Health Monitoring Smart Clothing: Understanding its Acceptance among Older Adults

by

Nasif Mahmood

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Approved by

Young-A Lee, Chair, Associate Professor, Consumer and Design Sciences
Karla P. Teel, Associate Professor, Consumer and Design Sciences
William Murrah, Assistant Professor, Educational Foundations, Leadership, and Technology

Abstract

The overall purpose of this study was to investigate and understand the factors that affect older adults' perception and intention to adopt health monitoring smart clothing. The specific objectives of this study were: (1) to develop a theoretical framework by identifying the key factors that explain older adults' acceptance of health monitoring smart clothing and (2) to examine the perception and wearing intention of older adults' health monitoring smart clothing by testing the hypothetical research model. The conceptual model was developed by adapting theoretical elements from Functional-Expressive-Aesthetic Consumer Needs Model combined with tracking dimension and Unified Theory of Acceptance and Use of Technology.

An online survey was conducted with a nationwide convenience sample of 376 older adults living in U.S., purchased from reliable market service companies. Before answering the survey questionnaire, participants were guided to watch a short video clip introducing health monitoring smart clothing. The questionnaire consisted of (a) demographic information and (b) close-ended questions including 52 items adapted from the existing scales to measure the 11 constructs, using a 5-point Likert-type scale. Structural equation modeling was used to test overall fit and proposed hypothesized relationships among variables in the model. Moderating effect of the construct, familiarity with technology, in the model was tested by using the latent moderated structural equation.

The results from the overall model testing confirmed the positive significant effect of perceived expressive and tracking attributes on performance expectancy and effort expectancy. Perceived expressive attributes also significantly influenced social influence. Wearing intention was significantly influenced by performance expectancy and social influence. Seven out of 16 hypothesized paths in the proposed theoretical framework were supported.

The findings imply that older adults who are satisfied with expressive and tracking attributes of health monitoring smart clothing find it useful, easier to use, and socially acceptable, which lead them to more likely use it. This study addressed the existing literature gap which did not consider the impact of clothing attributes on perception and wearing intention of healthcare wearables. The findings can be a useful guide for the apparel industry professionals to expand their product category in this wearable healthcare market. Recommendations for future studies were also presented along with the limitations of this study.

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CHAPTER 1: INTRODUCTION

Smart wearables refer to electronic or computing devices that are worn or located near the body to track activities and transmit data (Fernández-Caramés & Fraga-Lamas, 2018). Using smart wearable devices, it is possible to read different biosignals emanating from the human body and monitor the health condition of an individual (Kaniusas, 2012). Smart clothing, one type of smart wearables, is created by integrating sensors into garments (Mendes, Vieira, Pires, & Stevan, 2016). With recent developments in conductive yarns and print-inks, it is now possible to integrate light-weight sensors within garments which can continuously monitor the health condition of a person (Majumder, Mondel, & Deen, 2017; Michael & Howard, 2017). Also, advancement has been made in developing power efficient, light-weight, and inexpensive computing devices which can analyze and transmit information in real-time (Majumder et al., 2017). These advancements have made producing and marketing health monitoring smart clothing for consumers a reality (Majumder et al., 2017; Michael & Howard, 2017). Smart clothing provides an unobtrusive, natural, and convenient method of tracking health parameters such as heart rate, respiratory rate, and body temperature (Fernández-Caramés & Fraga-Lamas, 2018).

With the increase of life expectancy in the U.S., healthcare for the aging population has become a major concern (Mather, Jacobsen, & Pollard, 2015). Health monitoring smart clothing, one type of smart clothing, provides an efficient solution to remotely care for older adults' health. Constant monitoring of vital signs (e.g., heart rate, blood pressure, body temperature) enables real-time healthcare from any location and alert healthcare providers in the case of an emergency. It also reduces the need for using on-site facilities (i.e., going to a medical or nursing center), which minimizes the associated cost and need of personnel. Wearing health monitoring smart clothing could eventually improve the quality of life for older adults by ensuring comfort, independent living, and participation in social activities.

The market for health monitoring smart clothing for older adults is at an initial stage. Less than 20 companies (e.g., Hexoskin, OMsignal, Supa, & AmbioTex) have launched health monitoring smart clothing in the globe (Sanyal, 2019; Sayem, Teay, Shahariar, Fink, & Albarbar, 2019). Health monitoring smart clothing that is currently available on the market are compression shirts that can track heart rate, respiratory rate, body temperature, and can detect a fall (Lin, Yang, Zhou, & Wu, 2018). However, market research shows huge potential for the growth of smart clothing in the future. Global Market Insights, Inc. predicts market share of smart clothing to cross 4 billion USD by 2024 (PR Newswire, 2017). Most of the research on health monitoring smart clothing that has been done is focused on developing related wearable technology and prototypes of embedded wearable devices (Aziz & Chang, 2018; Scataglini, Andreoni, & Gallant, 2018; Wei, Nagai, Jing, & Xiao, 2019). As such, with the growth of the market and to meet the healthcare demands of older adults, it is crucial to understand the factors that may influence older adults' perception and intention to wear health monitoring smart clothing.

Study Purpose and Objectives

The existing theories and literature related to health monitoring smart clothing for older adults are domain specific. Several theories exist to explain technology acceptance among individuals; for example, Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT), and United Theory of Acceptance and Use of Technology (UTAUT) (Davis, 1989; Rogers, 1995, Venkatesh, Morris, Davis, & Davis, 2003). However, these models did not comprehensively consider some important predictors such as psychological, biophysical, and contextual factors (Peek et al., 2016), which may play a major role in the case of technology acceptance, here acceptance of health monitoring smart clothing, by older adults.

Literature from geriatrics and gerontology provide explanations behind the behavior of older adults coping with aging-related difficulties (Macedo, 2017; Waites, 2013; Wang, Rau, & Salvendy, 2011). Clothing attributes of health monitoring smart clothing also need to be considered as it will be worn on the human body. To find a holistic answer, there is a need for a multidisciplinary approach taken by combining theories and findings from diverse disciplines such as clothing, geriatrics, healthcare, and technology to develop a conceptual model explaining older adults' perception and intention to wear health monitoring smart clothing.

Thus, the overall purpose of this study is to investigate and understand the factors that affect older adults' perception and intention to adopt health monitoring smart clothing by developing and evaluating a holistic model that consists of various concepts adopted from different fields. Specific research objectives of this study are:

1. To develop a theoretical model by identifying the key factors that explain older adults' acceptance of health monitoring smart clothing.
2. To examine the perception and wearing intention of older adults' health monitoring smart clothing by testing the hypothetical research model including the following variables: perceived functional attributes, perceived expressive attributes, perceived aesthetics attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention of smart clothing.

This study will provide a unique insight into factors that are needed to be considered while developing health monitoring smart clothing for older adults. By integrating theories and findings from different disciplines (e.g., clothing, healthcare, geriatrics, and technology acceptance), this study hopes to present a comprehensive solution that can guide the development of health monitoring smart clothing for older adults. Existing studies on healthcare wearables did not much consider clothing attributes; this literature gap will be addressed by this study. Future research on clothing with technological aspects can use this study as a guide for combining theoretical models from different disciplines while considering the specific needs of the target population. Findings from this study will also have practical implications. As the conceptual framework of this study is user-centered, product developers can utilize the findings from this study to make health monitoring smart clothing more compatible for older adults.

Theoretical Framework

The theoretical framework of this study is constructed primarily by adapting theoretical elements from: (1) Functional-Expressive-Aesthetic Consumer Needs (FEA) Model (Lamb & Kallal, 1992) combined with tracking dimension from Bakshian and Lee's (2018) holistic framework for the use of wearables and (2) Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Some other concepts are also included in the theoretical framework of this study to have a comprehensive understanding about acceptance of health monitoring smart clothing for older adults. The following sections explain the usage of these theories to develop an integrated theoretical framework which explains the acceptance of health monitoring smart clothing among older adults.

Consumers' Functional-Expressive-Aesthetic-Tracking Needs

Lamb and Kallal (1992) developed the Functional-Expressive-Aesthetic Consumer Needs (FEA) Model to identify needs and design apparel products with a specific purpose. The model consists of three clothing attributes: functional, expressive, and aesthetics. The FEA model did not include tracking attributes which is one of the unique features of smart clothing (Bakshian & Lee, 2018). Tracking attributes within Bakshian and Lee's (2018) holistic framework for the use of wearables was added as an additional dimension with three attributes of FEA model developed by Lamb and Kallal (1992). Functional attributes relate to the utilitarian aspects (fit, mobility, comfort, protection, and donning/doffing) of the apparel product. Expressive attributes relate to communicative or symbolic aspect (values, roles, status, and self-esteem) of the apparel product. Aesthetic attributes relate to beauty or attractiveness of the apparel product. Tracking attributes relate to monitoring aspect (physical health condition, mental health condition, healthy lifestyle, and productivity management) of the apparel product. Lamb and Kallal (1992) had the target consumer (intended user) at the center of their FEA model. Culture acted as the mediator between intended user and desired properties in apparel products.

The FEA model was chosen for this study as it is a user centered model focusing on consumer needs, which can be used to evaluate perception of older adults towards clothing attributes of health monitoring smart clothing. The FEA model is also one of the most commonly used clothing design models because it classifies clothing attributes into three themes (functional, expressive, and aesthetic) that can be applied to identify consumers' needs regardless of design types. The model has been used in previous studies related to smart clothing (e.g., Bakshian & Lee, 2018; Hwang, Chung, & Sanders, 2016; Lee, 2012).

The FEA model combined with tracking dimension from Bakshian and Lee's (2018) model provided an efficient approach to identify the clothing attributes of health monitoring smart clothing in this study. Clothing attributes identified from these two models were used in this study to understand the perception of older adults about clothing attributes of health monitoring smart clothing. In this study, the functional, expressive, aesthetic, and tracking attributes were integrated to form the clothing attributes proposed in the conceptual framework.

Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was developed by Venkatesh et al. (2003) to explain computer and information technology acceptance and use. Venkatesh et al. (2003) compared and synthesized eight prominent theories and models about technology acceptance (e.g., the technology acceptance model) to develop this unified model. According to the UTAUT model, intention to use technology is influenced by performance expectancy, effort expectancy, and social influence. Actual technology usage is influenced by facilitating condition and intention to use technology. The original UTAUT model had four variables (age, gender, experience, and voluntariness of use) moderating the relationships among the variables.

The UTAUT model has been chosen for this study because it is considered as a comprehensive model for explaining acceptance and usage of technology (Venkatesh, Thong, & Xu, 2016). Venkatesh et al. (2003) addressed limitations of existing models explaining technology acceptance while developing the UTAUT. In a longitudinal study, Venkatesh et al. (2003) showed the UTAUT can explain higher amount of variance in acceptance of technology compared to other technology acceptance models. The UTAUT model has been adapted previously in various studies looking into healthcare and technology acceptance among older adults (Gao, Li, & Luo, 2015; Macedo, 2017; Zhang, Luo, Nie, & Zhang, 2017). In this study, the following variables from the UTAUT model, performance expectancy, effort expectancy, and social influence, will be integrated into the proposed conceptual framework to explain wearing intention of health monitoring smart clothing among older adults.

Integration of Theories Used in the Study

To create the conceptual framework for the acceptance of health monitoring smart clothing for older adults in this study, functional-expressive-aesthetic attributes from Lamb and Kallal (1992), and tracking attributes from Bakshian and Lee (2018) will be combined with the following variables, performance expectancy, effort expectancy, and social influence, in the UTAUT model (Venkatesh et al., 2003).

In the FEA model, Lamb and Kallal (1992) divided clothing attributes into three groups: functional, expressive, and aesthetic. To integrate the health monitoring aspect of smart clothing in this study, tracking dimension was added to the conceptual framework as another clothing attribute like Bakshian and Lee (2018) proposed in their study. According to the UTAUT model (Venkatesh et al., 2003), performance expectancy, effort expectancy, and social influence are predictors for intention to use technology.

In this proposed conceptual framework, functional, expressive, aesthetic, and tracking attributes are the predictors for technology acceptance variables. Subsequently, the variables from the UTAUT model, performance expectancy, effort expectancy, and social influence, will predict the wearing intention of health monitoring smart clothing. However, the UTAUT model does not encompass all the variables that may influence or moderate the wearing intention of health monitoring smart clothing for older adults. Privacy concern was found to be a significant predictor in the case of adopting wearable healthcare devices (Li, Wu, Gao, & Shi, 2016). Several studies in older adults' technology adoption (Chen & Chan, 2014; Mahmood, Yamamoto, Lee, & Steggell, 2008; Peek et al., 2016; Schulz et al., 2014) found that existing health conditions have a significant influence on technology acceptance among older adults and in a healthcare context.

According to Social Emotional Selectivity Theory (Carstensen, 2006), with aging, individuals become selective in investing their efforts that will lead to maximum gain. Thus, previous experience or familiarity with technology may moderate influence of performance expectancy, effort expectancy, and privacy concern on wearing intention of health monitoring smart clothing. Figure 1 represents the conceptual framework proposed in this study.

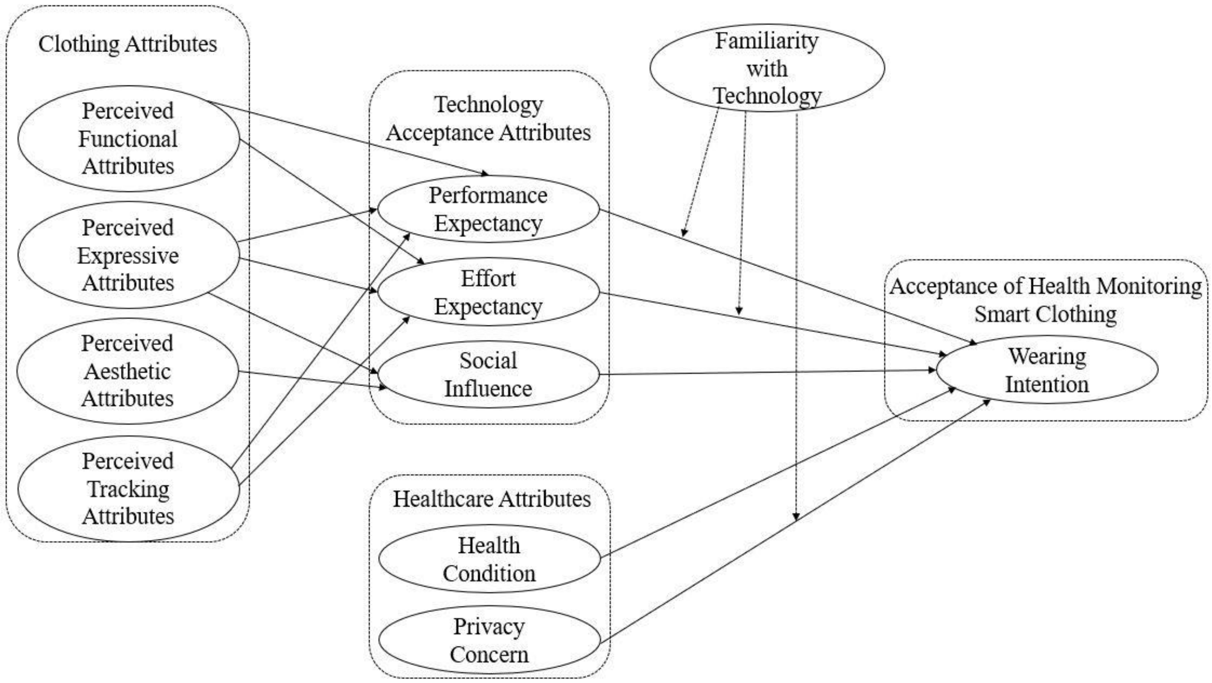

Figure 1. The proposed conceptual framework.
Note. The dotted line refers to moderating effect of the variable.

Definitions of Variables

Effort Expectancy: Refers to the degree of ease associated with the use of health monitoring smart clothing (Venkatesh et al., 2003).

Familiarity with Technology: Relates to the prior experience of older adults using similar kinds of technology.

Health Condition: Refers to the self-reported condition of physical and cognitive abilities of older adults.

Perceived Aesthetic Attributes: Relates to older adults' evaluation of attractiveness for styles and proportions in case of health monitoring smart clothing (Lamb & Kallal, 1992).

Perceived Expressive Attributes: Relates to the older adults' evaluation of communicative and symbolic aspects of health monitoring smart clothing that convey particular messages about the wearer in terms of identity, roles, status, and self-esteem (Lamb & Kallal, 1992).

Perceived Functional Attributes: Relates to the older adults' evaluation of utility of health monitoring smart clothing in terms of comfort, fit, protection, safety, thermal balance, mobility, and donning/doffing (Lamb & Kallal, 1992)

Perceived Tracking Attributes: Relates to older adults' evaluation of the monitoring of health conditions aspect of health monitoring smart clothing (Koo, 2017).

Performance Expectancy: The degree to which an older adult believes that using the health monitoring smart clothing will help them attain their goals. (Venkatesh et al., 2003).

Privacy Concern: Defined as older adults' concern about potential misuse of personal health information (Li et al., 2016).

Social Influence: Defined as the degree to which older adults perceive the importance that others believe they should use the health monitoring smart clothing (Venkatesh et al., 2003).

Wearing Intention of Smart Clothing: Refers to older adults' conscious plan to wear health monitoring smart clothing.

Assumptions

The assumptions made for this study are stated below in two categories: theoretical assumptions and methodological assumptions.

Theoretical Assumptions

1. Clothing is the most proximal human-built environment of human beings and meets various levels of needs.
2. Health monitoring smart clothing helps older adults to fulfill their health-related needs and wants.

Methodological Assumptions

1. Participants can understand the items and stimulus presented in the survey questionnaire and respond honestly.
2. The older adult sample obtained from the sampling company is representative of the U.S. older adult population.

CHAPTER 2: LITERATURE REVIEW

This chapter reviews relevant literature to explain the acceptance of health monitoring smart clothing among older adults regarding the variables proposed in the conceptual framework (see Figure 1). The first section of this chapter outlines the overall trends observed in the healthcare industry for older adults and the usage of smart clothing for remote monitoring. In the later sections, the proposed variables from the existing models (e.g., the FEA model, the UTAUT model) are discussed with arguments in favor of the hypothesized relationships. A hypothetical research model is proposed at the end of this chapter that is based on the literature review.

Wearable Technology and Health

Health Care for Older Adults

With the increase of longevity, health and wellness have become a major concern of the elderly population aged 65 years or older, also called “older adults.” In the U.S., 15% of the population is older than 65 years and it is predicted to grow to 24% in 2060 (Mather et al., 2015; Ortman, Velkoff, & Hogan, 2014). According to the projections of the U.S. Census Bureau (2018a), older adults will outnumber the population under the age of 18 by 2035. This trend is also visible worldwide; the World Health Organization predicts a rise in older adults around the globe from 524 million in 2010 to 1.5 billion by 2050 (National Institute on Aging, 2010).

