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Health empowerment through activity trackers: An empirical smart wristband study

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ABSTRACT

The increasing popularity of activity trackers has shown a remarkable shift in human computer interaction; individuals seem willing to wear a device that constantly tracks health related metrics such as movement, exercise, sleep, and calorie burn. Using the insights derived from their activity trackers, individuals are expected to be more empowered to set and stick to personal health goals. Whereas the outcome of using activity trackers is of great importance to both individuals and society at large, there are no empirical studies substantiating this presumption. This study aims to contribute to filling this research gap. Making use of self-regulation theory as theoretical framework, we developed a model that proposes six system specific elements (attractiveness, monitoring, feedback, privacy protection, readability, and gamification) as determinants of health empowerment, and thereof health commitment. Using survey data collected from individuals wearing smart wristbands ($N = 210$), the model was validated. Overall, the results provide strong support for the health empowering capabilities of smart wristbands. The paper concludes with implications for theory and practice, and some suggestions for future research.

1. Introduction

Following the increased attention toward healthier lifestyles in society, we recently have seen an increase in the adoption and use of so-called activity trackers (Martin, 2015). These activity trackers, which are usually offered to individuals as smart wristbands, watches, and clip-ons, represent a form of wearable technology that monitors and tracks activities such as movement, sleeping, and use of calories (Dontje, de Groot, Lengton, van der Schans, & Krijnen, 2015). With the collected data and presented information, users not only gain insight into their daily activities but are also supported in setting and adjusting personal health goals (cf. Quinlan, 2015). Remarkably, academic research into the use of activity trackers is scarce and has been openly demanded (Bice, Ball, & McClaran, 2015; Wiederhold, 2015). In this paper we aim to add to the underexplored field of activity tracker research by examining how and to what extent activity trackers may empower their users in setting and sticking to personal health goals. We believe the answers to these questions are of particular interest, as relationships between activity trackers and user empowerment implicitly have been suggested through related studies such as those involving mobile activity apps (e.g. Achterkamp Hermens, & Vollenbroek-Hutten, 2015; Bice et al., 2015). However, to the best of our knowledge, these relationships have never been tested.

We will focus our inquiry on smart wristbands because these constitute the largest segment of the activity tracker market (Statt, 2015), adding to the external validity of our study. Smart wristbands are devices worn on the wrist and constantly monitor an individual's activity, inactivity, light, and deep sleep, and feed back the information to an application on a mobile phone or tablet (Sullivan, 2013). The information usually is presented in a simple format, which displays the individual's current activity and compares it with their daily goals (Dominus, 2015). However, smart wristbands are not only used for utilitarian purposes, but also fulfill an aesthetic function and can give individuals an enjoyable, almost game-like experience, by having them set and achieve positive new health goals (Bice et al., 2015). It is the combination of utilitarian,

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aesthetic, and gamified elements that characterize the smart wristband as a multipurpose information appliance (Hong & Tam, 2006), which makes it of particular interest to see how and to what extent the different smart wristband characteristics may lead to feelings of health empowerment.

This paper intends to make three contributions to the existing body of literature. First, using the principles of self-observation and self-regulation as put forward in self-regulation theory as a theoretical anchor (Bandura, 1991), we propose and test a model relating system-specific characteristics of smart wristbands to perceptions of health empowerment and health commitment. As such, we intend to demonstrate the applicability of self-regulation theory as an explanatory mechanism in activity tracker settings and come up with observations regarding the overall influence of smart wristbands on user behavior in terms of setting and sticking to personal health goals. Second, by including attractiveness, monitoring, feedback, privacy protection, readability, and gamification as system-specific determinants of health empowerment (cf. Hong, Chan, Thong, Chasalow, & Dhillon, 2013) we intend to generate knowledge about the predictive validity of these individual system elements. Given the limited amount of research on actual influence of smart wristbands, this will lead to first insights into the relevance of these system-specific elements. Third, the findings of our study aim to serve various stakeholders associated with smart wristbands, as our results will show the extent to which the system-specific elements may empower their users in terms of achieving healthy behavior. Developers might use these insights to prioritize particular development efforts whereas health organizations might use the information to help their clients more effectively.

In the remainder of this paper we first provide a conceptual background by describing the concept of activity trackers and reviewing the few studies available. We then proceed with the introduction of our research model and hypotheses. Next, we present our research method and report on the outcomes of the data analysis. We conclude with a discussion of the implications of our findings for research and practice and highlight some interesting directions for future research.

