Development of Protective Gloves for Gardening

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Introduction. A house with a beautiful yard will not only increase the property value but also help the owner fit into a local community (Robbins, Polderman, & Birkenholtz, 2001), build connections with neighbors, and demonstrate personal values (Nassauer, 1988). Moreover, gardening could benefit people of different ages. Gardening practice teaches children patience, establishes a moral code, enhances a sense of responsibility, develops the love of nature and improves social cohesion (Montessori, 1964). The concept of "gray and green" indicates the role of gardening in successful aging such as promoting healthy lifestyle, and producing fresh foods. As expected, gardening is becoming a popular home-based activity for US families (Clayton, 2007; Wright & Lund, 2000). A survey conducted by National Gardening Association showed a 2% annual increase in gardening participation in 2013. Meanwhile, A 1% increase in retail sales of lawn and garden product also suggested potential demands for gloves on manual performance (National Gardening Association, 2013), which suggested potential demands for gloves on manual performance. Although protective gloves are not a brand new concept—the first literature can be dated back to the World War II (Griffin, 1944), there is little research on more protective gloves for gardening. Therefore, this study aimed to determine gardeners' needs for protective gloves and identify important design factors. Its results will eventually provide gardeners with effective protection and help designers develop protective gardening gloves by understand consumer needs and wants.

Literature/Theoretical framework. A hand has two general functions: sensory and motor (Jones & Lederman, 2006). Sensory function includes tactile sensing, which gives information about texture or temperature, and active haptic sensing such as the stimulation resulted from objects' attaching to skin or joints. Motor function consists of prehensile movements, such as gripping or grasping, and non-prehensile skilled movements, such as gestures. All of these functions are essential to the development of a protective gardening glove and the final product needs to provide users with favorable sensory function without compromising any motor functions. Besides comfort and protection, social and aesthetic demands also needs researchers' attention. Hence, the three basic requirements for protective gardening gloves are comfort, function, and aesthetics.

Methodology. First, market research identified features of protective gardening glove which meet the any one of the three basic requirements identified in the literature review. After reviewing 52 gardening gloves on the current market, the extracted important design factors were: skin protection, comfortable movements, breathability, thermal comfort, low weight, thinness, length, ease of taking on and off, strain and dirt resistance, flexibility, softness, machine washability, ease of grip, water resistance, fire retardance, size, color, infection prevention, versatility, and sustainable designs. Second, 112 participants (male: 66%, female: 34%; M_{age}=31, SD_{age}=9.22) took an IRB-approved online questionnaire on personal preferences for each design

factor. Participants had to rank each product for each design factor based on detailed designs, corresponding product images, and descriptive sentences. Twenty open-ended questions collected participants' suggestions on glove designs. Descriptive analysis was conducted for quantitative data and open-coding for open-ended questions. Third, researchers developed a glove prototype based on the literature review, market research, and online survey. A user test focused on elderly women over their 60s, a majority in gardening with weak skins (National Gardening Association, 2009). Email invitations to a public lifelong center recruited participants. Thirteen female volunteers (M_{age}=70, SD_{age}= 6.46) who agreed on consent forms, 70% of whom garden at least once a week, participated. Participants tried on the glove prototypes and provided their perceptions in a group interview. The interviews were video-recorded and transcribed, data were coded, and main themes were extracted.

Results. The selected research results are: a) from the online questionnaire, 68% respondents indicated they had gotten injuries during gardening; b) the important design factors were: skin protection, comfortable movement, breathability, thermal comfort, low weight, ease of application and removal, prevention of dirt and insects, strain resistance, durability, flexibility, thinness, and infection prevention; c) Additional suggested design factors that were not indicated in the questionnaire were material (e.g., organic, hard), color (e.g., easy to find), smell (e.g., aroma, odorless), appearance (e.g., attractive), slippage prevention, and others (e.g., easy to carry, smart function, and certification); d) in the user test, all participants had suffered injuries when doing gardening and all except one said she would not purchase the glove since it was too bulky; e) design factors of the glove prototype most favored by users were: dirt prevention, protection, texture, durability, thickness, and ease of grip; f) the ideal price range was $30-$40; and g) potential uses of glove were suggested by users, such as protection from insects, ease of care, and chemical protections, which offer valuable insights for market positioning.

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