

Promoting Health-Related Abilities and Behaviors via Health Apps: A Self-Regulation Perspective

Research-in-Progress

Shaoxiong Fu

Fei Liu

Zhao Cai

Eric T.K. Lim

Chee-Wee Tan

Dongming Xu

Tingru Cui

Abstract

Motivated by the gap between the use of health technologies and actual health-related outcomes, this study builds on self-regulation theory to construct a research model that aims to unveil how technological intervention of health app overall quality affects self-regulated abilities and behaviors about health app use, health information literacy, and physical activity, which together determine health-related outcomes pertaining to health status and satisfaction with life. Responding to the lack of exploration of the interaction among different apps, narcissistic theory is applied to explain how the usage of selfie apps reinforce the effects of health apps. To empirically test our proposed research model, we plan to administer a large-scale survey questionnaire on health app usage.

Keywords: Health app, selfie app, self-regulation theory, narcissistic theory, health

Introduction

Health applications (hereafter referred to as health apps), which deliver health, fitness, or medical care services through mobile devices, are becoming pervasive. There are over 318,000 health apps accessible from app stores worldwide in 2018 and the global health app market is estimated to reach 3.7 billion app downloads in 2017 (Liquid State 2018). On the surface, the exponential growth of health app users should be a cause for joy because past studies have alluded to the instrumental role of technology in augmenting health-related abilities (Kim et al. 2018) and bolstering one's capability to make informed

health decisions (Niemelä et al. 2012). Yet, despite the optimism, recent reports have indicated that the physique of college students in America has been declining due to the lack of physical activity and unhealthy lifestyle (American Council on Education 2018), a worrying trend which runs contrary to the popularity of health apps. Furthermore, a study commissioned by the National Health Commission of China revealed that only 19% of Chinese residents have adequate levels of Health Information Literacy (HIL) (Health Commission of China 2017), a measure of one's capacity in acknowledging health information needs, sourcing for health information to meet those needs, ascertaining the credibility of acquired health information, and harnessing credible health information for making informed health decisions (Medical Library Association 2003). Taken together, the abovementioned contradictory phenomena appear to challenge conventional wisdom that the prevalence of health apps will naturally culminate in health benefits for their users.

One plausible reason for the disappointing effects of health app usage on users' HIL can be attributed to the tendency of users to abandon health apps prematurely. As documented by Perze (2016), nearly one in four users abandon mobile apps after a single usage session, thereby implying that users' motivation is critical in determining their continued usage of mobile apps. The same applies to health apps. Within extant literature, there is an abundance of empirical evidence that has attested to the positive effect of narcissism on health-related behaviors offline (Hill 2016), a trend which we suspect will be amplified in the mobile context due to the explosion in selfies. Due to the relative ease with which selfies can be shared through social media, selfie taking has become an indispensable aspect of daily life for many individuals with the top three selfie apps in China (i.e., BeautyCam, MeiTu, and B612) recording a monthly average number of 126.33 million, 112.46 million, and 48.36 million active users respectively (BigData-Research 2018). Because selfie can be conceived as the embodiment and perpetuation of narcissism online (Weiser 2015), we endeavor to shed light on the interdependency between health and selfie apps in promoting health-related behaviors. Specifically, we draw on self-regulation and narcissistic theories to conceptualize how technological interventions (i.e., health app quality, and selfie app) affects users' self-regulated abilities and behaviors (i.e. health app usage, HIL, and physical activity), which in turn influence health-related outcomes (i.e. health status, satisfaction with life). In so doing, this study attempts to address the following two research questions:

