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# DEEP STRUCTURE USE OF MHEALTH: A SOCIAL COGNITIVE THEORY PERSPECTIVE

Monica Fallon
*University of Mannheim*, fallon@uni-mannheim.de

Kai Spohrer
*University of Mannheim*, spohrer@uni-mannheim.de

Armin Heinzl
*University of Mannheim*, heinzl@uni-mannheim.de

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*Research in Progress*

Fallon, Monica, University of Mannheim, Mannheim, Germany, fallon@uni-mannheim.de

Spohrer, Kai, University of Mannheim, Mannheim, Germany, spohrer@uni-mannheim.de

Heinzl, Armin, University of Mannheim, Mannheim, Germany, heinzl@uni-mannheim.de

## Abstract

*Consumer health information technology, such as mobile health applications (mHealth), enable consumers adopt healthy behaviours and improve health outcomes. We take a closer look at use concepts to understand how mHealth use facilitates behaviour change. We review the mHealth literature in information systems (IS) and health IS journals and find that superficial mHealth use concepts (e.g. binary and duration of use) dominate this literature stream. In line with contemporary IS research, we suggest that rich and theoretically-driven concepts of mHealth use can help to better understand what users do with mHealth and how this affects relevant outcomes. We take a social cognitive theory (SCT) perspective to conceptualize mHealth deep structure use, a rich concept of use centred on the extent to which tasks represented in mHealth facilitate behaviour change. This paper contributes to IS research in three key ways. First, we review mHealth literature and identify use concepts that have been employed to explain effects on outcomes. Second, we provide a theoretically-driven mHealth deep structure use concept from a SCT perspective. Third, we offer a conceptual lens that captures how mHealth deep structure use facilitates behaviour change. Future research will empirically evaluate aspects developed in this mHealth deep structure use concept.*

*Keywords: mHealth; deep structure use; social cognitive theory; health behaviours; behaviour change*

## 1 Introduction

Consumer health information technology has tremendous potential for enabling individuals to take an active role in the management of their own health (Chiasson and Davidson, 2004; Agarwal, Gao, DesRoches and Jha, 2010; Kohli and Tan, 2016). With the rapid development and diffusion of mobile technologies, mobile health applications (mHealth) have become a prevalent type of health information technology among consumers. This is evident in both the number of mHealth apps on the market and the increasing downloads (Research2Guidance, 2017, 2018). Consumers download mHealth to enable them to change behaviours and improve health outcomes (Krebs and Duncan, 2015). Behaviour change, such as quitting smoking, eating a balanced diet, and increasing physical activity, is essential for preventing the onset of adverse health outcomes, disease and premature death (WHO, 2014). However, research results regarding the effects of mHealth use on changing behaviours and improving health outcomes remains largely inconsistent (Sawesi et al., 2016; Zhao, Freeman and Li, 2016).

Superficial concepts of mHealth use, such as binary measures of use or the duration of use, provide little understanding into how the desired outcome is actually achieved. Information Systems (IS) researchers have recently started to criticize superficial use concepts, and instead conceptualize use as context-specific interactions between the IS and the tasks it represents (Burton-Jones and Straub, 2006; Robert and Sykes, 2017; Sykes and Venkatesh, 2017; Bala and Bhagwatwar, 2018). Deep structure use is a rich use concept that explains how the deep structure of an IS can represent real-world tasks and how these tasks can be used to facilitate the desired outcome (Burton-Jones & Straub, 2006). However, different IS are used to achieve different outcomes. For instance, mHealth is used to change behaviours and improve health outcomes (Krebs and Duncan, 2015), whereas provider order entry systems are used to improve coordination with patient care teams (Harle et al., 2012). Accordingly, IS researchers have called for contextualizing measures of use, especially in the health domain (Burton-Jones and Volkoff, 2017; Romanow, Rai and Keil, 2018). We follow this call and propose that superficial concepts of mHealth use are hindering a deeper understanding of how mHealth use facilitates behaviour change.

Against this backdrop, the overarching goal of this paper is to acquire knowledge on the key mechanisms that facilitate behaviour change through mHealth use. We answer the following research questions: (1) *What concepts of mHealth use are currently researched in IS literature?* (2) *How can mHealth deep structure use be theoretically conceptualized?* And (3) *Which mHealth deep structure use interactions facilitate behaviour change?* To do so, we review literature on mHealth use and identify weaknesses in current use concepts. Then, we take a closer look at mHealth deep structure use from a social cognitive theory (SCT) perspective. SCT is one of the most extensively used theoretical foundations for enabling individuals to change health behaviours (Painter et al., 2008) and specifies determinants of behaviour change (Bandura, 1991). An SCT perspective allows us to develop a context-specific and theory-driven mHealth deep structure use concept. The research approach of the paper is conceptual in nature by envisioning a new way to conceptualize mHealth use (MacInnis, 2011). This paper adds to existing IS literature by (1) reviewing the literature to identify which current mHealth use concepts are employed to explain effects on outcomes; (2) providing a theoretically-driven concept of mHealth deep structure use from an SCT perspective; and (3) offering a conceptual lens that captures how mHealth deep structure use facilitates behaviour change. In order to achieve these goals, we adapt previously used guidelines for conceptualizing deep structure use (Burton-Jones & Straub, 2006) and relate SCT constructs with mHealth capabilities. For our future work, we will further develop a theory of mHealth effective use by integrating aspects of the user and empirically validating a model of mHealth deep structure use for behaviour change.