Many factors have contributed to this unprecedented demographic shift: aging of the baby boomer generation, reduction in smoking behavior, advancement in medical treatment, and promoting an active lifestyle (Garza, 2016; Ortman et al., 2014). However, more than 80% of older adults are dealing with one or more chronic conditions such as cancer, dementia, diabetes, arthritis, obesity, heart disease, and falls (Garza, 2016; National Institute on Aging, 2010). As such, the existing infrastructure of the healthcare system will be challenged as the aging population continuously increases.

The aging population will require more healthcare resources as they are living longer and may suffer from various complications. On average in the U.S., annual healthcare cost of a person increases significantly with multiple chronic conditions (Sambamoorthi, Tan, & Deb, 2015). In 2014, older adults accounted for 35% of national health care expenditure in the U.S., although they were the smallest population group (15% of the total population; Centers for Medicare & Medicaid Services, 2019). Demands for caregivers is also increasing dramatically. There is a severe shortage in the number of registered nurses and physicians to meet the aging population's demands (IHS Markit Ltd., 2019). According to a projection by IHS Markit Ltd., (2019), the shortage of physicians in the U.S. will increase to 121,900 in 2032 from 20,400 in 2017. Due to various reasons (e.g., finance, transportation, geographical location), older adults may be hindered from getting the healthcare they need (Williams-Roberts, Abonyi, & Kryzanowski, 2018).

To offset the deficiencies in the current healthcare of older adults and to put emphasis on aging in place (i.e., remaining in own home during later years of life), remote monitoring of vitals of older adults can play a significant role. The need for healthcare resources of personnel, equipment, and hospital space will decrease via using remote monitoring system (Schulz et al., 2015). Continuous monitoring will also lead to better understanding of the dynamic nature of aging and disease while allowing older adults to live independently (Kang et al., 2010). In this study, the focus is remote monitoring of health conditions by using one type of wearables, smart clothing, for older adults.

Smart Clothing for Remote Monitoring

Smart clothing, when compared to other wearable devices, is a preferable choice for monitoring the vitals and other data related to health and wellness of older adults. Clothing is one of the closest environments with the human body and naturally embedded with our everyday life (Lee, 2011). Stigma associated with using visible medical devices can also be avoided by using inconspicuous smart clothing (Melenhorst, Roger, & Fisk, 2007). Smart clothing can capture more bio-signals than other wearable devices (e.g., wristband, chest strap) as it is in contact with larger amount of the human body (Fernández-Caramés & Fraga-Lamas, 2018).

Smart clothing generally operates using wearable sensors which integrate wireless sensor technology (Mendes et al., 2016). Generally, a wearable sensor system consists of sensors, memory and computational unit, power supply, and wireless communication protocol (Majumder et al., 2017). For older adults, sensors embedded in smart clothing are usually utilized for vital sign monitoring, physical activity recognition, and location detection (Wang, Yang, & Dong, 2017).

Regular monitoring of older adults' vital signs will help to establish a baseline for an individual's health, which will help to predict, diagnose, and alert the current health conditions to older adults and their health care providers, which can minimize the potential for a high risk medical situation. In addition, with advancement in technology, it is possible to continuously monitor vital signs of the human being comfortably with non-invasive sensors, which remain in contact with the human body (Fernández-Caramés & Fraga-Lamas, 2018). Monitoring of body temperature, heart rate, respiration rate, blood pressure, pulse oxygenation, and blood glucose gives valuable insights into physical and mental wellbeing of a person (Khan, Ostfeld, & Lochner, 2016). For example, anomaly in body temperature may indicate that a person is suffering from infection, fever, or reduced blood flow due to circulatory shock (Khan, Ostfeld, Lochner, Pierre, & Arias, 2016). Monitoring heart rate can help detect cardiovascular diseases

(Evans, Hodgkinson, & Berry, 2001).

Accelerometers and gyroscopes are mainly used in smart clothing as sensors to detect body movement (Heinz, Kunze, Gruber, Bannach, & Lukowicz, 2006). Through the monitoring system, both normal and irregular body movement such as lying down, walking, standing, reacting to chest pain, and falling can be monitored (Li et al., 2009). In the case of emergency, GPS and similar sensors can alert the location of older adults to emergency care providers. Nearly one-third of older adults living in the U.S. experience falling and one-third of older adults experiencing falling need medical intervention for their injuries (Stevens, Mack, Paulozzi, & Ballesteros, 2008). Thus, smart clothing will be very beneficial for older adults to detect and summon help after fall.

Clothing Attributes of Health Monitoring Smart Clothing for Older Adults

Functional Attributes

Comfort, fit, protection, safety, thermal balance, mobility, donning/doffing and other similar utilitarian properties are considered as functional attributes for clothing (Lamb & Kallal, 1992). Comfort is considered the most important aspect which is related to overall satisfaction of consumers with clothing (Sontag, 1985). Many researchers while looking into the applied use of clothing such as military, sailing, dancing, skating, cycling, and rock-climbing found the significant role of comfort to affect the wearer’s expectancy and satisfaction with clothing (Bye & Hakala, 2005; Dickson & Pollack, 2000; Jin & Black, 2012; Michaelson, Teel, & Chattaraman, 2018; Mitchka, Black, Heitmeyer, & Cloud, 2009; Shanley, Slaten, & Shanley, 1993; Stokes & Black, 2012). Clothing fit is another concern, especially among older adults, considering dramatic body shape changes that occur with aging (Lee, Dramhost, Lee, Kozar, & Martin, 2012).

In a study conducted on middle aged women, Huberty, Ehlers, Kurka, Ainsworth, and Buman (2015) found that comfort was one of the two main factors affecting the acceptability of wearable heath monitoring device. In another study by Charness, Best, and Evans (2016), the first impression of comfort and aesthetics influenced the acceptability of health monitoring smart devices among older adults. Hwang et al. (2016) found that perceived comfort (functionality) of solar powered smart clothing significantly influenced effort expectancy. In the same study, they also found the positive association between perceived comfort (functionality) and performance expectancy although influence of perceived comfort (functionality) was insignificant on performance expectancy.

Smart clothing may have additional integrated components compared to conventional clothing, which may cause discomfort and reduce acceptance among consumers (Cho, Lee, & Cho, 2009). Smart clothing considering functional attributes (e.g., making it more comfortable) will have higher performance expectancy and effort expectancy for users as they do not have to consider discomfort of the clothing. Based on the above arguments, the following proposition can be made that older adults' satisfaction with functional attributes of health monitoring smart clothing will positively influence performance expectancy and effort expectancy. Thus, hypothesis 1 is derived:

> **H1:** Perceived functional attributes of health monitoring smart clothing will have a positive, direct influence on (a) performance expectancy and (b) effort expectancy.

Expressive Attributes

Expressive attributes relate to the communicative and symbolic aspect of clothing (Lamb & Kallal, 1992). Clothing plays a vital role in the expression of self, commonly referred to as 'the visible self' (Sontag & Schlater, 1982). Older adults also want to express their own ideal image of self through the clothing they wear (Lee, 2011). Mainly, older adults are concerned about the age-appropriateness of clothing and compatibility with the image they want to present (Lee et al., 2012).

In a study on purchase intention of smart clothing (Ko, Sun, & Yun, 2009), compatibility (i.e., consistency with self-image) positively influenced acceptance of smart clothing among users. For solar-powered smart clothing, Hwang et al. (2016) found perceived compatibility (expressiveness) to be the strongest predictor for performance expectancy and its significant influence on effort expectancy.

Kellerman and Laird (1982) in an experimental study showed that perception about a person by him or herself (i.e., self-perception) or by others is influenced based on what the person is wearing. If an individual wants to be accepted within a certain group, the individual will conform to the norms set by the group (Deutsch & Gerard, 1955; Festinger, 1954). Self-image perceived by older adults through wearing health monitoring smart clothing will subsequently form social influence felt by older adults. Thus, it can be argued that if health monitoring smart clothing is consistent with the image of self that older adults want to represent, it will positively influence variables related with technology acceptance. Therefore, the following hypothesis 2 is derived:

> **H2:** Perceived expressive attributes of health monitoring smart clothing will have a positive, direct influence on (a) performance expectancy, (b) effort expectancy, and (c) social influence.

Aesthetic Attributes

Aesthetic attributes are related to individuals' desire for beauty (Lamb & Kallal, 1992). People consider style, color, design, and appearance of clothing while evaluating the aesthetics of clothing (Patrick & Xu, 2018). Previous research has found that older adults, especially older women, are concerned more about aesthetic attributes of the clothing they purchase (Borcherding

& Bubonia, 2015; Lee et al., 2012). For the studies conducted on older adults with various health conditions (e.g., cancer survivors, obese individuals, alzheimers), no matter which health condition they faced, aesthetics played a major role in increasing the acceptance and usability of wearable tracking devices (Abbate, Avvenuti, & Light, 2014; Batsis et al., 2018; Charness et al., 2016; Hardcastle et al., 2018).

In previous studies on acceptance of smart clothing, the significant relationship was found between aesthetic attributes and attitude towards smart clothing (Hwang et al., 2016; Lee, 2016). No previous research has specifically investigated aesthetic attributes of clothing regarding its influence on how consumers feel about perception of their peers although several studies suggested the relationship between these two concepts (Johnson, Lennon, & Rudd, 2014; Lee et al., 2012). Aesthetics of clothing can influence how a person feels about self and behavior, which in turn influences the perception of others (Johnson et al., 2014). Older adults similar to other age groups want to look attractive and are concerned about how they are perceived by others through the means of clothing they wear in society (Borcherding & Bubonia, 2015; Lee et al., 2012). Thus, it can be proposed that perceived aesthetic attributes of health monitoring smart clothing will positively influence social influence.

H3: Perceived aesthetic attributes of health monitoring smart clothing will have a positive, direct influence on social influence.

Tracking Attributes

Tracking different body parameters is one of the main features of health monitoring smart clothing. The original FEA model proposed by Lamb and Kallal (1992) did not include the dimension to examine tracking attributes, which can be limiting when implementing the FEA model in the study of smart clothing. Reflecting this limitation, Bakshian and Lee's (2018) included tracking attributes as one of the main constructs and proposed a holistic framework for the use of wearables by integrating clothing attributes and consumer behavioral aspects.

Thus, in this study, perceived tracking attributes will be used in addition to functional, expressive, and aesthetic attributes in the FEA model. Koo (2017) found that consumers who had a higher preference for tracking found wearable devices to be useful and easy to use. Thus, it can be assumed that satisfaction with tracking attributes of health monitoring smart clothing will positively influence performance expectancy and effort expectancy among older adults. The following hypothesis 4 is derived:

> **H4:** Perceived tracking attributes of health monitoring smart clothing will have a positive, direct influence on (a) performance expectancy and (b) effort expectancy.

The UTAUT Variables Related to Health Monitoring Smart Clothing for Older Adults

Performance Expectancy

In this study, performance expectancy refers to older adults' belief that using health monitoring smart clothing will increase their effectiveness in monitoring health conditions (Venkatesh et al., 2003). Many theoretical models investigating acceptance of new technology proposed the perceived usefulness of product (i.e., performance expectancy) as the strongest predictor for intention to use new technology. In various studies investigating the adoption of new technology in healthcare for older adults, performance expectancy or similar variable such as perceived usefulness played a significant role in predicting intention to use (Chen & Chan, 2014; Gao et al., 2015; Li, Ma, Chan, & Man, 2019). Based on the literature presented here, it can be assumed that older adults who think health monitoring smart clothing will help them to effectively monitor their health conditions are more likely to wear health monitoring smart clothing. Thus, the following hypothesis 5 is derived:

> **H5:** Performance expectancy will have a positive, direct influence on wearing intention of health monitoring smart clothing.

Effort Expectancy

Another variable in the original UTAUT model for predicting usage intention is effort expectancy; in this study, it refers to degree of ease associated with the use of health monitoring smart clothing (Venkatesh et al., 2003). In several studies related to smart clothing, ease of use was found to have positive influence on consumers' attitudes, which subsequently lead to purchase intention of smart clothing (Chae, 2009; Hwang et al., 2016). In some studies related to wearable healthcare devices, effort expectancy had a significant influence on technology adoption (Chen & Chan, 2014; Gao et al., 2015). Thus, the following hypothesis 6 is derived:

> **H6:** Effort expectancy will have a positive, direct influence on wearing intention of health monitoring smart clothing.

Social Influence

Social influence is another variable in the UTAUT model predicting usage intention of technology (Venkatesh et al., 2003). In the context of this study, social influence refers to the extent to which older adults' decision to use health monitoring smart clothing is influenced by important others' (e.g., family members, peers) perception of health monitoring smart clothing (Venkatesh et al., 2003). For different types of healthcare technology, social influence positively affected consumers' intention to adopt the healthcare device or technology (Miltgen, Popovič, & Oliveira, 2013; Sun, Wang, Guo, & Peng, 2013). As health monitoring smart clothing will likely be a new kind of product for older adults, they may dependent on suggestions from the people they believe to be important in their life. Thus, the following hypothesis 7 is derived:

> **H7:** Social influence will have a positive, direct influence on wearing intention of health monitoring of smart clothing.

Other Variables Related to Health Monitoring Smart Clothing for Older Adults

Health Condition

In addition to the UTAUT variables, performance expectancy, effort expectancy, and social influence, it is crucial to consider other variables (e.g., physical and cognitive abilities of older adults) to holistically capture wearing intention of health monitoring smart clothing for older adults. Consumers are more willing to adopt new technology to deal with ailments when they are more likely to suffer from it (Prentice-Dunn & Rogers, 1986). Perception of poor health can encourage older adults to adapt new technology (Chappell & Zimmer, 1999). Mahmood et al. (2008) identified health as one of the internal factors influencing adaptation of gerontechnology while aging in place. Thus, the following hypothesis 8 is proposed:

> **H8:** Health condition will have a negative, direct influence on wearing intention of health monitoring smart clothing.

Privacy Concern

Information collected by health monitoring smart clothing is comparatively sensitive and private compared to other kinds of information. According to Li et al. (2016), individuals decide their adoption of healthcare wearable devices based on the risk-benefit analysis of sharing personal information as suggested by the privacy calculus theory (Laufer & Wolfe, 1977), meaning that individuals compare benefits with probable negative consequences before sharing private information (Laufer & Wolfe, 1977). Gao et al. (2015) found perceived privacy risk as the most significant predictor for individuals' intention to adopt healthcare wearable devices. Keeping consistent with the prior theory and findings, the following hypothesis 9 is proposed:

> **H9:** Privacy concern will have a negative, direct influence on wearing intention of health monitoring smart clothing.

Familiarity with Technology

Familiarity with technology refers to previous experience of older adults using similar kinds of technology. Prior similar experience reduces uncertainty related with the present by providing relevant insights (Gefen, 2000). Chae (2009) found that consumers with higher technological innovation had higher perception of usefulness and ease of use with smart clothing, leading to higher acceptance of smart clothing, compared to consumers with low technological innovation.

Older adults in the U.K. with high prior experience had a positive perception of usefulness, ease of use, and efficacy towards Internet usage, and used the Internet more often (Adams, Stubs, & Woods, 2005). In another study on adoption of telemedicine (Menachemi, Burke, & Ayers, 2004), patients found telemedicine easier to use and useful when they were familiar with the apparatus used, which increased adoption of telemedicine.

According to Socioemotional Selectivity Theory (Carstensen, 2006), with aging, individuals become selective in investing effort that will lead to maximum gain. Thus, prior similar experience will motivate older adults to put more effort in activities they are familiar with (Carstensen, 2006). The effect of performance expectancy, effort expectancy, and privacy concern on the wearing intention may be moderated by familiarity with technology. Such an effect will be stronger with higher familiarity with technology. Thus, the following hypothesis 10 is proposed:

> **H10:** Familiarity with technology will moderate the effect of (a) performance expectancy, (b) effort expectancy, and (c) privacy concern on wearing intention of health monitoring smart clothing.

In sum, Figure 2 depicts the hypothetical relationships among the variables that will be examined in this study.

Summary

In this chapter, healthcare related problems that older adults face have been discussed with recent developments of health monitoring smart clothing, which can reduce the resources needed for healthcare and improve quality of life for older adults. Clothing is an integral part of an older adults' life and has been found helpful to cope with difficult situations. With the identification of clothing needs for older adults considering various clothing attributes (i.e., functional, expressive, and aesthetic), previous researchers have been able to design, develop, and/or find effective clothing for older adults (e.g., tennis wear, golf wear, activewear for female older adults). Tracking attributes also have been added with other clothing attributes to encompass the monitoring capability of health monitoring smart clothing.

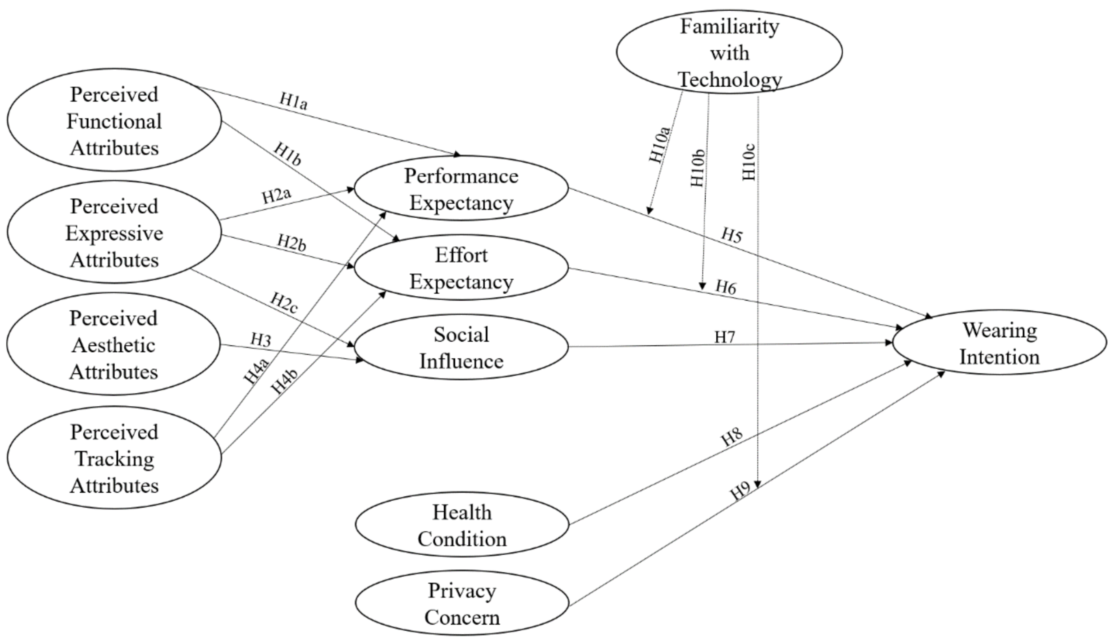

Figure 2. The proposed hypothesized model.
Note. The dotted line refers to moderating effect of the variable.