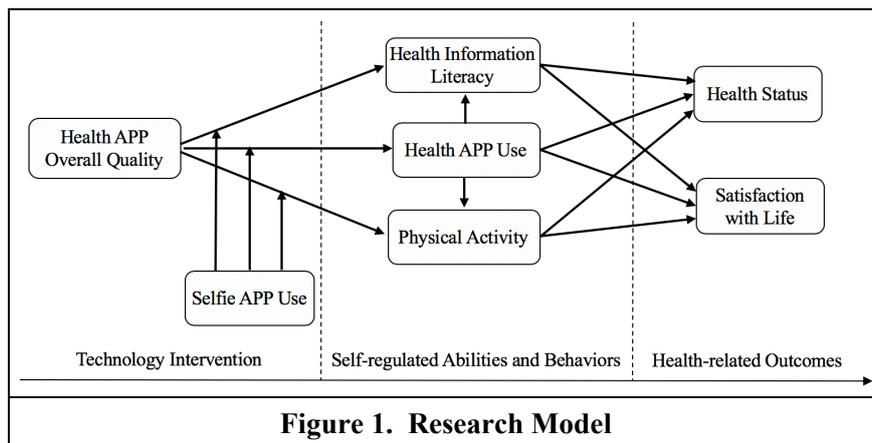
- (1) *What is the effect of technological intervention, in the form of health app quality, on health-related outcomes?*
- (2) *How does the usage of selfie apps influence the effect of technological intervention on health-related outcomes?*

Theoretical Foundation

Self-Regulation Theory: Self-regulation has been conceived as “self-generated feelings, thoughts, and actions that are cyclically adapted and planned to the attainment of individual goals” (Zimmerman 2000). Self-regulation denotes one's ability to formulate and attain long-term goals, even in the absence of immediate external rewards. Individuals, who exhibit high levels of self-regulation, are only driven to change their behaviors for the better, they are also able to effectively manage the change progress and persist with the changes over time. Consequently, self-regulation theory has been employed to elucidate the mechanisms underlying the conversion of one's intentions into actions. In this sense, self-regulation theory acts as a lens for comprehending user behavior and is applicable to contexts involving technological intervention for inducing self-regulated abilities and behaviors as well as outcomes arising from their manifestation (Sage et al. 2017).

Unsurprisingly, self-regulation theory has been applied extensively in healthcare research. Past studies, which embraced self-regulation theory, has largely concentrated on managing unhealthy behaviors (Neal and Carey 2004) as well as health-related problems like chronic pain and physical illness (Sage et al. 2017). More recently however, self-regulation theory has also been employed to guide exploration on ways to promote healthy lifestyles in the likes of dietary supplements (Allom et al. 2017). Indeed, a handful of studies have espoused self-regulation theory to examine technology-based interventions on behavioral change (Sage et al. 2017). Smartphones and by extension, mobile apps can hence support users in regulating their health-related behaviors through technological interventions (Sage et al. 2017).

Fundamentally, self-regulation is an articulation of the mechanisms through which individuals seek to achieve goals through self-directed enactment and modification of strategies (Sandars and Cleary 2011). Though multiple conceptions of self-regulation theory exist within extant literature, most depict self-regulation as a three-stage process (Sandars and Cleary 2011). In the same vein, we advance a research model that delineates the self-regulation process, which is induced via health apps, into three stages: (i) *technological intervention*: it is during this initial self-monitoring phase that users seek to learn about their health indicators via health apps before formulating concrete goals and plans to promote health-related outcomes; (ii) *self-regulated abilities and behaviors*: it is during this second self-performance phase that users attempt to promote health-related outcomes by employing select tactics like increasing the ability to obtain health information as well as the frequency of health app usage and physical activity; (iii) *health-related outcomes*: it is during this final self-reaction phase that users strive to pinpoint key factors (i.e., health app use, HIL, and physical activity), which may culminate in success or failure, and self-evaluate whether they have attained their self-regulated goals (see Figure 1).