## 2 Literature Review of mHealth Use

Given our focus on how consumers effectively use mHealth to achieve desired outcomes, we were interested in how previous research conceptualizes mHealth use and whether use facilitates behaviour change. We reviewed the IS basket of eight journals (*European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, and MIS Quarterly*) and the top three health IS journals from the AIS SIG Health list (*Journal of American Medical Informatics Association, International Journal of Medical Informatics, and Journal of Medical Internet Research*). Health IS journals were added given the limited amount of mHealth research published in the basket of eight. We included studies that specifically explored mHealth, focused on the consumer as the user, and examined behaviour change or health outcomes as a dependent variable. These restrictions allowed us to limit the scope of our review. Research that focused on tools for health information seeking or health information archival (e.g. health records) were excluded to avoid blurring boundaries with related health technologies with different desired outcomes (Agarwal and Khuntia, 2009). We also excluded studies that focus on physicians' use of mHealth because they use mHealth to achieve different outcomes (e.g. patient-physician communication) (Gagnon, Ngangue, Payne-Gagnon and Desmartis, 2015). The selected studies were reviewed, measures of use were classified, and outcomes were assessed. We classified use consistent with the conceptualization from Burton-Jones & Straub (2006). Superficial and lean use concepts were classified as binary use (use/no use), the extent of use (time in app/days used/ app login), or the breadth of use (number of features used). Rich use concepts were classified as including the user context and/or task context by measuring the degree to which a user employs a system (e.g. cognitive absorption) or the degree to which the system is employed in a task (e.g. deep structure use). Table 1 shows the primary contributions of our review. Several things can be observed.

First, we find that a vast majority of mHealth research uses superficial use concepts, such as lean or a combination of different lean use concepts. These include binary measures of use (e.g. Kirwan, Duncan, Vandelanotte and Mummery, 2012), the extent of use (e.g. Mohr et al., 2017), and breadth of use (e.g. Helander, Kaipainen, Korhonen and Wansink, 2014). We did not find any studies that used rich use concepts or examined the extent to which mHealth use facilitates tasks for behaviour change. These superficial mHealth use concepts, reveal little insight into how users effectively use mHealth to achieve the desired outcomes.

| **Use** | **Study** | **Use Evaluation** | **Main findings** |
|---|---|---|---|
| **mHealth use facilitates behaviour change** | | | |
| Binary | Kirwan et al., 2012 | mHealth vs. internet | mHealth use resulted in increased likelihood to log greater than 10k steps. |
| | Carter, et al., 2013 | mHealth vs. website vs. paper diary | mHealth users lost more weight, decreased BMI, and had less body fat (compared to diary and web). |
| | Turner-McGrievy et al., 2013 | mHealth vs. no mHealth (physical activity); mHealth vs. website vs. diary (diet) | mHealth users had more frequent self-monitoring of physical activity, lower BMI, and consumed less energy. |
| Binary / Extent of Use | Litman et al., 2015 | use of mHealth vs. use of mHealth and discontinued vs. never used mHealth; time since using app | App users exercise more. BMI is negatively correlated with time since using app. |
| Extent of Use | Hales et al., 2016 | social app vs.standard app (control); use per week | Participants with social mHealth app lost more weight and had greater BMI reduction than participants with standard app (control). Use per week was greater for social app. |
| **Unclear if mHealth use facilitates behavior change** | | | |
| Binary | Turner-McGrievy & Tate, 2014 | mobile device (mHealth, mp3 player) vs. stationary technology (desktop) | Trend towards greater weight loss in app users vs. website users, but non-significant. |
| Binary/ Breadth of Use | Ernsting et al., 2017 | use vs. no use; features used | 20.53% of smartphone users use an mHealth app. Apps with planning impact physical activity. Apps with feedback or monitoring impact physical activity. Apps with feedback or monitoring impact adherence to doctor advice. |
| Extent of use | Ribeiro et al., 2017 | use per day | Participants increased frequency of some cancer prevention behaviors. Unclear if use of app impacted cancer prevention behaviors. |
| | Plaza et al., 2017 | use per day | Changes in mindfulness awareness with app use were insignificant. |
| | Mohr et al., 2017 | number of treatment app sessions; time in app | Participants showed a reduction in depression and anxiety. The extent of use was not analyzed in connection with changes in depression/ anxiety. |
| | Pratap et al., 2018 | problem solving app vs. cognitive training app vs. information app (control); number of days in app | Depressive symptoms improved, but no differences between app groups. Problem solving app and information app had more active days of use. |
| Breadth of use | Helander et al., 2014 | number of picture uploads, number of ratings, pictures per day | Only 9% of active users had a positive trend in their average healthiness ratings. |
| Binary / Extent of Use/ Breadth of Use | Direito, et al., 2015 | immersive app vs. non-immersive app vs. no app; time spent in app; number of features used | Both app groups improved time to complete fitness test, but no significant differences between immersive/ non-immersive/ control groups. Only 31% of participants used the app more than three times per week. The features of the immersive app received the most positive feedback. |

