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Ergonomic analysis of washing machines for elderly people: A focus group-based study

He Huang[a,*], Minggang Yang[a], Taifeng Lv[b]

[a] School of Art, Design and Media, East China University of Science and Technology, No.130, Meilong Road, Shanghai, 200237, China
[b] College of Engineering, Ocean University of China, No.238, Songling Road, Qingdao, 266100, China

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ABSTRACT

Household appliances are especially important for elderly people living in homes. However, current manufacturers and designers of home appliances do not consider elderly people much more when pursuing new technology and new products. This study investigated the ergonomic problems for elderly people in the use of washing machines. Four focus groups with 31 Chinese elderly participants were conducted to explore four main topics: 1) Inconveniences and difficulties in the use of washing machines, 2) suggestions for the improvement of current washing machines, 3) demands and intentions for the functions of washing machines, and 4) human-machine interface design and user preferences for washing machines. The semi-structured script and open-ended questions could make the participants fully discuss the topics and express their opinions, and also allowed researchers to get a deep understanding of user's ideas. The results showed that using focus group method could get detailed insights of many ergonomic problems for elderly people, which could provide needed information for planning the development and design of more ergonomic washing machines considering elderly people.

Relevance to industry: More and more household appliances with new technology and new functions have entered our daily life. However, the characteristics and needs of elderly people are often neglected. This paper can provide guidelines and references for the inclusive design of washing machines and other household appliances.

1. Introduction

Countries all over the world are facing the challenge of an aging population. According to the estimates of the U. S. Census Bureau, the number of elderly people (aged 65 years and over) worldwide is expected to reach 829 million by 2025 (U. S. Census Bureau, 2004). The population of China has also been aging society since 1999, and China has a much faster population aging rate than many developed countries. In 2017, there were nearly 158 million people aged 65 years and over in China, accounting for 11.4% of the total population (NBS, 2017). By 2050, the proportion of the elderly population aged 65 and over will exceed 20% and China will continue to be the country with the largest aging population (UN DESA, 2017).

Aging is frequently associated with the gradual degeneration of physiological and cognitive functions, such as impairments of vision and hearing, loss of hand grip and dexterity, and decline in motor skills, reaction, memory and learning abilities. For example, a study conducted in Taiwan reported that nearly 10% of people aged 65 and older suffered from corrected visual impairment (Kuang et al., 2007). Tanjani et al. (2015) found that approximately half of people aged 60 and over had vision problems, approximately one-third had hearing problems, and nearly 40% had motor problems. After 60 years of age, there is also a rapid decline in hand-grip strength by as much as 20–25%, which reaches a 50% decline for people aged 80 and older and affects the normal functioning of their hands (Baumgartner et al., 1998; Carmeli et al., 2003). A survey from Parker et al., in 2006 revealed that the manual dexterity impairments of elderly people aged ≥65 years was nearly 18.0%. The data that Welford (1984, 1988) reviewed suggested that the simple reaction time of elderly people was approximately 20% longer than that of young people. Two previous studies reported that the prevalence rate for age-associated memory impairment and cognitive decline of elderly people (68–78 years of age) was 38.4% and 26.6%, respectively (Koivisto et al., 1995; Hänninen et al., 1996). Castro-Lionard et al. (2011) found that 19.9% of elderly people indicated that they had problems with their memory (short-term and episodic memory) in that study. Age-related deficits in learning abilities were also found in other previous studies (Van De Watering, 2005; Boulton-Lewis, 2010; Mohadis and Ali, 2014).

All of these impairments were also considered to cause limitations in performing activities of daily living (ADL) and instrumental activities

* Corresponding author.
E-mail address: 1983222hh@163.com (H. Huang).

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Table 1
Outline of the focus group session.

Event	Description	Estimated duration
Opening remarks	After a short speech of welcome, the moderator introduced the purposes of the study and encouraged the participants to discuss any point raised in the group, express their opinions freely. All their opinions were valued and equally welcome.	3 min
Survey	A written survey of the participants' overall ability/disability levels and usage of current washing machines.	10 min
Warm-up	Play the videos, illustrations, and pictures of using washing machines by elderly people, aimed to make a relax atmosphere preparing for the discussion of the topics.	10 min
Topic 1	Open-ended discussion of inconveniences and difficulties for elderly people in the use of washing machines, and the shortages of current machines.	25 min
Topic 2	Open-ended discussion of suggestions for the improvement of current washing machines.	20 min
Intermission	Participants reviewed five latest prototypes of washing machines (newly listed in 2017) placed on the edge of the conference room. A technical expert explained the latest functions and effects of washing machines to the participants.	10 min
Topic 3	Open-ended discussion of elderly people's demands and intentions for the functions of washing machines: • Elderly people's demands for the basic functions of washing machines, • Elderly people's intentions for the new functions of washing machines.	20 min
Topic 4	Open-ended discussion of human-machine interface design of washing machines and user preference: • Design of the washing machine doors, • The interface layouts of the control panel of washing machines, • The ways of select laundry procedure, • The displays of laundry information and program setting, • Types of buttons.	25min
Closing remarks	All participants could express any additional comments or opinions. Moderator thanked the participants.	2 min