To understand the acceptance of health monitoring smart clothing among older adults, the relationship between clothing attributes and technology acceptance variables has been investigated in this study. Previous researchers Bakshian & Lee (2018) and Hwang et al. (2016) have proposed a relationship between clothing attributes and technology acceptance variables. Bakshian and Lee (2018) proposed a holistic framework, integrating functional, expressive, aesthetic, and tracking attributes with the technology acceptance model to explain the attitude and purchase intention of smart wearables among consumers. For solar-powered smart clothing, Hwang et al. (2016) found significant influence of clothing attributes on technology acceptance attributes.

In previous studies in which older adults used wearable tracking devices, attributes such as comfort and aesthetics were found to be influential in forming the opinion of older adults about effort expectancy, performance expectancy, and social influence. In this study, to understand the influence of clothing attributes on the acceptance of health monitoring smart clothing among older adults, the relationship between clothing attributes (functional, aesthetic, expressive, and tracking) and technology acceptance variables from the UTAUT model has been hypothesized.

Previous research showed the clear relationship of effort expectancy, performance expectancy, and social influence with usage intention of technology. Previous research also suggested that older adults are more willing to use technology if they perceive their health condition as poor. Intention to use health monitoring devices is also dependent on the privacy concern of users. Older adults will consider negative consequences of sharing information before using devices which has access to sensitive health related information.

Based on these findings from the previous studies, a conceptual model was proposed in this study. Findings of this study can provide valuable insights for academia and industry as limited research has been done to understand older adults’ perception and acceptance of smart clothing. Findings from this study can be used as a guide to make health monitoring smart clothing more compatible by understanding concerns and needs of older adults.

CHAPTER 3: METHOD

The overall purpose of this study was to investigate and understand the factors that affect older adults' intention to adopt smart clothing for health monitoring purposes. To achieve this objective, a self-administered online survey was used to test the hypothesized research model. A short video (see APPENDIX A) was used to familiarize the participants of the study with the concept of health monitoring smart clothing prior to questionnaire administration.

Statement on the Use of Human Subjects

Institutional Review Board (IRB) approval was requested from the University's Human Subject Review Committee before conducting the study. An approval from the IRB demonstrated that the rights and welfare of the human subjects was protected, the confidentiality of data from voluntary participants was assured, any possible risks to the subjects was avoided, and the data of this study was obtained by appropriate procedures of informed consent.

Population and Sample

The target population of this study was older adults, males and females age 65 and above who live in the U.S. A nation-wide convenience sampling approach was used, and the study participants were recruited via two different sources, Amazon's Mechanical Turk (MTurk) and Qualtrics. MTurk is an open, online, crowdsourcing marketplace that allows workers (paid task completers) to perform tasks that can be done at a computer (e.g., surveys) assigned by task creators (Buhrmester, Kwang, & Gosling, 2011). Previous empirical studies indicated that MTurk data are as reliable as traditional methods (Buhrmester, Kwang, & Goslin, 2011; Casler, Bickel, Hackett, 2013; Goodman, Cryder, & Cheema, 2013). Qualtrics consumer panel was also used to recruit the study participants. Qualtrics consumer panel recruits participants from various sources including website intercept recruitment, member referrals, targeted email lists, gaming sites, customer loyalty web portals, permission-based networks, and social media (Boas, Christenson, & Glick, 2018).

It is difficult to present the definite number of sample size for studies using structural equation modeling (SEM) (Kline, 2005). Several guidelines to estimate sample size have been proposed by various researchers; minimum sample size of 200 (Kline, 2005) or at least 10 cases per variable (Nunnally, 1967) is recommended to run SEM. Some researchers (Westland, 2010; Wolf, Harrington, Clark, & Miller, 2013) argue that it is problematic to use these guidelines to determine the sample size as these methods are not model-specific and do not consider some factors that may affect the sample size. Improper use of these guidelines may cause underestimating the sample size, which can lead to inadequate statistical power in the study (Westland, 2010).

To estimate the minimum sample size required for this study, software (Soper, 2019) based on a formula developed by Westland (2010) was used. Westland's formula (2010) considered anticipated effect size, number of latent variables, number of measured variables, statistical power, and statistical significance while making a priori estimation of the minimum sample size required for SEM. For this study, the minimum sample size should be 195 for the model structure and to detect effect, considering the number of observed items (52) and latent variables (11), anticipated effect size (.5), desired probability (.05), and statistical power level (.8). Since the sample size was estimated to be between 300-400 older adults in this study, it fulfills the minimum recommendation for sampling adequacy.

Data Collection Procedure

This study was administered via two different sources, MTurk and Qualtrics, to evaluate survey participants' perception and acceptance of health monitoring smart clothing. Participants was provided with an informed consent letter including an introduction of the study purpose and their rights prior to participating in the survey (see APPENDIX B, C, D, and E).

After they agreed to participate, they watched the short video clip describing health monitoring smart clothing features with product descriptions (monitoring of heart activity, respiration, fall detection, inactivity, and body temperature), benefits, and instructions on how to use the product as a stimuli (see APPENDIX A). Participants then responded to the survey questions including the following variables: perceived functional attributes, perceived expressive attributes, perceived aesthetics attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention of smart clothing (see APPENDIX F). The survey took approximately 10-15 minutes to complete. Participants who completed the survey were compensated for their time.

Stimuli

Prior to answering the questionnaire in the online survey, the participants viewed an informative video describing health monitoring smart clothing features. This video included images of commercially available health monitoring smart clothing (i.e., Master Caution® from Healthwatch) with product description (monitoring of heart activity, respiration, fall detection, inactivity, and temperature), benefits, and instructions on how to use the product (see Figure 3 and APPENDIX A).

To find a video complying with the stimulus criteria of this research (i.e., a video that explains smart clothing made for older adults for monitoring health related vitals), companies that are developing or marketing health monitoring smart cloths were first identified, using the keyword 'health monitoring smart clothing companies' in Google search engine. Sayem et al.'s

(2019) article including a comprehensive list of companies developing health monitoring smart clothing was identified and used as a reference to choose the right stimulus for this study.

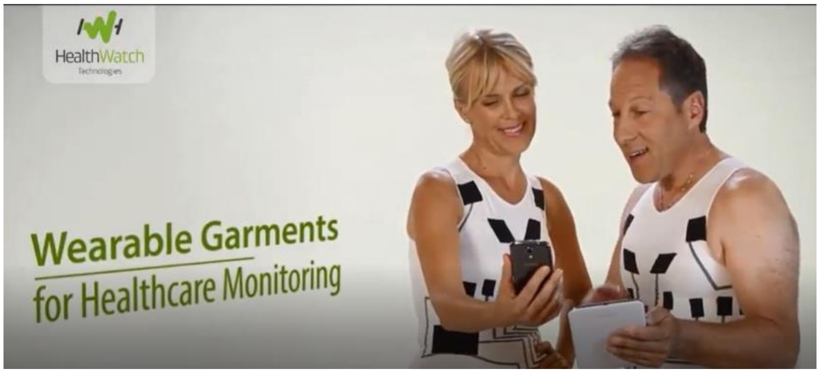

Figure 3. Screenshot from the video clip that was used as stimuli.

Sayem et al. (2019) listed the following 12 companies – Biodevices SA, Hexoskin, OM Signal, Emglare, Healthwatch, Siren, Neopanda, Mimo, AiQ, Myant, Smartlife Shirt, and BioSerenity – that are currently developing health monitoring smart clothing. Websites of these health monitoring smart clothing were explored to identify an informative video that can explain the features of health monitoring smart clothing for older adults. Neopanda and Mimo were omitted because their products were for newborns and babies.

Among the remaining companies, a video clip explaining features of Master Caution® from Healthwatch (https://www.youtube.com/watch?v=DLzDRyiLZ8o) was selected. Master Caution® from Healthwatch is a line of health monitoring smart clothing which continuously monitors the vitals of older adults. The selected video was considered the most compatible stimuli for this study. The original video was two minutes long and the researcher adjusted the clip to one and half minutes, which was used as the stimuli to measure perception toward the health monitoring smart clothing in this study (see APPENDIX A).

Instruments

The online survey questionnaire composed of three parts: (1) overall understanding of smart clothing by watching a short video clip about health monitoring smart clothing, (2) measures of the variables that are identified in this study, and (3) demographic information. The following measures was adapted from the previous research and modified for this study and presented in Table 1.

Perceived functional attributes. To measure older adults' perceived functional attributes (PFA) of health monitoring smart clothing, an eight-item scale was adapted from Lee (2016)'s functional needs dimension. A five-point Likert-type scale ranging from 1 = "strongly agree" to 5 = "strongly disagree" was used for all measurement items.

Perceived expressive attributes. Ten items were adapted from Lee (2016)'s perceived satisfaction with expressive needs dimension to measure the importance of perceived expressive attributes (PEA) towards health monitoring smart clothing for older adults. A five-point Likert-type scale ranging from 1 = "strongly agree" to 5 = "strongly disagree" was used for all measurement items.

Perceived aesthetic attributes. To measure perceived aesthetic attributes (PAA), eight items was adopted from Lee (2016)'s perceived satisfaction of aesthetic needs dimension. A five-point Likert-type scale ranging from 1 = "strongly agree" to 5 = "strongly disagree" was used for all measurement items.

Perceived tracking attributes. To measure perceived tracking attributes (PTA), four items was adapted from the study by Koo (2017). A five-point Likert-type scale ranging from 1 = "strongly agree" to 5 = "strongly disagree" was used for all measurement items.

Performance expectancy. To measure performance expectancy (PE) of health monitoring smart clothing among older adults, a three-item scale was adapted from Gao et al. (2015)'s study with changes in wording to fit the context of this study. A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Effort expectancy. To measure effort expectancy (EE) of health monitoring smart clothing among older adults, a four-item scale was adapted from Venkatesh et al. (2003) with changes in wording to fit the context of the study. A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Social influence. Three items were adapted and modified from Gao et al. (2015) for measuring social influence (SI). A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Health condition. To measure health condition, three-items will be adapted from Li et al. (2019). A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was be used for all measurement items.

Privacy concern. To measure privacy concern (PC), three-items were adapted from Li et al. (2016) and modified to fit the context of the study. A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Wearing intention. To measure wearing intention (WI) of smart clothing, three-items were adapted from Zhang et al. (2017) and modified to fit the context of the study. A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Familiarity with technology. To measure familiarity with technology in this study, three-items were adapted from Ryu, Kim, and Lee (2009) and modified to fit the context of the study. A five-point Likert-type scale ranging from 1 = “strongly agree” to 5 = “strongly disagree” was used for all measurement items.

Demographic information. Based on the assumption that study participants' responses will be influenced by their demographic characteristics as previous studies suggest (Creusen, 2010), participants were asked to provide demographic information (e.g., age, ethnicity, employment, education, household income, experience with the use of wearable technology) at the end of the questionnaire. Identified demographic characteristics were referred to analyze and interpret data results and provide implications and suggestions for future research. Table 1 summarized all measurement items, their respective response scales, and adaption sources for each measurement used in this study.

Data Analysis

Data analysis was performed with various steps based on the objectives of this study: descriptive analysis, confirmatory factor analyses for each scale, structural model test for important theoretical predictors of wearing intention of health monitoring smart clothing, and correlation analysis among variables. SPSS and Mplus was employed to conduct statistical analysis and model testing.

Descriptive statistics was used to present the participants' demographic information. The research model was tested using SEM as it is a powerful analytical tool to evaluate causal relationships among variables while allowing for measurement errors (Kline, 2005). A two-step approach was taken for SEM (Anderson & Gerbing, 1988). First, a measurement model was established and tested through confirmatory factor analysis (CFA) conducted with maximum likelihood estimation to examine the reliability and validity of measurements. Then, the proposed path model was tested to examine the hypothesized relationships among variables and model fit. Lastly, latent moderated structural equation (LMS) was used to test moderating effect (Klein & Moosbrugger, 2000).

Table 1. *Survey instrument: Measurement items, response scales, and sources*

Measurement Items	Response scales	Sources (Reported Cronbach's α)
Perceived Functional Attributes (8 items)		
Comfort of the smart clothing is important to me. Fit of the smart clothing is important to me. Protection of the smart clothing is important to me. Ventilation quality (e.g., being able to feel cool) of the smart clothing is important to me. Insulation quality (e.g., being able to feel warm) of the smart clothing is important to me. Bulkiness of the smart clothing matters to me. Convenience of wear and transport of the smart clothing is important to me. Satisfaction with the functional design characteristics of the smart clothing is important to me.	1 = Strongly disagreed, 5 = Strongly agreed	Lee (2016) (.84)
Perceived Expressive Attributes (10 items)		
Wearing smart clothing would help me see myself as a health-conscious person. Smart clothing would not distract from professionalism. Smart clothing would not distract from toughness/aggressiveness. Smart clothing would not make me look funny. Wearing smart clothing would help me convey my health-conscious identity as a person. Smart clothing would help me perform an appropriate gender role. Wearing the smart clothing would help with my self-image as a confident person. Wearing the smart clothing would positively impact my commitment to healthy lifestyle. Wearing the smart clothing would play an important role of conveying the importance of healthy lifestyle to others. The overall expressive design characteristics of smart clothing is important to me.	1 = Strongly disagreed, 5 = Strongly agreed	Lee (2016) (.93)

Table 1. (continued)

Measurement Items	Response scales	Sources (Reported Cronbach's α)
<u>Perceived Aesthetic Attributes</u> (8 items)		
The color of the smart clothing is important to me. The style of the smart clothing is important to me. The texture of the smart clothing is important to me. The uniqueness of the smart clothing is important to me. The unique design features of the smart clothing is important to me. The sleekness of the smart clothing is important to me. The gender appropriate design features of the smart clothing is important to me. The overall aesthetic design characteristics of the smart clothing is important to me.	1 = Strongly disagreed, 5 = Strongly agreed	Lee (2016) (.91)
<u>Perceived Tracking Attributes</u> (4 items)		
Tracking my physical health condition (e.g., heart rate, respiration, hydration) using smart clothing is important to me. Tracking my mental health condition (e.g., stress level, moods, and feelings) using smart clothing is important to me. Tracking my healthy lifestyle (e.g., fitness, physical activities, weight and diet) using smart clothing is important to me. Tracking my productivity management (e.g., location, time management skills, work productivity) using smart clothing is important to me.	1 = Strongly disagreed, 5 = Strongly agreed	Koo (2017) (.856)
<u>Performance Expectancy</u> (3 items)		
I find the smart clothing useful in my daily life. Using smart clothing helps accomplish things more quickly. Using smart clothing improves the quality of my daily healthcare seeking.	1 = Strongly disagreed, 5 = Strongly agreed	Gao et al. (2015) (.844)

Table 1. (continued)

Measurement Items	Response scales	Sources (Reported Cronbach's α)
Effort Expectancy (4 items)		
My interaction with the smart clothing will be clear and understandable. It would be easy for me to become skillful at using the smart clothing. I would find the smart clothing easy to use. Learning to operate the smart clothing is easy for me.	1 = Strongly disagreed, 5 = Strongly agreed	Venkatesh et al. (2003) (.91)
Social Influence (3 items)		
People who are important to me would think that I should use smart clothing. People who influence me would think that I should use smart clothing. People whose opinions are valued to me would prefer that I should use smart clothing.	1 = Strongly disagreed, 5 = Strongly agreed	Gao et al. (2015) (.865)
Health Condition (3 items)		
My health status is very good. My health status is very good compared with that of my peers. My auditory ability, visual ability, and mobility are very good.	1 = Strongly disagreed, 5 = Strongly agreed	Li et al. (2019) (.906)
Privacy Concern (3 items)		
It would be risky to disclose my personal health information to smart clothing vendors. There would be high potential for loss associated with disclosing my personal health information to vendors providing smart clothing. There would be too much uncertainty associated with giving my personal health information to vendors providing smart clothing.	1 = Strongly disagreed, 5 = Strongly agreed	Li et al. (2016) (.846)

Table 1. (continued)

Measurement Items	Response scales	Sources (Reported Cronbach's α)
Familiarity with Technology (3 items) (Experience in using automated healthcare services, wearable devices, using smartphones and computers)		
I have many experience in using the above-mentioned services. I believe that the experiences were quite useful for me. I can evaluate that these prior experiences were quite positive.	1 = Strongly disagreed, 5 = Strongly agreed	Ryu et al. (2016) (.938)
Wearing Intention of Smart Clothing (3 items)		
I am interested in using the smart clothing. I plan to adopt the smart clothing in the future. I will develop healthy habits with the smart clothing in the future.	1 = Strongly disagreed, 5 = Strongly agreed	Zhang et al. (2016) (.8733 male; .8909 female)

To determine internal consistency of each scale of variables, Cronbach's α greater than .70 was considered as an acceptable value (Cortina, 1993). Both convergent validity and divergent validity was tested to establish validity of the constructs. To test convergent validity, the following values were examined: standardized factor loadings of each variable, composite reliability (CR), and average variance extracted (AVE). For standardized factor loadings, .50 was set as a minimum acceptable value (Bagozzi & Yi, 1988). For CR and AVE, .70 and .50 was set as a minimum acceptable value (Nunnally & Bernstein, 1994; Fornell & Larcker, 1981), respectively. For divergent validity, AVE value of each variable was compared with square variances.

Finally, a structural path model was tested to examine the hypothesized relationships among variables and model fit. Chi-square (χ^2) and goodness-of-fit indices (e.g., CFI, TLI, RMSEA, SRMR) was estimated to test model fit with the data. Path coefficient (β), *p*-value, and R^2 values were examined. Hypotheses with $p < .05$ were accepted. Table 2 summarized methods used for data analyses of this study.

Table 2. *Methods used for data analysis*

Purpose of Analysis	Subjects Used in Analysis	Data Used in Analysis	Statistics Used
Demographics	300-400 participants of this study	Variables about personal demographics (e.g., age, ethnicity, education, gender)	Frequencies, percentages, descriptive statistics
Measurement model testing	300-400 participants of this study	Every variable in the conceptual framework	CFA, Cronbach's *α*, CR, AVE
Model fit and hypothesis testing	300-400 participants of this study	Every variable in the conceptual framework	SEM, LMS

CHAPTER 4: RESULTS

This chapter includes descriptions of the sample characteristics as well as the results of each research objective. Two research objectives are stated, the data are analyzed, and the findings are presented and discussed.

