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The role of individual differences on perceptions of wearable fitness device trust, usability, and motivational impact

Michael A. Rupp*, Jessica R. Michaelis, Daniel S. McConnell, Janan A. Smither

University of Central Florida, USA

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ABSTRACT

Lack of physical activity is a severe health concern in the United States with fewer than half of all Americans meeting the recommended weekly physical activity guidelines. Although wearable fitness devices can be effective in motivating people to be active, consumers are abandoning this technology soon after purchase. We examined the impact of several user (i.e. personality, age, computer self-efficacy, physical activity level) and device characteristics (trust, usability, and motivational affordances) on the behavioral intentions to use a wearable fitness device. Novice users completed a brief interaction with a fitness device similar to a first purchase experience before completing questionnaires about their interaction. We found computer self-efficacy, physical activity level, as well as personality traits indirectly increased the desire to use a fitness device and influenced the saliency of perceived motivational affordances. Additionally, trust, usability, and perceived motivational affordances were associated with increased intentions to use fitness devices.

1. Introduction

Interest in wearable fitness technology is increasing rapidly and many people believe that these devices will increase their motivation to exercise and ability to achieve fitness and health goals (Consumer Technology Association, 2013). Wearable fitness technologies include devices that continuously monitor wearers' physical activity (e.g., steps, calories) and physiological data (e.g., heart rate, skin temperature) throughout the day (Mackinlay, 2013; Mancuso et al., 2014). Prior research has also suggested these fitness devices will become an integral component of a more personalized forthcoming healthcare system that will allow patients and physicians to access a continuous stream of health data (Odubogun, 2015) while increasing individuals' daily physical activity levels. However, while their effectiveness has been validated (e.g., Butryn, et al., 2016; Strath et al., 2011; Mercer et al., 2016), the acceptance of this technology is limited as up to one-third of purchasers stop using their devices within six months of ownership (Ledger and McCaffrey, 2014). A recent longitudinal study of Fitbit devices found 25% of participants dropped out after the first week and 50% dropped out after the second week of the study (Shih et al., 2015). Long-term adoption is a critical concern that needs to be addressed in order for this technology to be beneficial. The current study investigates three primary concerns that were cited as potential sources of disuse of these devices: 1) lack of motivational ability, 2) poor design and usability, and 3) lack of trust in the technology (Ehmen et al., 2012; Lazar et al., 2015; Mancuso et al., 2014; Shih et al., 2015) called device characteristics. The current study also examines how user characteristics (individual differences in age, personality, and computer self-efficacy) predict user perceptions of each of the device characteristics. Finally, we also compare how user and device characteristics relate to behavioral intentions to use fitness technology in the future.

1.1. Motivational ability of the device

People are generally motivated to complete behaviors that achieve their needs or goals. One motivational theory, Self-Determination Theory (SD-Theory), theorizes that people have three core psychological needs: autonomy, competence, and relatedness. Activities that meet these needs will be seen as intrinsically rewarding and will motivate individuals to engage in them long term (Deci and Ryan, 2000; Ryan and Deci, 2000). Autonomy is the need to make meaningful choices and be in control. Competence is the need to be skillful, effective, meet challenges, and achieve goals. Finally, relatedness is the need to feel connected to others and have social support (Ryan and Deci, 2000). Further, when these needs are ignored or incorrectly implemented, individuals may be demotivated instead (Ryan and Deci, 2000). This may lead to disuse of the devices.

Zhang (2008) used the term motivational affordances to signify properties of a technology that are aligned with motivational theory to support the user's needs or goals. A wearable device with high

* Corresponding author. Department of Psychology, University of Central Florida, Orlando, FL 32816, USA.
E-mail address: mrupp@knights.ucf.edu (M.A. Rupp).

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motivational affordances will have features to fully support individuals self-determining needs. It can also be said that devices with greater motivational affordances may help increase users' motivation to exercise. Such devices may support autonomy by allowing individuals to choose how and when they engage in physical activity. The devices may support competence by providing recommendations and feedback about activity levels and progress toward goals. They may also support relatedness by connecting friends and family to observe and encourage user progress (Mekky, 2014) or by posting fitness statistics to social media sites (He et al., 2013).

SD-theory has been used to describe the desire to engage in exercise (Edmunds et al., 2006; Wilson et al., 2008) and one recent study, (Lee et al., 2015), successfully applied the SD-theory framework into the unified theory of technology acceptance and use. Lee and colleagues found that meeting individuals' autonomy, competence, and relatedness needs were critical to predicting future use of a technology. However, this combined framework has not been studied with wearable fitness technology, which represents a clear gap in the literature.

1.2. Usability

Even the most motivated individual will be prevented from using a technology if it has poor usability or design issues (Fogg, 2009). Although usability is an important concern, most of the prior research that focused on a limited selection of devices indicated more research is needed in this area. Within the extant research, several issues were identified. First, colors and font sizes used were hard to see especially for older adult participants (Preusse et al., 2014a). Next, the display of critical information such as steps taken and battery life were hard for users to interpret (Preusse et al., 2014a). Another study showed that logging food was difficult and that specific items were hard to locate in the database (Preusse et al., 2014b). Another study (Meyer et al., 2015) found device comfort was a critical issue and some designs led to devices that were difficult for users to secure, and so could be easily lost. The current study includes a wide variety of devices that vary in physical design to better assess how device features map to users' perceptions of the fitness technology.

