcement board</td>
<td>Dancing, chorus, hiking, gateball</td>
</tr>
<tr>
<td><strong>Associations</strong></td>
<td>FtF, phone, website, SMS</td>
<td>Calligraphy, drawing, photography, watching performance</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Phone</td>
<td>Special events</td>
</tr>
</tbody>
</table>
COMMUNICATION CHANNELS TO STAY CONNECTED

Major communication channels with other family members

- SMS: 34
- Online chatting: 16
- Email: 12
- FtF: 80
- Phone: 90

Major communication channels with friends

- Mail: 1
- SMS: 15
- Online chatting: 4
- Email: 18
- FtF: 65
- Phone: 77
# Health Problems

<table>
<thead>
<tr>
<th><strong>Typical age-related diseases</strong></th>
<th><strong>Problems with muscle-skeleton system</strong></th>
<th><strong>Problems with abdominal organs</strong></th>
<th><strong>Other</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>High blood pressure</td>
<td>Waist</td>
<td>Stomach</td>
<td>Eye problems</td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>Leg</td>
<td>Duodental ulcer</td>
<td>Sleep problems</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Cervical vertebra</td>
<td>Kidney</td>
<td>Cancer</td>
</tr>
<tr>
<td></td>
<td>Periarthritis of shoulder</td>
<td>Liver</td>
<td>cerebrovascular insufficiency syndrome</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypothyroid</td>
<td>Poor immunity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gall-stone</td>
<td>Hearing problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prostate</td>
<td>Memory problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teeth problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Constipation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dizziness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High uric acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low blood pressure</td>
</tr>
</tbody>
</table>
OBTAINING HEALTH-RELATED INFORMATION

**Sources of Health-Related Information**

- Lectures/training material: 21
- Internet: 28
- Family & friends: 21
- Sales: 5
- Book: 33
- Newspaper: 21
- TV: 71

**Wanted Information**

- Healthcare policy: 7
- Health products & supplements: 33
- Medicine knowledge: 39
- Exercise and massage: 39
- Healthy diet: 68

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FUTURE WORK

- Further analysis of qualitative and quantitative data to be done
- Results will be applied to modify design of location-based mobile social platform for older people...
FUTURE WORK

...and further development of mobile nutrition advisor.

- adequate amount of information in display
- self-explainable buttons
- no scrolling necessary
- adequate button size
- adequate font size (12pt)
THANKS FOR YOUR ATTENTION. ANY QUESTIONS?

Further contact:
• Email: gaoqin@tsinghua.edu.cn
• Tel: 8610-62788750