Sample Characteristics

Participants who met the criteria of this study were initially recruited via MTurk utilizing Qualtrics platform to host online survey. Only 220 useable responses were obtained through MTurk, which did not meet the sample size requirement (300-400) set for this study. To meet the desired sample size, Qualtrics' consumer panel service was used to obtain additional 156 responses using the same survey questionnaire. A comparison of demographic characteristics of 376 participants recruited from MTurk and Qualtrics is shown in Table 3. Participants recruited from both MTurk and Qualtrics showed similar demographic characteristics except for education and employment. Participants recruited from MTurk were more highly educated than those from Qualtrics. Compared with those from MTurk, the participants from Qualtrics were mostly retired.

Table 3. *Comparison between MTurk and Qualtrics panel participants* (N = 376)

Demographics	MTurk (n_M = 220)	Qualtrics Panel (n_Q = 156)
	Number (%)	Number (%)
Age (mean ± SD)		
65-69	131 (59.55%)	68 (43.58%)
70-74	69 (31.36%)	55 (35.26%)
75-79	17 (7.73%)	23 (14.74%)
80-84	3 (1.36%)	6 (3.85%)
85 and above	(0.00%)	4 (2.56%)
Gender		
Male	90 (40.91%)	55 (35.26%)
Female	130 (59.09%)	101 (64.74%)

Table 3. (continued)

Demographics	MTurk (n_M = 220)	Qualtrics Panel (n_Q = 156)
	Number (%)	Number (%)
<u>Ethnicity</u>		
White/European American	201 (90.13%)	139 (89.10%)
Black/African American	18 (8.07%)	15(9.62%)
American Indian/Alaska Native	3 (1.35%)	0 (0.00%)
Asian	1 (0.45%)	2 (1.28%)
Pacific Islander	0 (0.00%)	0 (0.00%)
Other	0 (0.00%)	0 (0.00%)
<u>Education</u>		
Less than high school	0 (0.00%)	1 (0.64%)
Some high school	3 (1.36%)	2 (1.28%)
High school degree	20 (9.09%)	47 (30.13%)
Some college	50 (22.73%)	42 (26.92%)
Associate degree	26 (11.82%)	15 (9.62%)
Bachelor’s degree	74 (33.64%)	21 (13.46%)
Some graduate school	8 (3.64%)	5 (3.21%)
Master’s degree	30 (13.64%)	18 (11.54%)
Doctorate Degree	5 (2.27%)	2 (1.28%)
Professional Degree	4 (1.82%)	2 (1.28%)
Other	0 (0.00%)	1 (0.64%)
<u>Employment</u>		
Retired	108(49.09%)	129 (82.69%)
Employed for wages	66 (30.00%)	16 (10.26%)
Self-employed	38 (17.27%)	4 (2.56%)
Out of work	3 (1.36%)	1 (0.64%)
Homemaker	0 (0.00%)	4 (2.56%)
Student	0 (0.00%)	0 (0.00%)
Military services	0 (0.00%)	0 (0.00%)
Unable to work	4 (1.82%)	2 (1.28%)
Other	1 (0.45%)	0 (0.00%)
<u>Income</u>		
Less than $10,000	11 (5.00%)	3 (1.92%)
$10,000 to $14,999	9 (4.09%)	11 (7.05%)
$15,000 to $24,999	31 (14.09%)	35 (22.44%)
$25,000 to $34,999	32 (14.55%)	22 (14.10%)
$35,000 to $49,999	31 (14.09%)	25 (16.03%)
$50,000 to $74,999	63 (28.64%)	36 (23.08%)
$75,000 to $99,999	21 (9.55%)	14 (8.97%)

Table 3. (continued)

Demographics	MTurk (n_M = 220)	Qualtrics Panel (n_M = 156)
	Number (%)	Number (%)
$100, 000 to $149,999	15 (6.82%)	5 (3.21%)
$150, 000 to $199,999	5 (2.27%)	2 (1.28%)
$200,000 or more	2 (0.91%)	3 (1.92%)

The demographic characteristics of the total sample (N = 376) are summarized in Table 4. In this study, the age of older adults ranged from 65 years to 88 years. The mean and median ages were 70.10 and 69, respectively with 4.12 standard deviation (SD). The sample comprised of 38.56% males and 61.44% females. The participants were predominantly White/European American (75%), followed by Black/African American (11%), American Indian/Alaska Native (0.79%), and Asian (0.79%). The median income range of the sample was $50,000 to $74,999. In terms of income, 26.33% earned $50,000 to $74,999, followed by the amounts of $25,000 to $34,999 (17.55%), $35,000 to $49,999 (14.89%), and $25,000 to $34,999 (14.36%). Around 45.23% of the participants held bachelor's degree or higher. The majority of the participants (63.03%) were retired.

Table 4. *Demographic characteristics of the research participants* (N = 376)

Demographics	Frequency	Percent (%)
Age		
65-69	199	52.93%
70-74	124	32.98%
75-79	40	10.64%
80-84	9	2.39%
85 and above	4	1.06%
Gender		
Male	145	38.56%
Female	231	61.44%

Table 4. (continued)

Demographics	Frequency	Percent (%)
<u>Ethnicity</u>		
White/European American	340	89.71%
Black/African American	33	8.71%
American Indian/Alaska Native	3	0.79%
Asian	3	0.79%
Pacific Islander	0	0.00%
Other	0	0.00%
<u>Education</u>		
Less than high school	1	0.27%
Some high school	5	1.33%
High school degree	67	17.82%
Some college	92	24.47%
Associate degree	41	10.90%
Bachelor's degree	95	25.27%
Some graduate school	13	3.46%
Master's degree	48	12.77%
Doctorate Degree	7	1.86%
Professional Degree	6	1.60%
Other	1	0.27%
<u>Employment</u>		
Retired	237	63.03%
Employed for wages	82	21.81%
Self-employed	42	11.17%
Out of work	4	1.06%
Homemaker	4	1.06%
Student	0	0.00%
Military services	0	0.00%
Unable to work	6	1.60%
Other	1	0.27%
<u>Income</u>		
Less than $10,000	14	3.72%
$10,000 to $14,999	20	5.32%
$15,000 to $24,999	66	17.55%
$25,000 to $34,999	54	14.36%
$35,000 to $49,999	56	14.89%
$50,000 to $74,999	99	26.33%
$75,000 to $99,999	35	9.31%
$100, 000 to $149,999	20	5.32%
$150, 000 to $199,999	7	1.86%
$200,000 or more	5	1.33%

To look at the representativeness of older adults in this study's sample with the U.S. older adult population, the composition of sample demographics was compared with the estimated older adult population demographics from the 2018 American Community Survey (U.S. Census Bureau, 2018b; U.S. Census Bureau, 2018c) (see Table 5). The participants' age of this study was more skewed towards the young-old (65-74 years old) when comparing with the U.S. older adult population. This may be caused by the data collection method, the self-administered online survey, used for this study. Participants of the survey were representative of the U.S. older adult population in terms of gender, education, and ethnicity. A greater portion of the study participants was within the lower-income range compared to the U.S. older adult population.

Table 5. C*omparison between the sample and U.S. older adult population*

Demographics	Study Sample (N = 376)	U.S. Older Adult Population Estimated in 2018 (n = 49,238,581)
	Percentage (%)	Percentage (%)
<u>Age</u>		
65-74	85.91%	57.95%
75-84	13.03%	29.44%
85 and above	1.06%	12.60%
<u>Gender</u>		
Male	38.56%	44.20%
Female	61.44%	55.80%
<u>Ethnicity</u>		
White/European American	89.71%	83.20%
Black/African American	8.71%	9.00%
American Indian/Alaska Native	0.79%	0.50%
Asian	0.79%	4.30%
Pacific Islander	0.00%	0.10%
Other	0.00%	1.80%
<u>Education</u>		
Less than high school graduate	0.00%	12.30%
High school graduate	17.82%	27.10%

Table 5. (continued)

Demographics	Study Sample (n = 376)	U.S. Older Adult Population Estimated in 2018 (n = 49,238,581)
	Percentage (%)	Percentage (%)
Some college or associate degree	35.37%	29.00%
Bachelor's degree or higher	44.96%	31.50%
Income		
Less than $10,000	3.72%	3.00%
$10,000 to $14,999	5.32%	2.00%
$15,000 to $24,999	17.55%	8.00%
$25,000 to $34,999	14.36%	12.00%
$35,000 to $49,999	14.89%	15.00%
$50,000 to $74,999	26.33%	18.00%
$75,000 or more	17.82%	41.00%

Preliminary Analysis of the Data

It is critical to investigate and describe the distribution of the data before data analysis, which allows to check any violation of assumptions for running structural equation model. The normality of the data was examined by looking at skewness and kurtosis value, histogram, and Q-Q plot for each item measured. Values for mean, variation, skewness, and kurtosis of each item are presented in Table 6. Additionally, correlations among all 52 items measured in this study are reported in APPENDIX G. The values of skewness ranged from -1.802 to 0.952, while the values of kurtosis ranged from -1.398 to 4.075. Absolute values of skewness of each item were less than 2. Absolute value of kurtosis for items measuring endogenous latent variables were less than 1.5. In this study, no additional steps were necessary to deal with missing data as the participants needed to answer every item before submitting the survey.

To perform subsequent statistical analyses (i.e., confirmatory factor analysis, structural equation modeling, latent moderated structural equation), a maximum likelihood estimation

Table 6. *Descriptive statistics of observed items*

Observed Items (Item Abbreviation)	Mean	Variance	Skewness	Kurtosis
Comfort of the smart clothing is important to me. (PFA_1)	4.314	0.779	-1.676	3.314
Fit of the smart clothing is important to me. (PFA_2)	4.261	0.757	-1.670	3.631
Protection of the smart clothing is important to me. (PFA_3)	4.005	0.947	-1.119	1.285
Ventilation quality (e.g., being able to feel cool) of the smart clothing is important to me. (PFA_4)	4.348	0.732	-1.802	4.075
Insulation quality (e.g., being able to feel warm) of the smart clothing is important to me. (PFA_5)	4.013	0.976	-1.069	0.997
Bulkiness of the smart clothing is important to me. (PFA_6)	4.215	0.924	-1.590	2.620
Convenience of wear and transport of the smart clothing is important to me. (PFA_7)	4.205	0.780	-1.384	2.353
The overall functional design characteristics of the smart clothing is important to me. (PFA_8)	4.218	0.825	-1.594	3.123
Wearing smart clothing would help me see myself as a health-conscious person. (PEA_1)	3.588	1.077	-0.755	0.220
Smart clothing would not distract from professionalism. (PEA_2)	3.548	0.913	-0.439	-0.166
Smart clothing would not distract from toughness/aggressiveness. (PEA_3)	3.569	0.899	-0.526	0.246
Smart clothing would not make me look funny. (PEA_4)	3.465	0.972	-0.370	-0.134
Wearing smart clothing would help me convey my health-conscious identity as a person. (PEA_5)	3.415	1.136	-0.515	-0.238
Smart clothing would help me perform an appropriate gender role. (PEA_6)	2.811	1.158	-0.093	-0.530
Wearing the smart clothing would help with my self-image as a confident person. (PEA_7)	2.923	1.300	-0.096	-0.751
Wearing the smart clothing would positively impact my commitment to healthy lifestyle. (PEA_8)	3.657	1.135	-0.908	0.457
Wearing the smart clothing would play an important role of conveying the importance of healthy lifestyle to others. (PEA_9)	3.253	1.322	-0.399	-0.578
The overall expressive design characteristics of smart clothing is important to me. (PEA_10)	3.641	1.214	-0.723	-0.065

Table 6. (continued)

Observed Items (Item Abbreviation)	Mean	Variance	Skewness	Kurtosis
The color of the smart clothing is important to me. (PAA_1)	3.476	1.058	-0.376	-0.435
The style of the smart clothing is important to me. (PAA_2)	3.918	0.820	-1.061	1.540
The texture of the smart clothing is important to me. (PAA_3)	4.168	0.655	-1.427	3.451
The uniqueness of the smart clothing is important to me. (PAA_4)	3.277	1.136	-0.238	-0.467
The unique design features of the smart clothing is important to me. (PAA_5)	3.463	1.057	-0.472	-0.241
The sleekness of the smart clothing is important to me. (PAA_6)	3.628	1.021	-0.644	0.157
The gender appropriate design features of the smart clothing is important to me. (PAA_7)	3.763	1.037	-0.859	0.541
The overall aesthetic design characteristics of the smart clothing is important to me. (PAA_8)	3.867	0.791	-0.826	0.828
Tracking my physical health condition (e.g., heart rate, respiration, hydration) using smart clothing is important to me. (PTA_1)	3.766	1.318	-0.822	-0.042
Tracking my mental health condition (e.g., stress level, moods, and feelings) using smart clothing is important to me. (PTA_2)	3.370	1.515	-0.422	-0.766
Tracking my healthy lifestyle (e.g., fitness, physical activities, weight and diet) using smart clothing is important to me. (PTA_3)	3.596	1.379	-0.703	-0.308
Tracking my productivity management (e.g., location, time management skills, work productivity) using smart clothing is important to me. (PTA_4)	3.093	1.574	-0.135	-1.001
I find the smart clothing useful in my daily life. (PE_1)	3.370	1.185	-0.549	-0.292
Using smart clothing helps accomplish things more quickly. (PE_2)	2.904	1.257	0.019	-0.680
Using smart clothing improves the quality of my daily healthcare seeking. (PE_3)	3.513	1.335	-0.746	-0.155
My interaction with the smart clothing would be clear and understandable. (EE_1)	3.723	0.769	-0.804	1.123
It would be easy for me to become skillful at using the smart clothing. (EE_2)	3.715	0.815	-0.754	0.826

Table 6. (continued)

Observed Items (Item Abbreviation)	Mean	Variance	Skewness	Kurtosis
I would find the smart clothing easy to use. (EE_3)	3.697	0.897	-0.734	0.587
Learning to operate the smart clothing is easy for me. (EE_4)	3.684	0.871	-0.689	0.559
People who are important to me would think that I should use smart clothing. (SI_1)	3.250	1.203	-0.349	-0.513
People who influence me would think that I should use smart clothing. (SI_2)	3.149	1.164	-0.197	-0.529
People whose opinions are valued to me would prefer that I should use smart clothing. (SI_3)	3.152	1.208	-0.242	-0.586
My health status is very good. (HC_1)	2.378	1.150	0.694	-0.212
My health status is very good compared with that of my peers. (HC_2)	2.332	1.094	0.699	0.020
My auditory ability, visual ability, and mobility are very good. (HC_3)	2.136	0.931	0.952	0.570
It would be risky to disclose my personal health information to smart clothing vendors. (PC_1)	2.628	1.239	0.227	-0.715
There would be high potential for loss associated with disclosing my personal health information to vendors providing smart clothing. (PC_2)	2.681	1.329	0.133	-0.900
There would be too much uncertainty associated with giving my personal health information to vendors providing smart clothing. (PC_3)	2.551	1.295	0.292	-0.742
I have many experience in using the above-mentioned services. (F_tech_1)	2.899	1.931	-0.057	-1.398
I believe that the experiences were quite useful for me. (F_tech_2)	3.351	1.462	-0.543	-0.572
I can evaluate that these prior experiences were quite positive. (F_tech_3)	3.335	1.372	-0.494	-0.515
I am interested in using the smart clothing. (WI_1)	3.338	1.543	-0.493	-0.742
I plan to adopt the smart clothing in the future. (WI_2)	3.059	1.263	-0.228	-0.533
I will develop healthy habits with the smart clothing in the future. (WI_3)	3.255	1.376	-0.436	-0.579

method was used in this study. According to Kline (2005), maximum likelihood is the preferred estimation method in SEM analysis when endogenous variables are continuous and normal. Kline (2005) also pointed out that most of the published articles conducting SEM used maximum likelihood over other estimation methods. However, Kline (2005) warns that the deviation from normality may bias the findings because this estimation method is based on normal theory (Kline, 2005). Finney and DiStefano (2006) noted, though there are no definite cutoff values, maximum likelihood estimation can be considered robust enough to handle skewness and kurtosis value approaching 2 and 7, respectively. Hair et al. (2018) also pointed out for multivariate analysis, effect of non-normality is quite low for sample sizes greater than 200. Based on the preliminary analysis, it was determined that the amount of non-normality presented in the observed data of this study is acceptable; thus, maximum likelihood estimation was applied when running data analysis for this study.

Measurement Model Testing

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) using Mplus 8.4 was executed to test validity and reliability of the following 11 constructs in the measurement model: perceived functional attributes, perceived expressive attributes, perceived aesthetics attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention. The composite and discriminant validity of all constructs were also examined. Before examining the goodness of fit of the measurement model, standardized factor loading and squared multiple correlations were reviewed to examine possible casual relationships between variables in the measurement model, and then the model fit was tested to assess how well the proposed measurement model fits the data. The initial CFA was conducted with the measurement model on 11 factors and 52 items.

As shown in Table 7, the initial CFA results revealed that standardized factor loadings of the indicators for all construct were statistically significant at $p < .001$. Standardized factor loadings ranged from .555 (PEA_2) to .958 (F_TECH_2). As shown in Table 8, the initial measurement model was in a good fit ($\chi^2 = 3100.835$, $df = 1219$, $p < .001$, CFI = .891, TLI = .882, RMSEA = .064, SRMR = .882). However, this model has a room to improve; thus, additional steps were taken to improve the initial measurement model.

According to Kline (2005), while re-specifying the measurement model, it is crucial to prioritize theoretical considerations. During this re-specification stage of the measurement model, it is also important to look over values of the standardized factor loading, standardized residuals, item correlation, and modifications indices (Hair et al., 2018; Kline, 2005). Followed by these guidelines, item removals from the initial measurement model were based on the theoretical grounds while considering other factors in this study. As a result, the following items were removed from the initial measurement model before running further analysis: one item from perceived functional attributes (PFA_5), seven items from perceived expressive attributes (PEA_1, PEA_5, PEA_6, PEA_7, PEA_8, PEA_9, PEA_10), three items from perceived aesthetic attributes (PAA_4, PAA_5, PAA_6), one item from perceived tracking attributes (PTA_4), and one item from effort expectancy (EE_1).