Narcissistic Theory: One often neglected but pertinent phenomenon in the age of social media is the manifestation of narcissism. As a personality trait, narcissism encapsulates special admiration for and interest in oneself that has been described as “self-love that shut out everyone else” (Dumitrescu et al. 2013, p. 496). Scholars have associated health-related behavior with narcissism. Narcissism can influence one’s health behaviors and status. Narcissism is positively linked to health behaviors and outcomes like happiness, healthy eating patterns, mental health, physical activity, and perceived well-being (Dumitrescu et al. 2013; Hill 2016). Personality traits like narcissism are strongly associated with technology usage. The selfie is the most representative manifestation of narcissistic behaviors via smartphones. Narcissists tend to be attention seeking, exhibitionistic, and highly concerned with their physical appearance. Selfie-posting frequency is an important predictor for narcissism (Weiser 2015). Furthermore, individuals’ personality like narcissism, which converts changing intention into actions, can play an active role in the self-regulated process (Neal and Carey 2004). Since narcissists crave others’ attention, narcissistic traits are helpful in comprehending self-control. Particularly, posting selfies can attract attention from others on social media, thereby fostering self-control of their appearance and physical health. Posting selfies could thus potentially serve as a novel mental maneuver through which narcissists to fulfill their self-regulated purposes (Weiser 2015). Prior research has mainly focused on the negative impact of selfies on mental health such as depression, loneliness, and technology dependence (Charoensukmongkol 2016). However, given the current trend where young people are immersed in smartphones and often interacting with a multitude of apps, we propose that the negativity surrounding selfies apps usage should be revisited, especially with respect to its potential for realizing health benefits. Specifically, our review of extant literature revealed that there has been little work that scrutinizes the interaction among technological interventions like the interactions between health and selfie. As attention-seeking and self-centered behaviors characterize narcissistic personality (Charoensukmongkol 2016), we posit that these characteristics will compel users to care more about their health status and physical appearance, thereby bolstering the corresponding usage of health apps.

Hypotheses Formulation

Health App Quality: Health app quality blends information quality, system quality, and service quality (Zha et al. 2015). Information quality denotes the quality of informational outputs produced by the health information system (DeLone and McLean 1992). System quality indicates the quality of the information system in terms of how it processes information, including evaluations of its data and software components. Essentially, it measures the extent to which the system is technically sound. Service quality refers to the degree of discrepancy between users' normative expectations for service and their perceptions of the service performance (Zha et al. 2015). Health app quality plays a key role in the process of transforming health technology intervention into self-regulated abilities and behaviors. Indeed, the quality of health apps can positively influence users' affinity with health apps, thereby boosting self-regulated behaviors by increasing the frequency and time of information seeking in health apps (Zha et al. 2015). Because health apps, as freely available and open resources, are increasingly confronted with questions about the reliability of their recommendations, we anticipate that their overall quality will positively influence their use (DeLone and McLean 1992). We therefore hypothesize that:

Hypothesis 1a: Quality of health apps is positively related to their use.

Self-regulated abilities can be mainly reflected by HIL. HIL is associated with the cognitive and social competencies required to deal with an increasingly complex health information environment (Niemelä et al. 2012). Low overall quality of health apps can lead to low health information quality, poor system design, and inferior service, which in turn negatively affects the ability of health technology intervention to promote self-regulated activities. Indeed, users may not be able to evaluate health information quality directly (Stvilia et al. 2009). In the absence of credible evidence, users are usually unable to distinguish health-related facts from opinions. Instead, they may depend on indirect quality dimensions (e.g. reputation) to assess or predict health app overall quality (Stvilia et al. 2009). They may easily trust the health information provided in health apps even if health information is at a lower quality level. Low health information quality of health apps can thus weaken users' competencies to judge health information quality. Meanwhile, users may develop incorrect information search habits due to poor design of health apps. Poor user experience with health apps will prohibit users from accessing much-needed health information. In contrast, high-quality health apps enable users to access reliable health knowledge and improve HIL. We therefore hypothesize that:

Hypothesis 1b: Quality of health apps is positively related to users' level of HIL.

Health technology intervention like apps can act on users' self-regulated behaviors. Since health apps have become the main source of health information and guidance, concerns about their quality will always exist (Grundy et al. 2016). Only when the content and functions of health apps are guaranteed will the doubts of users will be eliminated. Users can then effectively and safely use health apps to support self-regulated health behaviors like physical activities. A health app's overall quality is crucial in supporting users to be physically active (Schoeppe et al. 2017). High quality information supported by evidence-based content measures promote users' physical activities (Schoeppe et al. 2017). Effective system navigation can improve users' access to health care (Bhandari and Snowdon 2012). Personalized system services can promote health outcomes by providing services that better meet user needs (Laird et al. 2018). As higher overall quality of health apps facilitates users to obtain more practical health information via personalized service and seamless system navigation, users' adoption of health app-recommended physical activity could increase. We therefore hypothesize that:

Hypothesis 1c: Quality of health apps is positively related to users' level of physical activity.