2. Conceptual background

2.1. Activity tracker research

Activity trackers have been around for some time and can be used for routine daily activity as well as for monitoring more intense exercise (Dontje et al., 2015). Activity trackers have attracted the interest of the academic community at large (Bice et al., 2015; Dontje et al., 2015; Takacs et al., 2014). While such disciplines as movement science have been studying the technology for decades (Weerdesteyn, Nienhuis, Hampsink, & Duysens, 2004), information and social sciences have started to investigate rather recently what is growing to be a multi-disciplinary field (Achterkamp et al, 2015). One reason for this attention is we are seeing a widespread adoption due to the introduction of easy to wear and easy to use activity trackers, of which the smart wristband is one of the most prominent examples (Statt, 2015).

Past research has analyzed the benefits of smart wristbands from a variety of perspectives. Research on activity tracker usage in recovering patients suggests that the feedback of the health data could assist in returning to functional independence (Appelboom et al., 2014). Research in pharmaceutical literature has discussed whether health trackers such as smart wristbands should be recommended to the public in a similar manner as other health care devices (Mercer, Li, & Grindrod, 2015). The constant collection of health data has removed obstacles, which doctors and researchers have experienced, including time spent collecting data, patient/subject drop out rates, and subjective reports of health information (Appelboom et al., 2014). While past research on patients is encouraging, there is little research analyzing smart wristbands used by healthy individuals (Bice et al., 2015). Therefore, it is unknown whether utilization of a smart wristband contributes to empowering (healthy) users in setting and sticking to their health goals.

2.2. Empowerment

The concept of empowerment has its origins in the social sciences (Ward & Mullender, 1991) and has been most widely researched with organizational literature (Meyer, Allen, & Smith, 1993; Spreitzer, 1996; Thomas & Velthouse, 1990). Within this stream of research, researchers have studied quite extensively whether empowerment contributes to managerial effectiveness and work motivation (Gagné & Deci, 2005; Hochwalder & Bergsten Brucefors, 2005; Spreitzer, 1996). Health theorists have also adopted the empowerment concept, for example, in areas such as patient empowerment (Feste & Anderson, 1995) and consumer empowerment in healthcare (Lober & Flowers, 2011). Achterkamp et al. (2015) found that achievement feedback from mobile devices can increase elements related to empowerment in individuals striving towards a goal. The few studies we found mostly adopted research approaches analyzing an inter-device reliability. However, some studies focused on the impact of the technology on behavior of individuals (e.g. Dontje et al., 2015; Bice et al., 2015; Achterkamp et al., 2015), and showed significant influence on feelings such as affiliation, enjoyment, challenge, and positive health motivation (Bice et al., 2015).

In this study we consider empowerment from a self-regulation perspective. With the aid of the device's goal settings and feedback mechanisms an individual feels competent to define and impact their self-made goals. Unlike most past research the focus of this study is on individual health empowerment rather than empowerment inspired by another individual or authority. In other words, health monitoring is optional. We define empowerment as the belief that a person has a significant influence over an outcome, which includes: their ability to perform a task well or fit between the requirements of the tasks and their personal values, and feeling of control over the situation (Karasek & Theorell, 1990; Spreitzer, Kizilos, & Nason, 1997). This form of autonomy has proved to be a protective factor against ill health in the workplace (Spreitzer et al., 1997) and can be an important mechanism for reducing stress. We aim to add to past research by showing that smart wristbands positively influence feelings of health empowerment through self-made goals.

3. Research model and hypotheses

Fig. 1 displays the proposed research model. The overall structure of the model is rooted in the theory of self-regulation (Bandura, 1991), which postulates that human behavior is extensively motivated and regulated by the ongoing exercise of self-observation and self-influence (Bandura, 1991, p. 248). One of the presumptions of the theory is that people can only influence their own motivation and actions if they engage in self-observation of their activity. Such self-observation results in self-diagnostic information that is needed for setting behavioral goals and evaluating progress towards these goals. The theory further postulates that the collected self-diagnostic information has an important self-motivating function, that is, it gives people the capabilities to set goals of objective improvements and gives them the feeling that they can regulate these goals themselves (Bandura, 1991, pp. 250–251). This so-called self-regulation is, following Bandura and