The CFA results of the final model with 39-item 11 constructs showed that each factor loading of the indicators for each construct were statistically significant at $p < .001$. Standardized factor loadings ranged from .669 (PAA_1) to .958 (F_TECH_2) (see Table 9). As shown in Table 8, global fit indices showed the overall fit improvement of the final model ($\chi^2 = 1202.978$, $df = 647$, $p < .001$, CFI = .956, TLI = .950, RMSEA = .048, SRMR = .045) compared to the

Table 7. *Results of the initial measurement model testing with 11 factors and 52 items* (N = 376)

Constructs/Measurement Items (Item Abbreviation)	Standardized Factor Loading
Perceived Functional Attributes	
Comfort of the smart clothing is important to me. (PFA_1)	.824***
Fit of the smart clothing is important to me. (PFA_2)	.823***
Protection of the smart clothing is important to me. (PFA_3)	.799***
Ventilation quality (e.g., being able to feel cool) of the smart clothing is important to me. (PFA_4)	.816***
Insulation quality (e.g., being able to feel warm) of the smart clothing is important to me. (PFA_5)	.689***
Bulkiness of the smart clothing is important to me. (PFA_6)	.749***
Convenience of wear and transport of the smart clothing is important to me. (PFA_7)	.832***
The overall functional design characteristics of the smart clothing is important to me. (PFA_8)	.830***
Perceived Expressive Attributes	
Wearing smart clothing would help me see myself as a health-conscious person. (PEA_1)	.812***
Smart clothing would not distract from professionalism. (PEA_2)	.555***
Smart clothing would not distract from toughness/aggressiveness. (PEA_3)	.566***
Smart clothing would not make me look funny. (PEA_4)	.603***
Wearing smart clothing would help me convey my health-conscious identity as a person. (PEA_5)	.841***
Smart clothing would help me perform an appropriate gender role. (PEA_6)	.666***
Wearing the smart clothing would help with my self-image as a confident person. (PEA_7)	.772***
Wearing the smart clothing would positively impact my commitment to healthy lifestyle. (PEA_8)	.837***
Wearing the smart clothing would play an important role of conveying the importance of healthy lifestyle to others. (PEA_9)	.849***
The overall expressive design characteristics of smart clothing is important to me. (PEA_10)	.685***
Perceived Aesthetic Attributes	
The color of the smart clothing is important to me. (PAA_1)	.623***
The style of the smart clothing is important to me. (PAA_2)	.738***
The texture of the smart clothing is important to me. (PAA_3)	.718***
The uniqueness of the smart clothing is important to me. (PAA_4)	.691***
The unique design features of the smart clothing is important to me. (PAA_5)	.716***
The sleekness of the smart clothing is important to me. (PAA_6)	.697***

Table 7. (continued)

Constructs/Measurement Items (Item Abbreviation)	Standardized Factor Loading
The gender appropriate design features of the smart clothing is important to me. (PAA_7)	.723***
The overall aesthetic design characteristics of the smart clothing is important to me. (PAA_8)	.820***
Perceived Tracking Attributes	
Tracking my physical health condition (e.g., heart rate, respiration, hydration) using smart clothing is important to me. (PTA_1)	.860***
Tracking my mental health condition (e.g., stress level, moods, and feelings) using smart clothing is important to me. (PTA_2)	.848***
Tracking my healthy lifestyle (e.g., fitness, physical activities, weight and diet) using smart clothing is important to me. (PTA_3)	.874***
Tracking my productivity management (e.g., location, time management skills, work productivity) using smart clothing is important to me. (PTA_4)	.761***
Performance Expectancy	
I find the smart clothing useful in my daily life. (PE_1)	.913***
Using smart clothing helps accomplish things more quickly. (PE_2)	.789***
Using smart clothing improves the quality of my daily healthcare seeking. (PE_3)	.878***
Effort Expectancy	
My interaction with the smart clothing would be clear and understandable. (EE_1)	.775***
It would be easy for me to become skillful at using the smart clothing. (EE_2)	.868***
I would find the smart clothing easy to use. (EE_3)	.888***
Learning to operate the smart clothing is easy for me. (EE_4)	.915***
Social Influence	
People who are important to me would think that I should use smart clothing. (SI_1)	.921***
People who influence me would think that I should use smart clothing. (SI_2)	.928***
People whose opinions are valued to me would prefer that I should use smart clothing. (SI_3)	.938***
Health Condition	
My health status is very good. (HC_1)	.885***
My health status is very good compared with that of my peers. (HC_2)	.886***

Table 7. (continued)

Constructs/Measurement Items (Item Abbreviation)	Standardized Factor Loading
My auditory ability, visual ability, and mobility are very good. (HC_3)	.734***
Privacy Concern	
It would be risky to disclose my personal health information to smart clothing vendors. (PC_1)	.868***
There would be high potential for loss associated with disclosing my personal health information to vendors providing smart clothing. (PC_2)	.937***
There would be too much uncertainty associated with giving my personal health information to vendors providing smart clothing. (PC_3)	.882***
Familiarity with Technology	
I have many experience in using the above-mentioned services. (F_tech_1)	.793***
I believe that the experiences were quite useful for me. (F_tech_2)	.958***
I can evaluate that these prior experiences were quite positive. (F_tech_3)	.950***
Wearing Intention of Smart Clothing	
I am interested in using the smart clothing. (WI_1)	.917***
I plan to adopt the smart clothing in the future. (WI_2)	.930***
I will develop healthy habits with the smart clothing in the future. (WI_3)	.945***

Note. *$p < .05$; **$p < .01$; ***$p < .001$

Table 8. *Goodness of fit summary: Initial Measurement Model versus Final Measurement Model* (N = 376)

Fit Index	Measurement Model		Recommendation by Hu & Bentler (1999)
	Initial Model	Final Model	
Chi-square (χ^2)	3100.835 $df = 1219$ $p < .001$	1202.978 $df = 647$ $p < .001$	$p > .05$
χ^2/df	2.544	1.859	< 3.0
CFI	0.891	0.956	> .90
TLI	0.882	0.950	> .90
SRMR	0.064	0.045	< .08
RMSEA	0.064	0.048	< .08

Note. χ^2/df = normed fit chi-square; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = Standardized Root Mean Square Residual; RMSEA = root mean square error of approximation.

initial model. Based on the conventional guidelines regarding acceptable values for global model fit criteria, the global fit of the final measurement model is satisfactory (Hair et al., 2018; Hu & Bentler, 1999; Kline, 2005). Table 8 presented the model fit statistics of the initial and final measurement models and the comparison of these values with recommended fit values by Hu and Bentler (1999). Table 9 includes the results of measurement model testing with 11 factors and 39 items, which was used for the next step of the structural path model testing.

Table 9. *Results of the final measurement model testing with 11 factors and 39 items* (N = 376)

Constructs/Measurement Items (Item Abbreviation)	Std. Factor Loading	Cronbach's α	Construct Reliability (CR)	Average Variance Extracted (AVE)
<u>Perceived Functional Attributes</u>		.930	.930	.658
Comfort of the smart clothing is important to me. (PFA_1)	.829***			
Fit of the smart clothing is important to me. (PFA_2)	.827***			
Protection of the smart clothing is important to me. (PFA_3)	.794***			
Ventilation quality (e.g., being able to feel cool) of the smart clothing is important to me. (PFA_4)	.804***			
Bulkiness of the smart clothing is important to me. (PFA_6)	.748***			
Convenience of wear and transport of the smart clothing is important to me. (PFA_7)	.840***			
Satisfaction with the functional design characteristics of the smart clothing is important to me. (PFA_8)	.832***			
<u>Perceived Expressive Attributes</u>		.824	.825	.611
Smart clothing would not distract from professionalism. (PEA_2)	.797***			
Smart clothing would not distract from toughness/ aggressiveness. (PEA_3)	.785***			
Smart clothing would not make me look funny. (PEA_4)	.764***			

Table 9. (continued)

Constructs/Measurement Items (Item Abbreviation)	Std. Factor Loading	Cronbach's α	Construct Reliability (CR)	Average Variance Extracted (AVE)
Perceived Aesthetic Attributes		.865	.870	.573
The color of the smart clothing is important to me. (PAA_1)	.669***			
The style of the smart clothing is important to me. (PAA_2)	.815***			
The texture of the smart clothing is important to me. (PAA_3)	.791***			
The gender appropriate design features of the smart clothing is important to me. (PAA_7)	.699***			
The aesthetic design characteristics of the smart clothing is important to me. (PAA_8)	.800***			
Perceived Tracking Attributes		.896	.898	.746
Tracking my physical health condition (e.g., heart rate, respiration, hydration) using smart clothing is important to me. (PTA_1)	.895***			
Tracking my mental health condition (e.g., stress level, moods, and feelings) using smart clothing is important to me. (PTA_2)	.821***			
Tracking my healthy lifestyle (e.g., fitness, physical activities, weight and diet) using smart clothing is important to me. (PTA_3)	.873***			
Performance Expectancy		.893	.895	.740
I find the smart clothing useful in my daily life. (PE_1)	.923***			
Using smart clothing helps accomplish things more quickly. (PE_2)	.772***			
Using smart clothing improves the quality of my daily healthcare seeking. (PE_3)	.879***			
Effort Expectancy		.921	.922	.799
It would be easy for me to become skillful at using the smart clothing. (EE_2)	.856***			
I would find the smart clothing easy to use. (EE_3)	.893***			
Learning to operate the smart clothing is easy for me. (EE_4)	.930***			

Table 9. (continued)

Constructs/Measurement Items (Item Abbreviation)	Std. Factor Loading	Cronbach's α	Construct Reliability (CR)	Average Variance Extracted (AVE)
Social Influence		.950	.950	.863
People who are important to me would think that I should use smart clothing. (SI_1)	.921***			
People who influence me would think that I should use smart clothing. (SI_2)	.928***			
People whose opinions are valued to me would prefer that I should use smart clothing. (SI_3)	.938***			
Health Condition		.872	.875	.701
My health status is very good. (HC_1)	.883***			
My health status is very good compared with that of my peers. (HC_2)	.887***			
My auditory ability, visual ability, and mobility are very good. (HC_3)	.733***			
Privacy Concern		.924	.924	.803
It would be risky to disclose my personal health information to smart clothing vendors. (PC_1)	.868***			
There would be high potential for loss associated with disclosing my personal health information to vendors providing smart clothing. (PC_2)	.936***			
There would be too much uncertainty associated with giving my personal health information to vendors providing smart clothing. (PC_3)	.883***			
Familiarity with Technology		.921	.930	.816
I have many experience in using the above-mentioned services. (F_tech_1)	.792***			
I believe that the experiences were quite useful for me. (F_tech_2)	.958***			
I can evaluate that these prior experiences were quite positive. (F_tech_3)	.951***			

Table 9. (continued)

Constructs/Measurement Items (Item Abbreviation)	Std. Factor Loading	Cronbach's α	Construct Reliability (CR)	Average Variance Extracted (AVE)
Wearing Intention of Smart Clothing		.950	.951	.866
I am interested in using the smart clothing. (WI_1)	.918***			
I plan to adopt the smart clothing in the future. (WI_2)	.930***			
I will develop healthy habits with the smart clothing in the future. (WI_3)	.944***			

Note. *$p < .05$; **$p < .01$; ***$p < .001$

Assessment of Reliability and Validity

The values from the final model of CFA were used to assess the psychometric properties of the constructs. Construct reliability (CR) and average variance extracted (AVE) values were tested for examining the convergent validity presenting correlations among each item of the same construct and discriminant validity showing distinctions of constructs of the instrument (Fornell & Larcker,1981). The CR and AVE values for each construct were presented in Table 9. Values of all factors' CR were above .70, confirming reliability of each construct and the AVE values of each factor were also higher than an acceptable range of .50 (Fornell & Larcker,1981). Additionally, to establish internal consistency of each scale of variables, Cronbach's *α* was also measured and all values were greater than .70 (Cortina, 1993) (see Table 9). Convergent validity was determined adequate for this final measurement model as all standardized factor loadings were high and CR and AVE values were greater than .70 and .50, respectively (see Table 9).

To look at discriminant validity of the measurement model, the square root value of AVE with correlation coefficients (i.e., shared variances) between all possible pairs of latent constructs were compared as suggested by Fornell and Larcker (1981) (see Table 10). The square root value of AVE for each latent construct was greater than their corresponding correlation coefficients except for the following two pairs: perceived tracking attributes and performance expectancy, and performance expectancy and wearing intention. However, it was only two cases among 55 pairings of correlation coefficients and the difference by which the correlation coefficients exceeded square root value of AVE was considerably low. Moreover, the square root value of AVE of wearing intention exceeded its correlation with performance expectancy, and AVE values of latent constructs of perceived tracking attributes, performance expectancy, and wearing intention were quite high. Overall, the measurement model of this study exhibited acceptable discriminant validity.

Structural Path Model and Hypotheses Testing

After the measurement model was confirmed, subsequent analyses were done to test the hypothesized relationships among variables. To test the structural path model and main effects of the theoretical framework, SEM was performed using the maximum likelihood estimation method. LMS was used to test the moderating effect of the latent construct, familiarity with technology, shown in the hypothesis 10. The findings of these two analyses, SEM and LMS, are displayed with all relevant information in Figure 3. Ten hypotheses were developed based on theoretical grounds and previous empirical findings. The hypothesized model consisted of the following 11 latent constructs: perceived functional attributes, perceived expressive attributes, perceived aesthetics attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention of smart clothing.

Table 10. *Correlation coefficients among 11 latent constructs*

	PFA	PEA	PAA	PTA	PE	EE	SI	WI	PC	F_TECH	HC
PFA	**.811**										
PEA	.448***	**.782**									
PAA	.630***	.375***	**.757**								
PTA	.390***	.569***	.407***	**.863**							
PE	.359***	.687***	.382***	.881***	**.860**						
EE	.348***	.599***	.291***	.582***	.689***	**.893**					
SI	.214***	.516***	.279***	.697***	.796***	.492***	**.929**				
WI	.291***	.614***	.330***	.836***	.923***	.620***	.782***	**.930**			
PC	.089	.307***	.056	.338***	.363***	.310***	.271***	.373***	**.896**		
F_TECH	.230***	.283***	.256***	.347***	.449***	.442***	.327***	.424***	.014	**.903**	
HC	-.102	-.136*	-.059	.031	.003	.180**	.054	.043	.077	.105	**.837**

Note. [a] The bold diagonal values are the square root value of the average variance extracted for each construct.
[b] PFA = Perceived functional attributes; PEA = Perceived expressive attributes; PAA = Perceived aesthetic attributes; PTA = Perceived tracking attributes; PE = Performance expectancy; EE = Effort expectancy; SI = Social influence; WI = Wearing intention; PC = Privacy concern; F_TECH = Familiarity with technology; HC = Health concern.
[c] *p < .05; **p < .01; ***p < .001

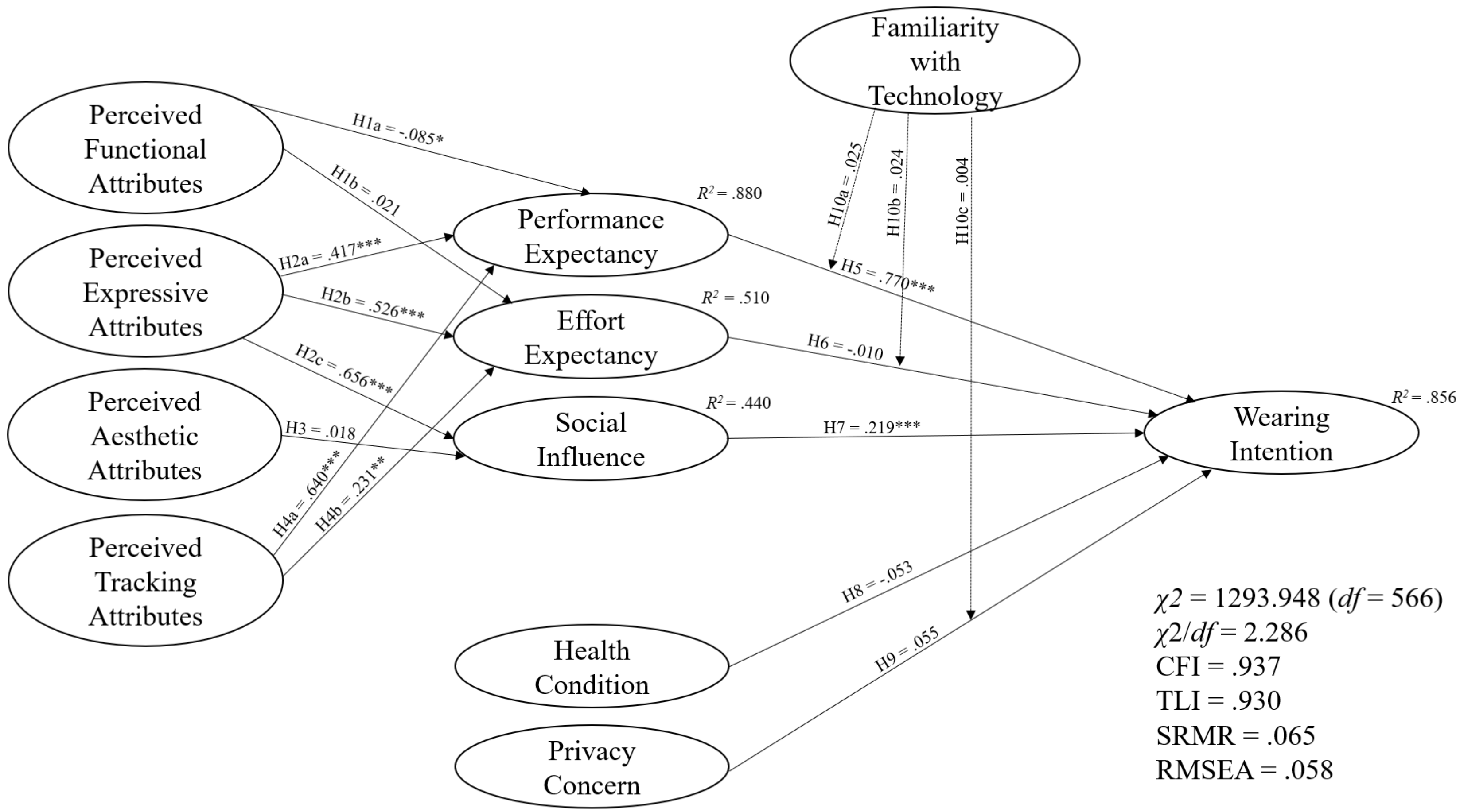

Figure 4. Research model with findings.

Note. *p < .05; **p < .01; ***p < .001
Standardized estimates values for H10 are from the LMS model and all other values reported here are from the SEM model.

Test of Main Effects Using Structural Equational Modeling

Model testing. The results of SEM for the hypothesized model revealed χ^2 of 1293.948 (*df* = 566, *p* < .001), CFI of .937, TLI of .930, RMSEA of .058, and SRMR of .065, confirming the satisfactory model fit.

Hypothesis testing. The following sections discuss the results of hypotheses (H1-H9).

> **H1:** Perceived functional attributes of health monitoring smart clothing have a positive, direct influence on (a) performance expectancy and (b) effort expectancy.

Results showed that perceived functional attributes did not exhibit a positive relationship with performance expectancy. Perceived functional attributes negatively influenced performance expectancy (H1a: *ß* = -.085, *p* = .011), which is opposite to the direction of the proposed hypothesis. Bivariate correlation between perceived functional attributes and performance expectancy was positive (.348), suggesting the presence of suppression effect (Kline, 2005). However, the *ß* value was quite small regardless of the direction, which can be interpreted as the minimal influence of perceived functional attributes on performance expectancy when considering all other variables in the structural model.