Health App Use: Self-regulated behaviors of users can influence their self-regulated abilities like HIL. Health apps are increasingly deemed as an integral part of health management (Ernsting et al. 2017), which now consists of an ecosystem consisting of health-related information, apps, and supporting online/offline communities. Individuals are expected to interact with health system to conduct proper self-management. However, individuals without sufficient HIL would have difficulties interacting effectively with health technologies in the health management context (Kim et al. 2018). Health app use is essential for users to access and utilize health information, and the subsequent assimilation of health information and utilization are important drivers of HIL (Enwald et al. 2016). Meanwhile, health

app users are normally considered more health literate than those who do not use health apps based on population-based surveys (Ernsting et al. 2017). We therefore hypothesize that:

Hypothesis 2a: Health app usage is positively related to users' level of health information literacy.

Interactions exist in users' self-regulated behaviors like health apps use and physical activity. Health apps are more appropriate than traditional methods like web or journals in inducing self-regulated behaviors such as physical activities. Health apps for chronic disease management are being developed at an increasing rate (Knight et al. 2015). These health apps address such health risks through promoting self-regulated behaviors, which are often about monitoring physical activities and developing physical activity plans (Knight et al. 2015). Based on measuring these health parameters and pairing them with peripheral health equipment, health apps are tasked with implementing evidence-based guidelines for physical training plans (Knight et al. 2015). Health App use can induce intentions to increase physical activity and adopt physical activity recommendations. We therefore hypothesize that:

Hypothesis 2b: Health app usage is positively related to users' level of physical activity.

Health apps serve as a promising means to regulate and motivate users to engage in a healthier lifestyle. Their usage could motivate behavioral changes with respect to health and fitness, culminating in positive self-regulated outcomes. Health apps can act as virtual health care providers for self-regulated behaviors, such as managing diabetes, obesity, heart diseases, choosing a healthy diet, and ovulation tracking (Ernsting et al. 2017; Rathbone and Prescott 2017). They can also provide mental counseling to improve mental self-regulated outcomes of users like managing stress, treating anxiety, and self-management for depression (Firth et al. 2017). Through self-regulated health behaviors, health apps can significantly improve users' physical and mental health (Firth et al. 2017). A national survey found health app users reported improved health status (Krebs and Duncan 2015). We thus hypothesize that:

Hypothesis 2c: Health app usage is positively related to users' health status.

Satisfaction with life, which is a judgmental cognitive process, is an important dimension of self-regulated outcomes. Individuals evaluate their satisfaction with life by appealing to preset criteria they have designated for themselves. These criteria could differ across individuals (Diener 1984). An individual's set of criteria concerning satisfaction is naturally affected by the environment and the prevalence of mobile apps could be deemed as an integral part of an individual's environment. Specifically, in health contexts, users of health apps tend to report better quality of life, such as health satisfaction, personal relationships satisfaction, and living condition satisfaction (Ernsting et al. 2017). We therefore hypothesize that:

Hypothesis 2d: Health app usage is positively related to users' satisfaction with life.

Health Information Literacy: In health context, self-regulated abilities of users could bring amounts of health outcomes. Individuals should possess sufficient knowledge of health-adverse behaviors in order to be motivated to change their behaviors for health purposes (Enwald et al. 2016). While knowledge could be regarded as a premise for changing behaviors, its sole existence might not necessarily result in change of unhealthy behaviors. Individuals with knowledge could be passive in searching health information or they could also be inclined to avoid searching for health information. Thus, health information that health promoters would like to deliver might not reach their target population. HIL among individuals reflect their abilities to identify demands for health information, and their abilities to obtain and utilize required health information (Erikssonbacka et al. 2012). Only users with sufficient HIL could utilize health information effectively in various channels to improve their health status (Enwald et al. 2016). We therefore hypothesize that:

Hypothesis 3a: Users' level of health information literacy is positively related to their health status.