of daily living (IADL), which are important for the life quality of elderly people. Survey data in industrialized countries, including the US, showed that nearly one-quarter of the population over the age of 65 had some form of disability (Pennathur et al., 2003; National Health Interview Survey, 2016). A national survey conducted in 22 provinces in China also found that nearly 40.5% of elderly people aged 65 and older had difficulties performing IADLs, of which 22.5% could only complete some ADLs (Hu, 2012).

Quality of life of elderly people has also received attention from ergonomists, and many studies have been conducted on elderly people. Some studies focused on the health and safety (Shephard, 2000; Zamora et al., 2008; Dueñas et al., 2016; Qiu and Xiong, 2017), activities and behavioural abilities of elderly people (Pinto et al., 2000; Kim et al., 2005; Dekker et al., 2007; Qu, 2015). Other studies focused on the usage and design of products for elderly people (Chan et al., 2009; Liang et al., 2012; Wu et al., 2015; Ma et al., 2016). Additionally, a series of inclusive design principles was also proposed (Clarkson et al., 2003; Coleman et al., 2007; Beniuk et al., 2011; Fletcher et al., 2015; Gonzalez and Morer, 2016).

However, few studies have been devoted to the ergonomic use of household appliances by elderly people. In recent decades, elderly people have become more likely to live alone and less likely to live with their children (Wu and Dang, 2013; UN DESA, 2017). Home-based care for elderly people makes household appliances more important to their quality of life, especially those who live independently. Although Koppa et al. (1989) analysed refrigerator designs for elderly people using an ergonomics approach, the variety of household appliances and high frequency of product updates today are not the same as those in the 1980s and 1990s for comparison purposes. Due to the use of products that have various functions and complex operations, the ergonomic problems of elderly people are increasingly prominent today, and existing products are not well adapted to their needs.

As one of the most important household appliances, washing machines are under constant development and include new products, technologies and functions. Panasonic used inclusive design principles to develop the “tilted-drum washing machine”, which could be easily used by most people, including elderly people and the disabled (Kawahara and Narikawa, 2015). However, there are still few products developed for elderly people in the market. Furthermore, most previous studies on washing machines mainly focused on energy consumption and the product's technical performance (Kim and Kim, 2007; Spelta et al., 2009; Bull, 2012; Jung and Jeong, 2015; Bao et al., 2017). Few studies have researched washing machines from the aspect of human factors. Therefore, it is necessary to conduct an ergonomic study of washing machines for elderly people.

This study used the washing machine as an example to explore ergonomic problems in the use of household appliances by elderly people. The aims of the present study were to

- investigate the inconveniences and difficulties of elderly people in using washing machines,
- acquire suggestions from elderly people for the improvement of current washing machines,
- explore the requirements and preferences of elderly people for washing machines,
- provide guidelines and references for the development and design of more ergonomic washing machines for elderly people.

2. Methods

As a robust user research method, focus groups have been widely used to help manufacturers and researchers explore the ergonomic problems of products (Caplan, 1990; Garmer et al., 2004; Savory et al., 2012; Stavrakos et al., 2016) and obtain deeper insights into the user's ideas and needs (Barrett, 2005; Blain-Moraes et al., 2012; Meng et al., 2016). The use of focus groups contributes to the development and design improvements of products (Bruseberg and McDonagh-Philp, 2002; Demirbilek and Demirkan, 2004; Savory et al., 2012). Compared with the use of a questionnaire survey and one to one interview, the focus group has the unique advantages of group interactions (synergy) through conference discussions and provides more insights into the experiences and viewpoints of users (Barrett and Kirk, 2000; Bruseberg and Mcdonagh-philp, 2002; Rajala and Väyrynen, 2011).

According to the recommendations of Barrett and Kirk (2000), using a focus group of elderly people should cover fewer topics and have a shorter session time. The focus group session performed in this study covered only four topics: 1) Inconveniences and difficulties in the use of washing machines, 2) suggestions for the improvement of current washing machines, 3) demands and intentions for the functions of washing machines, and 4) human-machine interface design and user preferences for washing machines. The whole session lasted nearly 2 h, and there was a 10 min intermission during which participants could review the five latest prototypes of washing machines presented in the conference room to better understand their new functions as explained by technical experts. It was important to adopt a semi-structured script and used open-ended questions (Table 1), which allowed the