The relationship between perceived functional attributes and effort expectancy also was not supported (H1b: *ß* = -.021, *p* = .667). This finding suggests that older adults do not think comfort and other utilitarian properties make wearing health monitoring smart clothing useful and easier, which contradicts with Hwang et al.'s (2016) findings on the acceptance of solar powered smart clothing among college students and faculty. This finding warrants further investigation if presence of other variable have caused such contradiction with previous studies.

> **H2:** Perceived expressive attributes of health monitoring smart clothing have a positive, direct influence on (a) performance expectancy, (b) effort expectancy, and (c) social influence.

All three proposed influences of perceived expressive attributes on performance expectancy, effort expectancy, and social influence were supported. The path between perceived expressive attributes and performance expectancy was positive and significant (H2a: $ß = .417$, $p < .001$). The paths of perceived expressive attributes on both effort expectancy and social influence also were positive and significant (H2b: $ß = .526$, $p < .001$; H2c: $ß = .656$, $p < .001$, respectively). Similar to Hwang et al.'s (2016) findings, perceived expressive attributes was the strongest predictor for technology acceptance attributes (see Figure 3). Other studies (Bakhshian & Lee, 2019; Lee, 2016) also found the significant influence of expressive attributes on consumers' attitude and behavioral intention of wearables. These findings extend the previous findings, which confirm that older adults prefer clothing compatible with their own image (Lee et al., 2012). This finding also illustrates the importance of an expressive aspect of health monitoring smart clothing when making health monitoring smart clothing be more adaptable for older adults.

H3: Perceived aesthetic attributes of health monitoring smart clothing have a positive, direct influence on social influence.

The hypothesis predicting positive influence of perceived aesthetic attributes on social influence was not supported (H3: $ß = .018$, $p = .758$). This finding is different to prior studies which found the significant relationship between aesthetic attributes and attitude towards smart clothing (Hwang et al., 2016; Lee, 2016). However, in the prior studies (Hwang et al., 2016; Lee, 2016), the end use of smart clothing was not healthcare related, which may be the reason behind the different result of this study compared with those of previous studies. This finding suggests, for older adults, aesthetic attributes of health monitoring smart clothing are less important than other clothing attributes such as expressive.

H4: Perceived tracking attributes of health monitoring smart clothing have a positive, direct influence on (a) performance expectancy and (b) effort expectancy.

The results showed that perceived tracking attributes positively influenced performance expectancy and effort expectancy (H4a: *ß* = .640, $p < .001$; H4b: *ß* = .231, $p = .003$), respectively. This result is consistent with the findings from Koo's (2017) and Gao et al.'s (2015) studies. The significance of the structural paths for the hypothesized relationship suggests that tracking health related parameters of wearers is the primary function of health monitoring smart clothing.

H5: Performance expectancy has a positive, direct influence on wearing intention of health monitoring smart clothing.

Performance expectancy positively predicted wearing intention of health monitoring smart clothing for older adults (H5: *ß* = .770, $p < .001$). When older adults perceive health monitoring smart clothing to be useful, they are more likely to use it. As shown in Figure 3, performance expectancy was the strongest predictor of wearing intention for older adults. This finding is consistent with the findings of previous studies on healthcare wearables and technology acceptance of older adults (Chen & Chan, 2014; Gao et al., 2015; Li et al., 2019).

H6: Effort expectancy has a positive, direct influence on wearing intention of health monitoring smart clothing.

Results of the path model testing did not support this hypothesis predicting a positive influence of effort expectancy on wearing intention (H6: *ß* = -.010, $p = .793$). This finding is quite contradictory to other studies that found effort expectancy to be an important predictor of technology acceptance (Chae, 2009; Chen & Chan, 2014; Gao et al., 2015; Hwang et al., 2016). This contradictory result may be due to the skewed sample of this study. Majority of the participants in this study belonged to the young-old and were familiar with the use of technology, which tells that the participants of this study might have higher proficiency and confidence to use new technology than those of the previous studies.

> **H7:** Social influence has a positive, direct influence on wearing intention of health monitoring of smart clothing.

Social influence positively influenced wearing intention of health monitoring smart clothing for older adults (H7: *ß* = .219, $p < .001$). This finding is consistent with previous findings related to technology acceptance (Gao et al., 2015; Miltgen et al., 2013; Sun et al., 2013). Similar to all other age groups, older adults are not apathetic toward opinions of their peers and intention to use health monitoring smart clothing is influenced by others' opinions. This finding supports Mathur's (1999) argument that technology adoption of older adults become easier with the presence of socializing agents (e.g., younger family member).

> **H8:** Health condition has a negative, direct influence on wearing intention of health monitoring smart clothing.

Influence of health condition was found not significant on wearing intention of health monitoring smart clothing for older adults (H8: *ß* = -.053, $p = .054$). This finding contradicts with the findings of previous studies using older adult population from other cultures and countries, which showed the significant influence of self-reported health condition on usage intention of healthcare wearables (Chen & Chan, 2014; Li et al., 2019). Differences in culture and skewed sample towards the young-old might have caused such a contradictory result of this study. As such, this finding warrants further investigation.

> **H9:** Privacy concern has a negative, direct influence on wearing intention of health monitoring smart clothing.

Influence of privacy concern was found not significant on wearing intention of health monitoring smart clothing for older adults (H9: *ß* = .055, $p = .055$). This result can be attributed to the prior finding, stating that older adults are generally less concerned about privacy related to health information than other age groups (Beach et al., 2009). It also suggests that privacy concerns are unlikely to act as an obstacle towards accepting health monitoring smart clothing for older adults.

Test of Moderating Effects Using Latent Moderate Structural Analysis

To test the moderating effects of the construct, familiarity with technology, latent moderate structural analysis (LMS) (Klein & Moosbrugger, 2000) was performed in Mplus 8.4 using the guideline given by Muthén & Muthén (1998-2012). Maximum likelihood estimation was used for the analysis. Three moderating effects (H10a through H10c) were proposed in the theoretical framework (see Figure 2). However, in Mplus software, only one latent interaction (i.e., moderating effect) can be included in the model during the analysis. Thus, the analysis of each moderating effect was separately examined. Model fit indices generally used in SEM (e.g., χ^2/df, CFI, TLI, RMSEA) has not yet been developed for LMS. Thus, the interpretations of LMS findings were done based on the steps proposed by Maslowsky, Jager, and Hemken (2015).

Three LMS with different latent interactions were conducted, here for H10a, H10b, and H10c. For each LMS, the model fit was assessed by comparing log-likelihood value (H_0), Bayesian Information Criterion (BIC), and if required, log-likelihood ratio test with the model only comprised of main effects (i.e., SEM model). Subsequently, path coefficients of the latent interaction were analyzed and variance explained by latent interaction term was determined by the difference between R^2 values from LMS model and SEM model.

> **H10:** Familiarity with technology moderates the effect of (a) performance expectancy, (b) effort expectancy, and (c) privacy concern on wearing intention of health monitoring smart clothing.

In the first LMS, the latent interaction between performance expectancy and familiarity with technology was included. The H_0 and BIC value in the first LMS was -15330.408 and 31562.114. The comparison of H_0 and BIC of the first LMS with SEM model (H_0 = -14020.270, BIC = 28846.963) presented the decrease in model fit. Familiarity with technology was not a significant moderator of the relationship between performance expectancy and wearing intention (*ß* = -.025, p = .276). The increase in R^2 value (.007) with inclusion of latent interaction between performance expectancy and familiarity with technology shows the minimal increase of variance explaining wearing intention.

The inclusion of the latent interaction between effort expectancy and familiarity with technology for the second LMS also showed the decrease in model fit (H_0 = -15330.478, BIC = 31562.254) compared to the SEM model (H_0 = -14020.270, BIC = 28846.963). Familiarity with technology was not a significant moderator of the relationship between effort expectancy and wearing intention (*ß* = -.024, p = .309). The increase in R^2 value (.005) was also minimal.

The result of the third LMS, the latent interaction between privacy concern and familiarity with technology, was similar to the results from the first and second LMS. Model fit of the third LMS (H_0 = -15330.986, BIC = 31563.270) decreased compared to the SEM model. Familiarity with technology was not a significant moderator of the relationship between privacy concern and wearing intention (*ß* = -.003, p = .897). The increase in R^2 value (.004) was also minimal.

Results of the three LMS showed that the moderating effect of familiarity with technology was negligible while predicting wearing intention. One of the reasons behind it can be related with skewness of the sample population towards the young-old who may have a similar level of familiarity with technology. The negligible moderating effect also can be due to the small sample size in the present study, considering complexity of the model used in LMS.

Overall, the proposed theoretical framework was considered effective in explaining acceptance of health monitoring smart clothing among older adults residing in U.S. The proposed framework has a strong ability to predict older adults' wearing intention of health monitoring smart clothing (R^2 = .856). The framework also accounts for 88% of the variance in performance expectancy, 51% of variance in effort expectancy, and 44% of variance in social influence using perceived clothing attributes such as functional, expressive, aesthetic, and tracking. The findings imply that older adults who are satisfied with expressive and tracking attributes of health monitoring smart clothing find it useful, easier to use, and socially acceptable, which lead them to more likely use it in the future.

Summary

This chapter presented the findings from data analyses (i.e., descriptive statistics, CFA, SEM, and LMS) according to the proposed hypotheses. Seven out of 16 paths in the proposed theoretical framework were supported. Table 11 presents a summary of hypothesis testing results. The findings from the statistical analyses confirmed that perceived expressive and tracking attributes positively impacted the performance expectancy and effort expectancy of the health monitoring smart clothing. Perceived tracking attributes was the strongest predictor for performance expectancy and perceived expressive attributes was the strongest predictor for both effort expectancy and social influence. Performance expectancy was the strongest predictor for wearing intention of health monitoring smart clothing. The influence of effort expectancy, health concern, and privacy concern was not significant on wearing intention of health monitoring smart clothing. This could be attributed to the fact that the participants of this study were skewed towards the young-old group with the high familiarity with technology. The model explained 86% of unique variance of wearing intention of health monitoring smart clothing. Thus, the proposed model was capable of predicting older adults' wearing intention of health monitoring smart clothing. Additionally, these results provide important insights for apparel industry professionals when developing new health monitoring smart clothing for older adults. It is crucial to consider expressive attributes, tracking attributes, usefulness, and social influence of the new product before introducing it to the market. More detail implications of this study are presented in Chapter 5 Conclusion.

Table 11. *Results of hypothesis testing*

Hypothesis	Standardized Estimate (ß)	*p*-value	Results
H1a: PFA→PE	-.085	*p* = .011	Not Supported (opposite direction)
H1b: PFA→EE	.021	*p* = .667	Not Supported
H2a: PEA→PE	.417	*p* < .001	Supported
H2b: PEA→EE	.526	*p* < .001	Supported
H2c: PEA→SI	.656	*p* < .001	Supported
H3: PAA→SI	.018	*p* = .758	Not Supported
H4a: PTA→PE	.640	*p* < .001	Supported
H4b: PTA→EE	.231	*p* = .003	Supported
H5: PE→WI	.770	*p* < .001	Supported
H6: EE→WI	-.010	*p* = .793	Not Supported
H7: SI→WI	.219	*p* < .001	Supported
H8: HC→WI	-.053	*p* = .053	Not Supported
H9: PC→WI	.055	*p* = .055	Not Supported
F_TECH ↓ H10a: PE→WI	-.025	*p* = .276	Not Supported
F_TECH ↓ H10b: EE→WI	-.024	*p* = .309	Not Supported
F_TECH ↓ H10c: PC→WI	-.003	*p* = .897	Not Supported

Note. PFA = Perceived functional attributes; PEA = Perceived expressive attributes; PAA = Perceived aesthetic attributes; PTA = Perceived tracking attributes; PE = Performance expectancy; EE = Effort expectancy; SI = Social influence; WI = Wearing intention; PC = privacy concern; F_TECH = Familiarity with technology; HC = Health concern

CHAPTER 5: CONCLUSION

This concluding chapter summarizes the objective of this study, the explanation of a proposed model, research methods, and discussions of the main findings in this study. It concludes with a discussion of the limitations of the study and suggestions for future research. Implications for academic and practice are also presented.

Summary of Research Design and Sample

This study focuses on older adults living in U.S. Healthcare for the aging population has become a major concern with the increase of life expectancy in U.S. Many of the older adults are facing health related difficulties and healthcare resources to deal with them is limited. To offset the deficiencies in the current healthcare of older adults and to put emphasis on aging in place, remote monitoring of older adults' vitals can play a significant role. Continuous monitoring also can lead to better understand the dynamic nature of aging and disease while allowing older adults' independent living. Smart clothing, when compared to other wearable devices, is a preferable choice for monitoring the vitals and other data related to health and wellness of older adults. The stigma associated with using visible medical devices also can be avoided by using inconspicuous smart clothing. The market for health monitoring smart clothing for older adults is still at an initial stage. As such, with the growth of the market and to meet the healthcare demands of older adults, it is crucial to understand the key factors that may influence older adults' perception and intention to wear health monitoring smart clothing.

The overall purpose of this study was to investigate and understand the factors that affect older adults' perception and intention to adopt health monitoring smart clothing by developing and evaluating a holistic model that consists of various concepts adopted from different fields. This study used an integrated theoretical framework to explain older adults' acceptance of health monitoring smart clothing. The framework was constructed by adapting theoretical elements from the functional-expressive-aesthetic (FEA) consumer needs' model (Lamb & Kallal, 1992) combined with the tracking dimension from Bakshian and Lee's (2018) holistic framework for the use of wearables, and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003).

The specific research objectives of this study were: (1) to develop a theoretical framework by identifying the key factors that explain older adults' acceptance of health monitoring smart clothing and (2) to examine the perception and wearing intention of older adults' health monitoring smart clothing by testing the hypothetical research model that included the following variables: perceived functional attributes, perceived expressive attributes, perceived aesthetics attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention of smart clothing.

An online survey was conducted with a nationwide convenience sample of 376 older adults living in U.S., purchased from reliable market service companies. Participants were recruited using Amazon MTurk and Qualtrics panel service. Before answering the survey questionnaire, participants were guided to watch a short video clip introducing health monitoring smart clothing. The online survey questionnaire consisted of (a) a short video clip introducing the features of health monitoring smart clothing, (b) close-ended questions including 52 items adapted from the existing scales to measure the 11 latent variables, using a 5-point Likert-type scale, and (c) demographic information.

The Statistical Package for the Social Sciences (SPSS Version 26.0) software and Mplus Version 8.4 were employed to conduct statistical analyses and model testing. Demographic data were analyzed using descriptive statistics. Using the maximum likelihood estimation method, two-step approach was used in structural equation modeling (SEM) to test overall fit and proposed hypothetical relationships in the model. Confirmatory factor analysis (CFA) was first used to test the measurement model fit in order to establish validity and reliability of the latent constructs. Then, the structural path model was examined to test the hypotheses proposed in the theoretical framework. To test the moderating effect of the construct, familiarity with technology, latent moderated structural equation (LMS) was used.

The participants' age range was from 65 to 88 years old with a mean age of 70. Most of the participants (85.91%) belonged to the age group of young-old (65-74 years old). Sixty-one percent of the participants were females and 39% were males. Around 45% had education higher than bachelor's degrees. The majority was White/European American (75%), followed by Black/African American (11%). Around 63% of the participants were retired. Overall, the data from the participants in this study were skewed towards the young-old along with White/European American ethnicity and higher level of education compared with those of the U.S. older adult population. Thus, attention is needed when generalizing these data.

Summary of Findings

Two objectives were proposed in this study as presented below. The findings are summarized and discussed.

1. To develop a theoretical model by identifying the key factors that explain older adults' acceptance of health monitoring smart clothing.
2. To examine the perception and wearing intention of older adults' health monitoring smart clothing by testing the hypothetical research model including the following variables: perceived functional attributes, perceived expressive attributes, perceived aesthetics

attributes, perceived tracking attributes, performance expectancy, effort expectancy, social influence, health condition, privacy concern, familiarity with technology, and wearing intention of smart clothing.

Prior to testing the hypothesis, which was the structural part of the model, the measure of the constructs was examine for adequacy. The initial CFA was run on a 52-item 11 factor measurement model. The standardized factor loadings ranged from .555 (PEA_2) to .958 (F_TECH_2) and all items were statistically significant at $p < .001$. The initial measurement model was a adequate fit ($\chi^2 = 3100.835$, $df = 1219$, $p < .001$, CFI = .891, TLI = .882, RMSEA = .064, SRMR = .882). To improve the initial measurement model fit, it was re-specified by removing one item from perceived functional attributes (PFA_5), seven items from perceived expressive attributes (PEA_1, PEA_5, PEA_6, PEA_7, PEA_8, PEA_9, PEA_10), three items from perceived aesthetic attributes (PAA_4, PAA_5, PAA_6), one item from perceived tracking attributes (PTA_4), and one item from effort expectancy (EE_1).

The CFA results of the final measurement model with 39-item 11 constructs showed that each factor loading of the indicators for each construct were statistically significant at $p < .001$. Standardized factor loadings ranged from .669 (PAA_1) to .958 (F_TECH_2). Global fit indices demonstrated the overall fit improvement of the final model ($\chi^2 = 1202.978$, $df = 647$, $p < .001$, CFI = .956, TLI = .950, RMSEA = .048, SRMR = .045) compared to those of the initial measurement model. Adequate level of validity and reliability was found for the measurement model by analyzing CR and AVE values. CR and AVE values for all factors were greater than .825 and .573, respectively. Internal consistency of each measurement scale was also adequate as Cronbach's α was greater than .924 for each factor. Thus, this final model was used for hypothesis testing.

The results of structural equation modeling (SEM) for the hypothesized model revealed a satisfactory fit of the model (χ^2 = 1293.948, *df* = 566, *p* < .001, CFI = .937, TLI = .930, RMSEA = .058, SRMR = .065). Seven out of 16 paths in the proposed theoretical framework were supported. Hypotheses 1a and 1b predicting influence of perceived functional attributes on performance expectancy and effort expectancy were not supported. All three hypothesized effects of perceived expressive attributes on performance expectancy, effort expectancy, and social influence (H2a, H2b, and H2c) were supported. The hypothesis 3 predicting influence of perceived aesthetic attributes on social influence was not supported. Perceived tracking attributes positively influenced performance expectancy (H4a) and effort expectancy (H4b). In the hypothesis 5, performance expectancy positively predicted wearing intention of health monitoring smart clothing for older adults. The hypothesis 6 predicting influence of effort expectancy on wearing intention of health monitoring smart clothing for older adults was not supported. The hypothesis 7 predicting influence of social influence on wearing intention of health monitoring smart clothing for older adults was supported. The hypothesis 8 predicting influence of health concern on wearing intention of health monitoring smart clothing was not supported. The hypothesis 9 predicting influence of privacy concern on wearing intention of health monitoring smart clothing was not supported. Regarding the moderating effects proposed in the hypothesis 10, no moderating effect of familiarity with technology was found.