As an aspect of self-regulated outcomes, satisfaction with life largely depends on the ability of individuals to subjectively evaluate their own well-being that could be related to their social, physical, and mental dimensions (Diener 1984). HIL in individuals mainly refers to their ability to recognize the need for health information and efficiently access and utilize health information to meet their health information needs (Enwald et al. 2016). The ability to obtain, comprehend, and utilize health

information is important for better health management and results in better health outcomes (Erikssonbacka et al. 2012; Enwald et al. 2016; Panagioti et al. 2018). We therefore hypothesize that:

Hypothesis 3b: Users' level of health information literacy is positively related to their life satisfaction.

Physical Activity: Considered as positive health self-regulated behaviors, physical activities are associated with better health-related outcomes. It has been reported that participating in daily physical activities could reduce lifestyle-related disease risks like overweight, cognitive decline, premature death, and chronic diseases (Warburton et al. 2006). Moreover, frequent physical activities have been associated with anxiety-reducing effect that could result in decreasing an individual's level of depression, positive emotion and mood, low risk of social withdrawal, better stress management, and high self-esteem. We therefore hypothesize that:

Hypothesis 4a: Users' engagement in physical activities is positively related to their health status.

The willingness to be physically active is strongly linked with mental health outcomes like self-reported quality of life. Specifically, indulging in physical activities can improve positive affect, self-worth, and self-efficacy in individuals (Elavsky et al. 2005). For young people, one effective method to increase life satisfaction is to promote physical activities (Pyky et al. 2017). Sustained lack of physical activities that induce hard breathing, sweating, and strengthening of muscles can all lead to reduced life satisfaction. As mentioned above, active participation in physical activities helps improve general health quality which improves general satisfaction with life (Pyky et al. 2017). We therefore hypothesize that:

Hypothesis 4b: Users' engagement in physical activities is positively related to their life satisfaction.

Selfie App Use: Studies in relation to selfie apps have found narcissism to be a key determinant of selfie-taking and selfie-posting behaviors (Weiser 2015). Selfie-taking using a smartphone has been thought of as the most representative of narcissistic behaviors. Narcissists tend to gain others' attention by constantly regulating their behaviors (Weiser 2015) and are extremely attentive to their physical appearance (Vazire et al. 2008). Since the use of selfie apps is the manifestation of narcissism, it would suggest that their users are generally highly attentive and aware of their general health and physical appearances. Such tendencies could magnify the positive effect of health apps overall quality on self-regulated behaviors. Accordingly, we hypothesize that:

Hypothesis 5a-c: Intensity of selfie app usage will reinforce the relationship between health apps' quality and users' level of health app use, health information literacy, and physical activity.

Methodology

We plan to administer a large-scale survey questionnaire on students enrolled at a Chinese university on their use of health apps. The survey was supported by the university's administration. Measurement items of health app overall quality was adapted from Zha et al. (2015) and comprise the three dimensions of information quality, system quality, and service quality. HIL was assessed using the screening tool designed by Niemelä et al. (2012). Satisfaction with life was evaluated by the measurement items designed by Pavot et al. (2008). Satisfaction with life assesses an individual's entire evaluation of their life. In the survey, we refer to apps such as Springraindoctor, Haodf, and Meiyou, as examples of health apps (iiMedia Research 2017). Likewise, we refer to BeautyCam, Meitu, B612, as examples of selfie apps (BigData-Research 2018). Health and selfie apps use will be measured via two dimensions: average duration of app use and the frequency of using apps (Krebs and Duncan 2015). In line with earlier studies in the health-care domain (Coyle et al. 2017), single-item measurement was adopted to measure health status. Physical activity was assessed in terms of the time and frequency of the user engaging in sport (Booth et al., 2001).

Expected Contributions

This study is among the first to systematically apply self-regulation theory to technological intervention in healthcare. Past studies, which espouse a self-regulatory view of healthcare, care little about the role of technology (e.g., health apps) in facilitating healthy behaviors. To this end, we draw on self-regulation theory to explicate the relationship among health technology intervention, self-regulated

behaviors, and health-related outcomes. Specifically, we explore the interplay between health and selfie apps usage from a narcissism angle. Findings from this study thus offers a useful reference for future research concerning the interaction among different types of apps and their impact on healthcare. Furthermore, our findings bear implications for how a resilient healthy lifestyle can be inculcated via incorporating selfie functionalities into health apps to target users with narcissistic tendencies.

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