1.3. Technological trust

Technological trust is the belief that a technology is supportive of one's goals in situations where the user cannot have complete knowledge (Lee and See, 2004) or the extent a user is willing to act on recommendations of a system (Madsen and Gregor, 2000). This is similar to interpersonal trust between individuals, which relies on an assessment of an individual's ability, benevolence, and integrity (Mayer et al., 1995). However technological trust relies different attributes. With technological devices, people assess trust based on the performance of the device, the process it uses, and purpose that the technology was designed (Lee and Moray, 1992). The technological trust literature cites several predictors of trust. Specifically users trust devices they perceive as accurate (e.g., Findley, 2015; Merritt, 2011), reliable (Meyer et al., 2015) and protect their personal information (Piwek et al., 2016; Ziefle et al., 2011) because they have good performance. Other design considerations that may affect trust include having desired functionality (Mcknight et al., 2011) because they use an appropriate process. Finally, devices that are more transparent are more likely to be trusted. Transparency is the concept of how well a system provides its purpose, processes, and performance to a user (Lee and See, 2004) so he or she can judge the veracity of what it claims.

The amount that an individual trusts a technology can directly affect their decision to use or disuse device (e.g., Hancock et al., 2011; Parasuraman and Riley, 1997). This concept is critical to the acceptance of fitness technology. Users must rely on a fitness device to transform the invisible biological data they generate throughout the day into accurate, actionable, and understandable depictions of their health and fitness. Both Hancock et al. (2011) and Hoff and Bashir (2015) argued that individual differences (e.g., experience, skill, personality), system characteristics (e.g., form, capability, feedback), and characteristics of the situation and task affect the degree to which users will trust a technology. Currently, research on how individual differences may affect fitness device acceptance, usage, and trust has been limited.

1.4. Individual differences

Individual difference characteristics such as age and personality are two factors that have not been fully addressed within the research on fitness devices (e.g., Ehmen et al., 2012). First, age effects are important to assess because as people age they become less active (Etnier et al., 2006) and may benefit more from daily physical activity (e.g., Baker et al., 2010). Older adults may be more resistant or hesitant to embrace novel technologies than younger adults due to differences in cultural factors, education and experience (Röcker et al., 2014). This underscores the need for user research of recent and novel technologies with the inclusion of older adult participants.

Second, differences in personality, specifically the five-factor model traits (i.e. openness to experience, conscientiousness, extroversion, agreeableness, and neuroticism, Goldberg, 1993), have been linked to differences in interactions with complex technology (Szalma and Taylor, 2011), trust of automated technologies (Calhoun et al., 2012), and the motivation to engage in physical activity (Yeung and Hemsley, 2007). Agreeable people are more trusting and less suspicious of others (Goldberg, 1993; McCrae and Costa, 2013), which may extend to fitness devices (Digman, 1990) and concerns over information privacy (Junglas et al., 2008). Greater conscientiousness is associated with greater planning ability, goal achievement, decision-making efficiency, working memory skills (Gramzow et al., 2004; Hmel and Pincus, 2002) and greater health and fitness behaviors (Booth-Kewley and Vickers, 1994; Rhodes and Smith, 2006). Greater extroversion is associated with being more social, and outgoing (Goldberg, 1993; McCrae and Costa, 2013) and extraverts are more likely to exercise than introverts (Rhodes and Dickau, 2012; Yeung and Hemsley, 2007). Neuroticism leads to greater feelings of distress when individuals experience negative emotions (Goldberg, 1993; McCrae and Costa, 2013) and may decrease coping ability to stressful situations (DeYoung et al., 2002) which may present a barrier to participation in physical activity (Courneya and Hellsten, 1998; De Moor et al., 2006). Personality factors may further impact how people interact with device motivational affordances or fulfill their psychological needs according to SD-Theory (Zhou, 2015).

1.5. Technology acceptance

Technology acceptance is a critical factor of long-term adoption of fitness technology. The technology acceptance model (TAM; Davis, 1989) determined that perceived usefulness and ease of use were two important drivers of usage behavior. Specifically usage behavior includes both the behavioral intention to use a product in the future and actual product use. The perceived usefulness component is the belief that a technology will help the user accomplish a goal and ease of use depends on the perceived usability of the device. Moreover, both of these subcomponents influence both the device and user characteristics (Davis, 1989). Thus, acceptance is contextually dependent on the product and its users.

Motivational affordances and Usability are two device characteristics thought to be predictive of acceptance because they directly relate to the perceived usefulness and ease of use criteria of the TAM, and may moderate attitudes and behavioral intentions to use a product (Legris et al., 2003). Recent research with the TAM has argued for including motivational factors to improve the predictability of the model. One study specifically included the autonomy, competence, and relatedness components of SD-Theory. Their results showed that both autonomy and relatedness indirectly predicted behavioral intentions to use