The findings of this study imply that older adults who are satisfied with expressive and tracking attributes of health monitoring smart clothing find it useful, easier to use, and socially acceptable. This study also implies that older adults who find health monitoring smart clothing useful and socially acceptable are more likely to use it. The proposed framework has a strong ability to predict older adults' wearing intention of health monitoring smart clothing (R^2 = .856).

Overall, the proposed theoretical framework was effective in explaining acceptance of health monitoring smart clothing among older adults residing in U.S.

Limitations and Future Research

The findings of this study should be evaluated in light of the following limitations. Suggestions for future research are also shared with the limitations.

1. T
2. The participants of this study were familiar with the usage of technology. It can be assumed because they participated in a self-administered online survey. Participants' familiarity with technology might have influenced the findings of this study. Future study might consider different methods of data collection to include more diverse older adult population in terms of the level of their familiarity with technology.
3. The proposed framework included only one moderating variable, familiarity with technology. For future research, it is suggested to add additional constructs (e.g., presence of social support, motivation for independent living) as a moderator and retest the revised theoretical framework. Because of the limited time frame and other constraints, this research could not include those variables.
4. In this study, the indirect effect of clothing attributes on wearing intention of health monitoring smart clothing mediated through technology acceptance attributes was not examined because of the marginal number of the sample size (N = 376) in this study. For future research, it is highly recommended to investigate a mediating effect of clothing attributes with the adequate number of the sample size.
5. In this study, the participants developed their perceptions about the attributes of health monitoring smart clothing by watching a short video clip demonstrating the features of health

monitoring smart clothing. This research design allowed to understand the participants' general perceptions of health monitoring smart clothing in general; however, it limited to examine the impact of the major attributes on their intentions of wearing different types of health monitoring smart clothing. Thus, it is suggested for future researchers to conduct another study using an experimental research design using various types of smart clothing. In the experimental study, researchers can identify design problems for a specific target population, develop prototypes of health monitoring smart clothing that can compromise these problems, evaluate the prototypes by conducting users' wear trials of the prototypes, and retest the proposed theoretical framework. This approach can provide a deeper understanding and complement the findings of this study.

Implications and Recommendations

The overall purpose of this research was to develop and evaluate a holistic theoretical framework that explains the factors that affect older adults' perception and intention to adopt health monitoring smart clothing. This research offered several academic and practical implications, which are discussed below.

Implications for Academia

This study contributes to the literature by providing unique insights into factors that are needed to be considered while developing health monitoring smart clothing for older adults. This research is the first attempt to investigate the health monitoring smart clothing needs from the consumer perspective of older adults. Prior research related to this study mainly considered factors only relevant to the domain of its discipline. Most of the studies related to technology adoption of healthcare wearables neglected to consider the importance of clothing attributes in their research framework (Gao et al., 2015; Li et al., 2019; Zhang et al., 2017). Some studies considered clothing attributes to explain wearing intention of smart clothing (Bakshian & Lee, 2018; Hwang et al., 2016; Lee, 2012); however, the focus of those studies was not healthcare related needs of older adults. This study addressed this existing literature gap and addressed the impact of clothing attributes on perception and wearing intention of healthcare wearables. Another unique aspect of this study relates to the use of a multidisciplinary approach while developing a holistic theoretical model. This study combined theoretical elements of FEA and UTAUT models to build the theoretical framework. This study also considered concepts and theories from different fields such as geriatrics, healthcare, and information system. Most importantly, this study provides a theoretical foundation for future healthcare wearable research from the perspective of consumers.

This study presented an effective theoretical model that explained 86% of the total variance in older adults' wearing intention of health monitoring smart clothing, which convinces a strong predictive power of the proposed framework. The findings from the hypotheses also offer important insights into the perspective of older adults. Within the clothing attributes, expressive and tracking were the important criteria to make health monitoring smart clothing more useful and easier to use among older adults. Among technology acceptance attributes, performance expectancy and social influence were the significant predictor for wearing intention of health monitoring smart clothing among older adults. A qualitative approach can be taken by future researchers to provide deeper understanding about the relationships among the variables proposed in this study. Some of the findings in this study were influenced by the high familiarity with technology and skewness of age towards the young old among the participants. These findings present the value in future comparative analyses of consumer characteristics such as age, gender, and expertise with technology to gain further insights in technology acceptance regarding healthcare wearables.

This study is also contributed with the approach it took to achieve the research objectives. This study developed and proposed the hypotheses bridging clothing attributes and technology acceptance attributes to build the conceptual model using SEM approach. Additionally, this study used LMS to test the moderating effect proposed in the theoretical framework. Using LMS instead of other traditional approaches (e.g., ordinary least square regression) to test moderation effect is advantageous as LMS considers the measurement error in the observed variables (Maslowsky et al, 2015). Comparison of the demographic characteristics of the study sample with those of U.S. older adult population helped this study gain more insights about the findings and generalizability. Research design and methodology adopted by this study can be also used as a guide for future research on clothing with technology aspects while considering the specific needs of the target population.

Implications for Practice

The findings of this study also have implications for practice. This study focused on the perception of older adults as users of health monitoring smart clothing. As such, product developers can use the findings of this study to make health monitoring smart clothing more compatible for older adults. Product developers are suggested to consider clothing attributes, especially expressive and tracking attributes, when developing health monitoring smart clothing. The design and appearance of health monitoring smart clothing should be consistent with the self-image of older adults who want to communicate to others. For example, an age appropriate design would help older adults to build positive self-image and remove any social barrier in using health monitoring smart clothing. Product developers also should focus on the tracking capabilities of health monitoring smart clothing to make sure that important health parameters are reliably measured and conveniently reported.

Findings of this study also provides insights for companies to prepare better marketing strategies for health monitoring smart clothing and to be competitive in the healthcare wearables' market. In their promotions, product developers should emphasize on the usefulness of health monitoring smart clothing and how it can meet the goal of leading a healthy lifestyle easier for older adults. Creating a supportive community of health monitoring smart clothing also is helpful for older adults in adopting this new technology. Shortly, the findings of this study can be a useful guide for the apparel industry professionals to expand their product category in this wearable healthcare market.

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APPENDIX A

STIMULI

Link to the stimuli introducing the key features of the health monitoring smart clothing.
(https://www.youtube.com/watch?time_continue=89&v=DLzDRyiLZ8o&feature=emb_logo&t=0m32s)

APPENDIX B

INVITATION EMAIL FOR MTURK CONSUMER PANEL

Dear Participants,

I would like to invite you to participate in my research study on older adults' acceptance of health monitoring smart clothing, garments in which sensors are integrated to monitor health condition of an individual. The study is conducted by Nasif Mahmood, Master's student under the direction of Dr. Young-A Lee, Associate Professor in the Department of Consumer and Design Sciences at Auburn University. I am seeking study participants for this study.

To be eligible for this study, you must be aged 65 years old and over living in the U.S. You should not participate if you are not 65 years of age. If you agree to participate, you will be asked to complete an online survey regarding your opinion on various aspects of health monitoring smart clothing and your demographics. Before answering the questions, you will first watch a one and half minute video clip introducing the key features of the health monitoring smart clothing. This survey will take approximately 10-15 minutes to complete.

Once you complete a valid survey, you will receive $0.50 incentive as compensation via Amazon Mechanical Turk. The study does not pose any risk to you as a participant greater than everyday use of the internet. Participation in this research is voluntary, and you are free to withdraw your participation at any time by closing out the survey window. The information you provide will be combined with that of other participants and your privacy will be protected to the maximum extent allowable by law. Your name will not be reported or made public. Research data will be aggregated for any presentation or publication purpose.

If you are interested to participate in this study, please click the web-link below:
https://auburn.qualtrics.com/jfe/form/SV_3vEDYCYXwbIZvLf

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Thank you for your consideration,

Nasif Mahmood, Master's Student
Student Principal Investigator
Department of Consumer and Design Sciences
Auburn University
Email: nzm0049@auburn.edu
Phone: (334) 275-1025

Young-A Lee, Ph.D.
Faculty Advisor of Principal Investigator
Department of Consumer and Design Sciences
Auburn University
Email: yalee@auburn.edu
Phone: (334) 844-6458

APPENDIX C

INVITATION EMAIL FOR QUALTRICS CONSUMER PANEL

Dear Participants,

I would like to invite you to participate in my research study on older adults' acceptance of health monitoring smart clothing, garments in which sensors are integrated to monitor health condition of an individual. The study is conducted by Nasif Mahmood, Master's student under the direction of Dr. Young-A Lee, Associate Professor in the Department of Consumer and Design Sciences at Auburn University. I am seeking study participants for this study.

To be eligible for this study, you must be aged 65 years old and over living in the U.S. You should not participate if you are not 65 years of age. If you agree to participate, you will be asked to complete an online survey regarding your opinion on various aspects of health monitoring smart clothing and your demographics. Before answering the questions, you will first watch a one and half minute video clip introducing the key features of the health monitoring smart clothing. This survey will take approximately 10-15 minutes to complete.

You will be compensated the amount you agreed upon before you entered into the survey.

The study does not pose any risk to you as a participant greater than everyday use of the internet. Participation in this research is voluntary, and you are free to withdraw your participation at any time by closing out the survey window. The information you provide will be combined with that of other participants and your privacy will be protected to the maximum extent allowable by law. Your name will not be reported or made public. Research data will be aggregated for any presentation or publication purpose.

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Thank you for your consideration,

Nasif Mahmood, Master's Student
Student Principal Investigator
Department of Consumer and Design Sciences
Auburn University
Email: nzm0049@auburn.edu
Phone: (334) 275-1025

Young-A Lee, Ph.D.
Faculty Advisor of Principal Investigator
Department of Consumer and Design Sciences
Auburn University
Email: yalee@auburn.edu
Phone: (334) 844-6458

APPENDIX D

INFORMED CONSENT FOR MTURK

Invitation for the Study on Health Monitoring Smart Clothing for Older Adults

Dear Participants:

I would like to invite you to participate in my research study on older adults' acceptance of health monitoring smart clothing, garments in which sensors are integrated to monitor health condition of an individual. This study is conducted by Nasif Mahmood, Master's student under the supervision of Dr. Young-A Lee, Associate Professor in the Department of Consumer and Design Sciences at Auburn University. As a result of this research, I hope to identify the key characteristics that older adults often mostly consider for using health monitoring smart clothing and develop a guideline to incorporate these identified features into the future health monitoring smart clothing design and development.

To be eligible for this study, you must be aged 65 years old and over living in U.S. You should not participate if you are not 65 years of age. If you agree to participate, you will be first asked to watch a one and half minute video clip introducing the key features of the health monitoring smart clothing. Then you will be asked to complete online survey regarding your opinion on various aspects of health monitoring smart clothing and your demographics. This online survey, using Qualtrics, will take approximately 10-15 minutes to complete.

Once you complete a valid survey, you will receive $0.50 incentive as compensation via Amazon Mechanical Turk.

Your responses are highly valued for this study. The study does not pose any risk to you as a participant greater than everyday use of the internet. Participation in this research is voluntary, and you are free to withdraw your participation at any time by clothing out the survey window. The information you provide will be combined with that of other participants and your privacy will be protected to the maximum extent allowable by law. Your name will not be reported or made public. Research data will be aggregated for any presentation or publication purpose.

The Auburn University Institutional Review Board has approved this document for use from January 6 to ------- Protocol #20-002 EX 2001, Mahmood, "Health monitoring smart clothing: Understanding its acceptance among older adults." If you have any questions or concerns about completing the survey or this study, please contact the principal investigator, Nasif Mahmood at nzm0049@auburn.edu, Ph: (334) 275-1025 or the faculty principal investigator, Dr. Young-A Lee at yalee@auburn.edu, Ph: (334) 844-6458. For questions about the rights of research subjects or research-related inquiry, you may contact the Office of Human Research (IRB), 115 Ramsay Hall, Auburn University, Auburn, AL 36849, Ph: (334) 844-5966, or irbadmin@auburn.edu.

If you agree to participate in this survey, please click on the "Accept" button below. If you want to retain a copy of this consent form for your records, print this page before clicking the

“Accept” button.

• You have read the above information.
• You voluntarily agree to participate.
• You are at least 65 years of age and live in U.S.

- o Accept
- o Decline

APPENDIX E

INFORMED CONSENT FOR QUALTRICS CONSUMER PANEL

Invitation for the Study on Health Monitoring Smart Clothing for Older Adults

Dear Participants:

I would like to invite you to participate in my research study on older adults' acceptance of health monitoring smart clothing, garments in which sensors are integrated to monitor health condition of an individual. This study is conducted by Nasif Mahmood, Master's student under the supervision of Dr. Young-A Lee, Associate Professor in the Department of Consumer and Design Sciences at Auburn University. As a result of this research, I hope to identify the key characteristics that older adults often mostly consider for using health monitoring smart clothing and develop a guideline to incorporate these identified features into the future health monitoring smart clothing design and development.

To be eligible for this study, you must be aged 65 years old and over living in U.S. You should not participate if you are not 65 years of age. If you agree to participate, you will be first asked to watch a one and half minute video clip introducing the key features of the health monitoring smart clothing. Then you will be asked to complete online survey regarding your opinion on various aspects of health monitoring smart clothing and your demographics. This online survey, using Qualtrics, will take approximately 10-15 minutes to complete.

You will be compensated the amount you agreed upon before you entered into the survey.

Your responses are highly valued for this study. The study does not pose any risk to you as a participant greater than everyday use of the internet. Participation in this research is voluntary, and you are free to withdraw your participation at any time by clothing out the survey window. The information you provide will be combined with that of other participants and your privacy will be protected to the maximum extent allowable by law. Your name will not be reported or made public. Research data will be aggregated for any presentation or publication purpose.

The Auburn University Institutional Review Board has approved this document for use from January 6 to ------- Protocol #20-002 EX 2001, Mahmood, "Health monitoring smart clothing: Understanding its acceptance among older adults." If you have any questions or concerns about completing the survey or this study, please contact the principal investigator, Nasif Mahmood at nzm0049@auburn.edu, Ph: (334) 275-1025 or the faculty principal investigator, Dr. Young-A Lee at yalee@auburn.edu, Ph: (334) 844-6458. For questions about the rights of research subjects or research-related inquiry, you may contact the Office of Human Research (IRB), 115 Ramsay Hall, Auburn University, Auburn, AL 36849, Ph: (334) 844-5966, or irbadmin@auburn.edu.

If you agree to participate in this survey, please click on the "Accept" button below. If you want to retain a copy of this consent form for your records, print this page before clicking the "Accept" button.

• You have read the above information.
• You voluntarily agree to participate.
• You are at least 65 years of age and live in U.S.

- o Accept
- o Decline

APPENDIX F

QUESTIONNAIRE

Health Monitoring Smart Clothing

Section 1: Understanding Health Monitoring Smart Clothing

First, please watch one and half minute video clip introducing the key features of the health monitoring smart clothing. (https://www.youtube.com/watch?time_continue=89&v=DLzDRyiLZ8o&feature=emb_logo&t=0m32s)

Section 2: Your Opinion about Health Monitoring Smart Clothing

Directions: The following questions ask about your opinions of health monitoring smart clothing for older adults. Please **select** your responses that best describes the level of your agreement with each of the following statements.

Your opinion about functional attributes of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Comfort of the smart clothing is important to me.					
Fit of the smart clothing is important to me.					
Protection of the smart clothing is important to me.					
Ventilation quality (e.g., being able to feel cool) of the smart clothing is important to me.					
Insulation quality (e.g., being able to feel warm) of the smart clothing is important to me.					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Bulkiness of the smart clothing is important to me.					
Convenience of wear and transport of the smart clothing is important to me.					
The overall functional design characteristics of the smart clothing is important to me.					

Your opinion about expressive attributes of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Wearing smart clothing would help me see myself as a health-conscious person.					
Smart clothing would not distract from professionalism.					
Smart clothing would not distract from toughness/aggressiveness.					
Smart clothing would not make me look funny.					
Wearing smart clothing would help me convey my health-conscious identity as a person.					
Smart clothing would help me perform an appropriate gender role.					
Wearing the smart clothing would help with my self-image as a confident person					
Wearing the smart clothing would positively impact my commitment to healthy lifestyle.					
Wearing the smart clothing would play an important role of conveying the importance of healthy lifestyle to others.					
The overall expressive design characteristics of smart clothing is important to me.					

Your opinion about aesthetic attributes of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The color of the smart clothing is important to me.					
The style of the smart clothing is important to me.					
The texture of the smart clothing is important to me.					
The uniqueness of the smart clothing is important to me.					
The unique design features of the smart clothing is important to me.					
The sleekness of the smart clothing is important to me.					

The gender appropriate design features of the smart clothing is important to me.					
The overall aesthetic design characteristics of the smart clothing is important to me.					

Your opinion about tracking attributes of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Tracking my physical health condition (e.g., heart rate, respiration, hydration) using smart clothing is important to me.					
Tracking my mental health condition (e.g., stress level, moods, and feelings) using smart clothing is important to me.					
Tracking my healthy lifestyle (e.g., fitness, physical activities, weight and diet) using smart clothing is important to me.					
Tracking my productivity management (e.g., location, time management skills, work productivity) using smart clothing is important to me.					

Your opinion about usefulness of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I find the smart clothing useful in my daily life.					
Using smart clothing helps accomplish things more quickly.					
Using smart clothing improves the quality of my daily healthcare seeking.					

Your opinion about simplicity of use of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My interaction with the smart clothing will be clear and understandable.					
It would be easy for me to become skillful at using smart clothing.					
I would find smart clothing easy to use.					
Learning to operate smart clothing is easy for me.					

Your opinion about social influence of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

People who are important to me would think that I should use smart clothing.					
People who influence me would think that I should use smart clothing.					
People whose opinions are valued to me would prefer that I should use smart clothing.					

Your wearing intention of health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am interested in using the smart clothing.					
I plan to adopt the smart clothing in the future.					
I will develop healthy habits with the smart clothing in the future					

Your opinion about privacy while using health monitoring smart clothing

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
It would be risky to disclose my personal health information to smart clothing vendors.					
There would be high potential for loss associated with disclosing my personal health information to vendors providing smart clothing.					
There would be too much uncertainty associated with giving my personal health information to vendors providing smart clothing.					

Your prior experience of using technology
(Experience in using automated healthcare services, wearable devices, using smartphones and computers)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have many experience in using the above-mentioned services					
I believe that the experiences were quite useful for me.					
I can evaluate that these prior experiences were quite positive					

Your self-assessed health condition

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My health status is very good.					
My health status is very good compared with that of my peers.					

