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Consumer adaptation and infusion of wearable devices for healthcare

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ABSTRACT

Consumers' concerns about health and privacy risks of the Internet of Things, and in particular healthcare wearable devices, have been recently intensified. Yet there is little research examining the impact of those concerns on consumers' behavioral patterns related to the post-adoptive use of healthcare wearable devices. The purpose of this study is to examine how consumers attain extended use of healthcare wearable devices in the presence of health and privacy concerns. This study empirically tests a novel research model drawing on coping theory and coping model of user adaptation. Data were collected from United States consumers using stratified and random sampling method. The effective sample included 260 responses from consumers. The results indicate that consumers' health and privacy concerns initiate a coping process. Problem-focused and emotion-focused coping efforts significantly predict the extended use of healthcare wearable devices. This study offers several implications for theory and research. Most notably, it demonstrates the viability of coping as a high-level theoretical lens for examining consumers' post-adoptive use of information technology.

1. Introduction

Wearable technology is one of the promising areas of the Internet of Things (IoT). Healthcare wearable devices range from the popular fitness trackers (e.g., Fitbit, AppleWatch, Samsung Gear) to more sophisticated healthcare wearable devices (Casselman, Onopa, & Khansa, 2017a, 2017b; Kim & Kim, 2016). They allow consumers to continuously monitor physiological parameters and manage their health and well-being on a personal basis, or grant physicians access to their health data and receive personalized medical care (Atzori, Iera, & Morabito, 2010; Hwang et al., 2016; Kim & Kim, 2016).

The ultimate impact of healthcare wearable devices on consumers as well as on a society can be substantial (Andersson & Mattsson, 2015; Atzori et al., 2010). Two salient features evidently characterize the extant research on healthcare wearable devices. First, it largely focuses on technological antecedents (e.g. usefulness, functionality, compatibility, affective quality, and cost) in examining consumers' use of healthcare wearable devices (Li, Wu, Gao, & Shi, 2016; Liu and Guo, 2017; Yang, Yu, Zo, & Choi, 2016). Second, the extant research predominantly employs technology acceptance theories to examine consumers' behavioral intention or initial use of healthcare wearable devices (Gao, Li, & Luo, 2015; Lunney, Cunningham, & Eastin, 2016; Yang et al., 2016).

A dark side of healthcare wearable devices is heightening consumers' fears about the devices' hidden harmful effects. Recently, scholars and experts have been increasingly discussing consumers' growing concerns about health and privacy risks of healthcare wearable devices (Evenson, Goto, & Furberg, 2015; Gao et al., 2015; Mills, Watson, Pitt, & Kietzmann, 2016; Piwek, Ellis, Andrews, & Joinson, 2016). However, no definitive research has been conducted to date to examine the impact of those concerns on consumers' behavioral patterns related to the use of wearable healthcare devices. There are some limitations of previous studies in terms of following two aspects. First, prior studies overlooked consumers' concerns about the unknown factors influencing their health and privacy risks resulting from healthcare wearable devices. Some users employing wearable technologies do not routinize their wearable healthcare device and stop making them part of daily lives (Casselman et al., 2017a, 2017b). According to research, one-third of users who adopted the wearable technology stop using their device after six months (Casselman et al., 2017a, 2017b; Constantini, 2014a, 2014b). Second, prior studies, applying technology acceptance model (TAM) and its extensions, have a limited capacity to address adoption stage and post-adoption stage of

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information technology (IT). When consumers adapt to the healthcare wearable devices well, their potential can be more fully realized. Hence, it is necessary to examine the entire process of infusion, i.e. the utilization of information technology to its fullest extent (Jones, Sundaram, & Chin, 2002), from the perspective of consumers' adaptation. Underutilization of the promoted capabilities harms both consumers and vendors; consumers receive a lower value for the price they pay, while vendors may incur substantial costs for maintaining the underutilized capacity of the technology.

Research questions (RQs) are as follows:

RQ 1: What are significant factors that cause stress from the perspective of consumers' concerns about the healthcare wearable devices?
RQ 2: How consumers evaluate and cope with the stress, resulting from the hidden harmful effects of healthcare wearable devices?
RQ 3: How their coping behavior relates to the infusion of the healthcare wearable devices?

The purpose of the present study is to analyze the whole process ranging from an awareness of the stress, resulting from the hidden harmful factors of healthcare wearable devices, to infusion. Thus, the present study does not consider positive determinants such as benefits and reliability of the healthcare wearable devices. The coping model of user adaptation (CMUA, Beaudry & Pinsonneault, 2005), which is based on coping theory (Lazarus & Folkman, 1984), can be applied to assess consumers' adaptation in the light of their growing concerns about hidden harmful effects of the health wearable devices. Considering health concerns and privacy risks of healthcare wearable devices, this study proposes that the adaptation process, in which consumers potentially revise and adapt their initial emotional response, usage pattern, or the technology itself to achieve greater efficiency, precedes the infusion. This study proposes a structural equation model integrating consumers' concerns, coping process, and infusion based on the CMUA, and tests hypotheses derived from the model by using data collected from current users of healthcare wearable devices in the United States.

