Health Monitoring Smart Clothing: Understanding its Acceptance among Older Adults

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Introduction. Healthcare for the aging population has become a major concern with the increase of life expectancy in U.S. (Mather et al., 2015). Mather et al. (2015) stated that 15% of the U.S. population is older than 65 years and it is predicted to grow to 24% in 2060. More than 80% of older adults are dealing with one or more chronic conditions (e.g., cancer, dementia, diabetes, arthritis, heart disease) (Garza, 2016). 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. This system may reduce the need for healthcare resources of personnel, equipment, and hospital space (Schulz et al., 2015). Continuous monitoring also will lead to better understand the dynamic nature of aging and disease while allowing older adults' independent living (Kang et al., 2010). 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 can also be avoided by using inconspicuous smart clothing (Melenhorst et al., 2007).

The market for health monitoring smart clothing for older adults is at an initial stage; in the globe, less than 20 companies (e.g., Hexoskin, OMsignal, Supa, AmbioTex) have launched health monitoring smart clothing (Sayem et al., 2019). 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, which is this study's overall purpose. Thus, a multidisciplinary approach was taken for this study to develop and evaluate a conceptual framework explaining older adults' perception and intention to wear health monitoring smart clothing.

Background. The conceptual framework of this study 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). As shown in Figure 1, perceived functional, expressive, aesthetic, and tracking attributes were the predictors for the technology acceptance variables (performance expectancy, effort expectancy, and social influence) (H1 to H4). These variables from the UTAUT

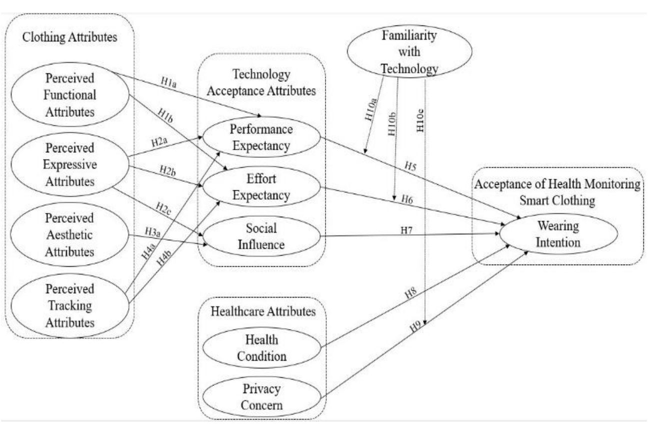

Figure 1. The conceptual framework of this study.

model subsequently would predict the wearing intention of health monitoring smart clothing (H5 to H7). However, the UTAUT model does not encompass all of the variables that may influence or moderate the wearing intention of older adults' health monitoring smart clothing. Several studies (e.g., Mahmood et al., 2008) found that existing health conditions have a significant influence on technology acceptance among older adults in a healthcare context (H8). Li et al. (2016) found the significant impact of privacy concern on adopting wearable healthcare devices (H9). According to the social emotional selectivity theory, with aging, individuals become selective in investing their efforts that will lead to maximum gain (Carstensen, 2006). Thus, previous experience, familiarity with technology in this study, may moderate the influence of performance expectancy, effort expectancy, and privacy concern on wearing intention of health monitoring smart clothing (H10).

Methods. An online survey was conducted with a nationwide convenience sample of 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 (Bakhshian & Lee, 2018; Gao et al. 2015; Koo, 2017; Li et al., 2016; Li et al., 2019; Ryu et al. 2016; Venkatesh et al., 2003; Zhang et al. 2016) to measure the 11 constructs, using a 5-point Likert-type scale. Mplus 8.4 was used for data analyses. Using the maximum likelihood estimation method, two-step approach was used in structural equation modeling (SEM) to test overall fit and proposed relationships in the model. To test the moderating effect of the construct, familiarity with technology, latent moderated structural equation was used. Both convergent and discriminant validities have been checked. All constructs were reliable with Cronbach's $\alpha > .7$.

Results. A total of 376 usable surveys was used for data analyses. 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 the rest were males. Around 45.23% 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.

Confirmatory factor analysis was performed to check the measurement model fit, resulting to a good model fit (χ^2=1202.978, df=647, RMSEA=0.048, SRMR=.045, CFI=.956, TFI=.950). The hypothesized path model was then tested and demonstrated a good model fit (χ^2=1293.948, df=566, RMSEA=0.058, SRMR=.065, CFI=.937, TFI=.930). Almost 86% of older adults' wearing intention of health monitoring smart clothing was explained by the proposed constructs in Figure 1. Eight out of 16 paths in the hypothesized model were statistically significant. Perceived functional, expressive, and tracking attributes significantly influenced performance expectancy (H1a: *ß*=-.085, p=.011; H2a: *ß*=.417, p<.001; H4a: *ß*=.640, p<.001, respectively). Effort expectancy was positively influenced by perceived expressive (H2b: *ß*=.526, p<.001) and tracking attributes (H4b: *ß*=.231, p=.003). Perceived expressive attribute also positively influenced social influence (H2c: *ß*=.656, p<.001). Results also showed wearing intention of health monitoring smart clothing for older adults was positively influenced by performance expectancy (H5: ß=.770, p<.001) and social influence (H7: ß=.219, p<.001). No moderating effect of familiarity with technology was found in the model.

Conclusion. 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. There are some limitations in this study. The study sample was skewed towards the young old; thus, another model fit test is recommended with a wide range of the aging population. The proposed framework included one moderating variable, familiarity with technology. It is suggested adding additional constructs (e.g., presence of social support) as a moderator and retest the revised framework.

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