My auditory ability, visual ability, and mobility are very good.					

Section 3: About Yourself

The following questions will help us gain a better understanding of you as a participant of the study.

Direction: Please answer the following questions by checking the appropriate selection, filling in the blanks, or writing up your answer.

1. What is your **gender?**

 MALE
 FEMALE
 PREFER NOT TO ANSWER

2. What is your **age?** __________ YEARS OLD

3. What is **the highest level of education** you have completed?

 8TH GRADE OR LESS
 SOME HIGH SCHOOL
 HIGH SCHOOL DEGREE
 SOME COLLEGE OR TECHNICAL SCHOOL
 COLLEGE DEGREE (4 YEARS)
 SOME GRADUATE SCHOOL
 GRADUATE DEGREE (MASTER'S, DOCTORATE, ETC.)
 Other, please specify ___________________________

4. What is your ethnicity? Check all that applies to you?

 White/European American
 Black/African American
 American Indian/Alaska Native
 Asian
 Native Hawaiian and other Pacific Islander
 Hispanic American/Latino
 Other, please specify ____________

5. Which of the following ranges includes your **total annual household income** from all sources before taxes in 2019?
 Less than $10,000
 $10,000 to $14,999
 $15,000 to $24,999
 $25,000 to $34,999
 $35,000 to $49,999
 $50,000 to $74,999

- □$75,000 to $99,999
- □$100, 000 to $149,999
- □$150, 000 to $199,999
- □$200,000 or more

6. What is your current **employment status**?
   - □ Employed for wages
   - □ Self-employed
   - □ Out of work
   - □ Homemaker
   - □ Student
   - □ Military services
   - □ Retired
   - □ Unable to work
   - □ Other, please specify ______________________

Now, you completed the survey. Thank you for participating this survey and we much appreciate your time and effort!

Appendix G

Correlation Matrices of Measurement Items

	PFA_1	PFA_2	PFA_3	PFA_4	PFA_5	PFA_6	PFA_7	PFA_8	PEA_1	PEA_2	PEA_3	PEA_4	PEA_5	PEA_6	PEA_7	PEA_8	PEA_9	PEA_10	PAA_1
PFA_1	1.000																		
PFA_2	0.749	1.000																	
PFA_3	0.670	0.674	1.000																
PFA_4	0.676	0.650	0.627	1.000															
PFA_5	0.541	0.541	0.578	0.649	1.000														
PFA_6	0.572	0.601	0.539	0.652	0.523	1.000													
PFA_7	0.689	0.665	0.652	0.662	0.527	0.684	1.000												
PFA_8	0.654	0.662	0.679	0.665	0.545	0.653	0.724	1.000											
PEA_1	0.324	0.281	0.434	0.278	0.322	0.204	0.292	0.383	1.000										
PEA_2	0.234	0.286	0.360	0.277	0.243	0.225	0.302	0.261	0.461	1.000									
PEA_3	0.343	0.359	0.397	0.293	0.236	0.256	0.312	0.356	0.446	0.642	1.000								
PEA_4	0.217	0.231	0.338	0.224	0.245	0.138	0.239	0.279	0.484	0.616	0.573	1.000							
PEA_5	0.260	0.288	0.406	0.244	0.303	0.177	0.260	0.321	0.741	0.445	0.474	0.472	1.000						
PEA_6	0.046	0.118	0.283	0.121	0.165	0.060	0.111	0.219	0.471	0.377	0.329	0.391	0.553	1.000					
PEA_7	0.161	0.211	0.391	0.161	0.280	0.110	0.172	0.276	0.573	0.398	0.380	0.432	0.637	0.699	1.000				
PEA_8	0.318	0.309	0.428	0.262	0.267	0.179	0.256	0.352	0.668	0.420	0.456	0.486	0.697	0.542	0.655	1.000			
PEA_9	0.210	0.235	0.374	0.208	0.278	0.131	0.201	0.304	0.673	0.380	0.397	0.448	0.746	0.582	0.705	0.731	1.000		
PEA_10	0.343	0.331	0.401	0.316	0.329	0.299	0.330	0.426	0.564	0.346	0.386	0.399	0.586	0.405	0.446	0.557	0.613	1.000	
PAA_1	0.292	0.310	0.223	0.265	0.256	0.259	0.311	0.259	0.214	0.170	0.123	0.094	0.145	0.139	0.113	0.113	0.193	0.339	1.000
PAA_2	0.428	0.453	0.372	0.394	0.358	0.366	0.457	0.390	0.247	0.166	0.231	0.135	0.267	0.137	0.177	0.249	0.281	0.434	0.622
PAA_3	0.503	0.508	0.465	0.522	0.393	0.391	0.510	0.457	0.297	0.277	0.323	0.279	0.292	0.097	0.213	0.310	0.303	0.392	0.479
PAA_4	0.156	0.246	0.329	0.270	0.320	0.144	0.200	0.243	0.399	0.287	0.215	0.242	0.437	0.426	0.466	0.402	0.544	0.481	0.392
PAA_5	0.259	0.293	0.375	0.303	0.290	0.187	0.235	0.342	0.415	0.264	0.264	0.283	0.446	0.367	0.387	0.378	0.484	0.536	0.325
PAA_6	0.310	0.337	0.351	0.347	0.351	0.323	0.306	0.341	0.389	0.253	0.307	0.246	0.395	0.280	0.335	0.398	0.415	0.520	0.386
PAA_7	0.352	0.346	0.382	0.366	0.355	0.259	0.344	0.378	0.298	0.226	0.222	0.224	0.355	0.309	0.316	0.369	0.378	0.469	0.504
PAA_8	0.361	0.371	0.370	0.400	0.338	0.332	0.380	0.448	0.335	0.274	0.279	0.247	0.316	0.241	0.273	0.362	0.358	0.546	0.523
PTA_1	0.309	0.285	0.413	0.281	0.209	0.166	0.273	0.360	0.689	0.396	0.374	0.458	0.636	0.412	0.513	0.656	0.617	0.518	0.128
PTA_2	0.199	0.208	0.354	0.201	0.228	0.119	0.190	0.301	0.617	0.346	0.371	0.426	0.623	0.504	0.551	0.604	0.659	0.518	0.168
PTA_3	0.305	0.265	0.379	0.220	0.229	0.138	0.239	0.367	0.609	0.342	0.371	0.399	0.623	0.421	0.515	0.629	0.629	0.523	0.148
PTA_4	0.142	0.153	0.331	0.133	0.263	0.094	0.120	0.269	0.542	0.324	0.338	0.354	0.582	0.557	0.615	0.583	0.648	0.482	0.182
PE_1	0.270	0.283	0.412	0.213	0.225	0.186	0.234	0.341	0.697	0.498	0.512	0.558	0.668	0.543	0.674	0.712	0.690	0.565	0.137
PE_2	0.124	0.151	0.322	0.121	0.239	0.064	0.100	0.214	0.601	0.352	0.329	0.389	0.625	0.622	0.652	0.605	0.671	0.472	0.143
PE_3	0.317	0.269	0.416	0.258	0.234	0.145	0.210	0.301	0.669	0.432	0.462	0.500	0.656	0.518	0.658	0.761	0.685	0.529	0.126
EE_1	0.301	0.349	0.357	0.323	0.296	0.200	0.265	0.360	0.500	0.390	0.435	0.456	0.527	0.328	0.487	0.505	0.534	0.483	0.175
EE_2	0.229	0.287	0.295	0.228	0.192	0.135	0.213	0.296	0.408	0.375	0.422	0.433	0.443	0.320	0.418	0.476	0.438	0.408	0.117
EE_3	0.305	0.312	0.380	0.206	0.206	0.136	0.240	0.293	0.419	0.401	0.458	0.456	0.467	0.369	0.454	0.492	0.429	0.413	0.080
EE_4	0.243	0.272	0.312	0.238	0.227	0.141	0.224	0.295	0.431	0.403	0.420	0.446	0.448	0.367	0.435	0.447	0.441	0.417	0.113
SI_1	0.161	0.130	0.270	0.111	0.188	0.050	0.148	0.228	0.590	0.364	0.328	0.392	0.539	0.457	0.504	0.549	0.589	0.468	0.126
SI_2	0.188	0.188	0.306	0.122	0.153	0.054	0.175	0.230	0.563	0.378	0.388	0.407	0.608	0.501	0.526	0.579	0.576	0.481	0.121
SI_3	0.135	0.120	0.250	0.113	0.162	0.035	0.132	0.196	0.589	0.377	0.351	0.401	0.577	0.465	0.525	0.567	0.574	0.458	0.110
WI_1	0.255	0.253	0.399	0.202	0.207	0.140	0.189	0.326	0.669	0.449	0.489	0.486	0.649	0.519	0.597	0.695	0.646	0.553	0.103
WI_2	0.161	0.183	0.323	0.161	0.210	0.077	0.119	0.264	0.641	0.406	0.401	0.465	0.650	0.541	0.593	0.639	0.649	0.515	0.125
WI_3	0.213	0.219	0.353	0.203	0.254	0.123	0.168	0.295	0.659	0.442	0.429	0.490	0.698	0.546	0.627	0.683	0.676	0.548	0.144
PC_1	0.032	0.043	0.083	0.016	0.021	0.023	-0.020	0.096	0.210	0.157	0.181	0.163	0.213	0.170	0.197	0.220	0.190	0.132	-0.043
PC_2	0.070	0.086	0.120	0.051	0.034	0.004	0.041	0.125	0.248	0.224	0.186	0.224	0.287	0.200	0.256	0.270	0.207	0.169	-0.027
PC_3	0.082	0.108	0.146	0.024	0.060	0.006	0.028	0.121	0.298	0.293	0.264	0.267	0.329	0.252	0.301	0.290	0.247	0.211	0.021
F_TECH_1	0.119	0.110	0.120	0.054	0.069	0.084	0.095	0.125	0.067	0.154	0.153	0.153	0.111	0.105	0.143	0.162	0.139	0.181	0.112
F_TECH_2	0.168	0.173	0.209	0.131	0.148	0.132	0.162	0.197	0.209	0.190	0.188	0.204	0.246	0.214	0.255	0.277	0.252	0.278	0.148
F_TECH_3	0.207	0.217	0.255	0.167	0.157	0.148	0.181	0.221	0.230	0.240	0.243	0.231	0.293	0.255	0.290	0.307	0.312	0.308	0.174
HC_1	-0.047	-0.068	-0.083	-0.088	-0.153	-0.074	-0.096	-0.041	0.001	-0.101	-0.057	-0.063	-0.018	-0.166	-0.054	-0.026	-0.045	-0.043	-0.079
HC_2	-0.047	-0.031	-0.091	-0.091	-0.187	-0.092	-0.085	-0.068	-0.033	-0.142	-0.092	-0.086	-0.050	-0.166	-0.059	-0.062	-0.054	-0.044	-0.026
HC_3	-0.062	-0.090	-0.080	-0.080	-0.113	-0.080	-0.111	-0.058	-0.016	-0.107	-0.079	-0.086	-0.026	-0.132	-0.005	-0.025	-0.014	-0.062	-0.073

Continued

	PAA_2	PAA_3	PAA_4	PAA_5	PAA_6	PAA_7	PAA_8	PTA_1	PTA_2	PTA_3	PTA_4	PE_1	PE_2	PE_3	EE_1	EE_2	EE_3	EE_4	SI_1
PFA_1																			
PFA_2																			
PFA_3																			
PFA_4																			
PFA_5																			
PFA_6																			
PFA_7																			
PFA_8																			
PEA_1																			
PEA_2																			
PEA_3																			
PEA_4																			
PEA_5																			
PEA_6																			
PEA_7																			
PEA_8																			
PEA_9																			
PEA_10																			
PAA_1																			
PAA_2	1.000																		
PAA_3	0.664	1.000																	
PAA_4	0.398	0.359	1.000																
PAA_5	0.415	0.415	0.810	1.000															
PAA_6	0.466	0.447	0.550	0.583	1.000														
PAA_7	0.521	0.516	0.445	0.496	0.493	1.000													
PAA_8	0.634	0.618	0.541	0.559	0.546	0.626	1.000												
PTA_1	0.247	0.354	0.331	0.367	0.381	0.248	0.332	1.000											
PTA_2	0.223	0.231	0.437	0.407	0.350	0.269	0.312	0.711	1.000										
PTA_3	0.284	0.329	0.353	0.386	0.366	0.262	0.341	0.788	0.735	1.000									
PTA_4	0.234	0.184	0.456	0.389	0.380	0.307	0.300	0.556	0.706	0.677	1.000								
PE_1	0.228	0.328	0.439	0.417	0.442	0.264	0.339	0.746	0.680	0.689	0.617	1.000							
PE_2	0.134	0.173	0.521	0.438	0.384	0.281	0.273	0.520	0.588	0.540	0.655	0.720	1.000						
PE_3	0.251	0.312	0.407	0.402	0.403	0.295	0.336	0.730	0.646	0.674	0.595	0.807	0.681	1.000					
EE_1	0.242	0.312	0.352	0.378	0.373	0.230	0.331	0.522	0.457	0.467	0.434	0.636	0.498	0.568	1.000				
EE_2	0.212	0.273	0.264	0.282	0.266	0.164	0.244	0.495	0.434	0.476	0.376	0.559	0.459	0.538	0.707	1.000			
EE_3	0.225	0.240	0.252	0.281	0.327	0.201	0.202	0.470	0.436	0.483	0.393	0.606	0.431	0.550	0.667	0.754	1.000		
EE_4	0.180	0.229	0.299	0.294	0.284	0.167	0.254	0.437	0.431	0.456	0.373	0.589	0.480	0.521	0.676	0.799	0.833	1.000	
SI_1	0.179	0.189	0.346	0.338	0.336	0.196	0.233	0.587	0.511	0.539	0.507	0.649	0.601	0.639	0.481	0.415	0.411	0.428	1.000
SI_2	0.198	0.203	0.376	0.348	0.349	0.257	0.259	0.574	0.575	0.560	0.575	0.669	0.632	0.692	0.493	0.385	0.442	0.411	0.854
SI_3	0.159	0.222	0.336	0.303	0.345	0.205	0.252	0.591	0.558	0.544	0.547	0.658	0.627	0.663	0.457	0.405	0.404	0.405	0.866
WI_1	0.204	0.282	0.426	0.448	0.458	0.273	0.315	0.708	0.663	0.662	0.587	0.820	0.661	0.780	0.540	0.498	0.548	0.521	0.656
WI_2	0.169	0.220	0.446	0.448	0.439	0.235	0.277	0.675	0.644	0.659	0.600	0.761	0.712	0.712	0.524	0.475	0.514	0.515	0.663
WI_3	0.210	0.283	0.467	0.453	0.450	0.282	0.310	0.706	0.681	0.671	0.596	0.790	0.702	0.763	0.555	0.526	0.527	0.538	0.688
PC_1	-0.023	0.016	0.037	0.083	0.038	0.009	0.033	0.238	0.186	0.196	0.143	0.278	0.221	0.238	0.189	0.191	0.203	0.166	0.183
PC_2	0.026	0.083	0.085	0.147	0.081	0.060	0.052	0.307	0.254	0.243	0.142	0.317	0.213	0.273	0.247	0.268	0.301	0.232	0.202
PC_3	0.016	0.079	0.146	0.198	0.116	0.083	0.120	0.337	0.272	0.286	0.229	0.366	0.296	0.293	0.296	0.305	0.303	0.297	0.263
F_TECH_1	0.110	0.074	0.127	0.118	0.199	0.117	0.181	0.140	0.171	0.159	0.161	0.294	0.200	0.249	0.241	0.284	0.278	0.310	0.195
F_TECH_2	0.133	0.160	0.214	0.246	0.266	0.163	0.256	0.289	0.272	0.291	0.263	0.392	0.327	0.356	0.337	0.374	0.332	0.388	0.289
F_TECH_3	0.166	0.213	0.230	0.271	0.301	0.203	0.285	0.308	0.300	0.321	0.301	0.414	0.342	0.409	0.383	0.394	0.367	0.423	0.287
HC_1	-0.058	0.037	-0.098	-0.076	-0.096	-0.079	-0.090	0.109	-0.007	-0.029	-0.066	0.022	-0.047	0.022	-0.095	-0.090	-0.091	-0.160	0.078
HC_2	-0.036	0.066	-0.047	-0.039	-0.094	-0.081	-0.058	0.056	-0.019	-0.016	-0.052	0.002	-0.032	-0.025	-0.091	-0.153	-0.145	-0.189	0.013
HC_3	-0.042	-0.002	-0.060	-0.069	-0.082	-0.084	-0.081	0.060	0.034	-0.041	0.025	0.028	0.027	-0.003	-0.056	-0.087	-0.098	-0.121	0.043

Continued

	SI_2	SI_3	WI_1	WI_2	WI_3	PC_1	PC_2	PC_3	F_TECH_1	F_TECH_2	F_TECH_3	HC_1	HC_2	HC_3
PFA_1														
PFA_2														
PFA_3														
PFA_4														
PFA_5														
PFA_6														
PFA_7														
PFA_8														
PEA_1														
PEA_2														
PEA_3														
PEA_4														
PEA_5														
PEA_6														
PEA_7														
PEA_8														
PEA_9														
PEA_10														
PAA_1														
PAA_2														
PAA_3														
PAA_4														
PAA_5														
PAA_6														
PAA_7														
PAA_8														
PTA_1														
PTA_2														
PTA_3														
PTA_4														
PE_1														
PE_2														
PE_3														
EE_1														
EE_2														
EE_3														
EE_4														
SI_1														
SI_2	1.000													
SI_3	0.869	1.000												
WI_1	0.671	0.660	1.000											
WI_2	0.666	0.675	0.855	1.000										
WI_3	0.695	0.702	0.853	0.889	1.000									
PC_1	0.212	0.194	0.279	0.273	0.238	1.000								
PC_2	0.248	0.212	0.311	0.304	0.302	0.817	1.000							
PC_3	0.265	0.278	0.388	0.409	0.359	0.764	0.823	1.000						
F_TECH_1	0.228	0.172	0.239	0.244	0.246	-0.093	-0.075	-0.044	1.000					
F_TECH_2	0.294	0.284	0.351	0.363	0.383	-0.004	-0.002	0.055	0.767	1.000				
F_TECH_3	0.316	0.299	0.381	0.399	0.422	0.014	0.008	0.083	0.746	0.910	1.000			
HC_1	0.059	0.078	-0.006	-0.012	-0.028	0.064	0.106	0.030	-0.101	-0.055	-0.101	1.000		
HC_2	0.003	0.023	-0.066	-0.037	-0.082	0.031	0.053	0.021	-0.105	-0.078	-0.095	0.784	1.000	
HC_3	0.042	0.058	-0.005	0.002	-0.012	0.062	0.103	0.024	-0.071	-0.073	-0.123	0.650	0.648	1.000