2. Theoretical background

2.1. Emerging concerns in the IoT

Internet of Things (IoT) has potential for a transformative change in many aspects of consumers' life (Andersson & Mattsson, 2015; Shin, 2017). However, they are already beginning to worry about health and privacy risks of the IoT. Experts have noted that today consumers are more concerned about the privacy than ever before (Kobie, 2016). Leading industry experts and policy makers recognize that privacy risks and potential for using consumers' personal data without their consent are among the major shortcomings of the healthcare wearable devices (Chui, 2016; Ramirez, 2015). PwC Health Research Institute reported that 82 percent of surveyed consumers were convinced that healthcare wearable devices compromised their privacy (PwC Health Research Institute, 2014). According to U.S. Federal Trade Commission chairwoman, Edith Ramirez, "Connected devices that provide increased convenience and improve health services are also collecting, transmitting, storing, and often sharing vast amounts of consumer data, some of it highly personal, thereby creating a number of privacy risks." (Ramirez, 2015, p. 2). Meanwhile, some argued that privacy concerns inhibit consumers from purchasing healthcare wearable devices, and consequently, prevent the infusion of the IoT (Meola, 2016).

Both practitioners and scholars recognize security as a significant limitation of the IoT. In particular, leading technology companies, including cybersecurity leader Kaspersky Lab and Hewlett-Packard (HP) have expressed serious concerns regarding the security flaws of the IoT (Esposito, 2016; Mowbray, 2016). A recent study conducted by HP reported that 70 percent of the most commonly used IoT devices contain security vulnerabilities (Mowbray, 2016). The study conducted by PwC Health Research Institute found that 86 percent of surveyed consumers concerned that healthcare wearable device was subject to security breaches (PwC Health Research Institute, 2014).

In a recent study conducted by McKinsey Global Institute, leading industry experts noted that, differently from other information technologies, security breaches in the IoT exposes consumers not only to informational threats but also to significant health threats (Chui, 2016). Scholars also have noted consumers' growing concerns regarding health consequences of healthcare wearable devices. Consumers are particularly concerned about accuracy and reliability of the obtained health data, as well as exposure to electromagnetic radiation (EMR) due to prolonged use of healthcare wearable devices (Ferguson, Rowlands, Olds, & Maher, 2015; Piwek et al., 2016; Zhao, Zhang, Chiu, Ying, & He, 2014). Such concerns can impede a sustained post-adoptive use of healthcare wearable devices (Mills et al., 2016; Vesnic-Alujevic, Breitegger, & Pereira, 2016).

Table 1 shows that health and privacy concerns are observed in major consumer applications of IoT such as self-driving cars, virtual reality, and healthcare wearable devices. Table 2 summarizes health and privacy concerns that have recently been widely discussed specifically in the context of healthcare wearable devices.

2.2. Coping theory

Psychology literature referred to coping as "person's behavioral or cognitive actions performed to respond to a problem." (Tunks & Bellissimo, 1988, p. 171). Lazarus and Folkman (1984) proposed a widely accepted process-based model of stress and coping, which explains how a person evaluates and copes with stressful events. Accordingly, coping is person's response that includes "the constant changing of cognitive and behavioral efforts to manage specific external and internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus & Folkman, 1984, p. 141). Internal demands are person's requirements to his/her environment, while external demands are contextual demands imposed onto the person.

Lazarus and Folkman (1984) suggested that a person makes his/her decision to engage in a particular coping behavior based on the appraisal of the stressful event. Primary and secondary appraisals are formed through the evaluation of potential outcomes of the stressful event. In primary appraisal, a person evaluates the impact of the stressful event on his/her personal well-being (e.g. "Does this situation affect me?" or "What is at stake in this situation?"). In secondary appraisal, a person evaluates the extent of his/her control over the stressful event (e.g. "Do I have control in this situation?") (Lazarus & Folkman, 1984). According to Lazarus and Folkman (1984), the stressful event can be appraised as a challenge or a threat. When appraised as a challenge, the event is regarded as an opportunity for gain or growth. In contrary, the threat appraisal implies that the event involves harm or loss that has not yet taken places, but is anticipated (Lazarus & Folkman, 1984).

Person's coping response depends on how he/she appraises the stressful situation. Lazarus and Folkman (1984, 1982) outlined two major coping behaviors: problem-focused coping and emotion-