*Table 1. mHealth Literature Review*

Second, our review reveals inconsistent findings on the effects of mHealth use on behaviour change. Some studies show that the mHealth use has positive effects on behaviour change (Kirwan et al., 2012; Litman et al., 2015) and health (Hales et al., 2016) while others show non-significant effects on behaviour change (Plaza et al., 2017) and health (Turner-McGrievy and Tate, 2014). These contradictory findings illustrate that superficial use concepts do not provide a powerful explanatory lens into how users interact with mHealth. Thus, in an mHealth context, lean measures of use are hindering a sufficient understanding of the true effects of the technology (Burton-Jones & Straub, 2006).

Third, our literature review indicates that the diversity in research on mHealth use hinders a cumulative research stream (Keen 1980). The mHealth literature relies on various use concepts for assessing mHealth effectiveness. For example, Hales et al. (2016) employed two different mHealth applications with slightly different features and examined the extent to which the applications were used per week. Other studies used even more simplistic measures of use, such as comparing behaviours of users provided with an mHealth app to a control condition without an mHealth app (e.g. Kirwan et al., 2012; Carter, Burley, Nykjaer and Cade, 2013). Although one way of measuring use is not necessarily better than the other, a systematic conceptualization of mHealth use provides more insights into user interactions and builds cumulative knowledge on the true effects of mHealth use.

To address the lack of theoretical and methodological clarity of mHealth use and its effects on behaviour change, the current paper works towards a concept of effective mHealth use. To enable effective use, the internal structure of an IS should faithfully represent tasks the user needs to carry-out to achieve the desired outcome (Wand and Weber, 1995; Burton-Jones and Straub, 2006; Burton-Jones and Grange, 2013). To achieve this, the deep structure of an IS should represent the real-world domain it is intended to model (Wand and Weber, 1995). Thus, in an mHealth context, the deep structure should represent behaviour change theory and tasks for changing behaviour. *Deep structure use* represents how features of the system that relate to core aspects of focal tasks are used to achieve the desired outcome (Desanctis and Poole, 1994) and captures the interaction of the IS and the tasks it represents (Burton-Jones & Straub, 2006). Using this view, our *mHealth deep structure use* concept represents how mHealth faithfully represents real-world tasks through features and how use facilitates behaviour change.

To overcome the lack of theoretical understanding and methodological weaknesses of prior mHealth use concepts, we leverage a SCT perspective to create a context-specific notion of mHealth deep structure use. We use SCT as a basis for identifying important tasks for behaviour change and identify how these tasks are achieved through mHealth use.

# 3 Social Cognitive Theory

There are numerous theories in the behavioural sciences that study behaviour change including the health belief model (Rosenstock, 1960), the theory of planned behaviour (Ajzen, 1991), and social cognitive theory (Bandura, 1977, 1986). Constructs in SCT have overlap with various other accepted behaviour change theories (Bandura, 2004) and due to the comprehensive set of determinants specified in SCT, it has emerged as one of the most extensively used theoretical foundations in health behaviour research (Painter et al., 2008). Moreover, SCT takes a human agency perspective, in which individuals have the capability to change their behaviours (Bandura, 2001). In this view, mHealth supports the agentic user in facilitating tasks necessary for behaviour change.

We follow a two-step method for conceptualizing deep structure use (Burton-Jones & Straub, 2006) based on SCT. First, we define elements of usage in an mHealth context as the interaction of a user employing the system to carry out specific tasks for behaviour change. Second, we select measures that relate theoretically to constructs in the SCT nomological network. There are two constructs in our case: system usage and tasks to facilitate behaviour change. Therefore, we chain backwards from theoretically derived SCT constructs for behaviour change to tasks that can be employed during use.

The concept of mHealth deep structure use in this paper is divided into four parts (Figure 1 and Table 2). The first involves a stimulus to facilitate forethought about specific behaviours. The second involves tasks for self-regulating behaviours. The third aspect involves tasks for incentivizing behaviours. And the fourth involves tasks for social interactions. The following section describes these aspects and their interdependence in detail and provides examples for how their use in mHealth can facilitate tasks for behaviour change.

| SCT Determinant | Task | mHealth Deep Structure Use Definition |
|---|---|---|
| Stimulus | Forethought | the extent to which users employ features to obtain information about desired behaviours or to guide their actions towards performing a behaviour |
| Self-regulating behaviours | Monitor | the extent to which users employ features to attend to behaviours for self-observation and self-motivation |
| | Goal-adjustment | the extent to which users employ features to judge their past behaviours to set realistic and attainable goals |
| | Feedback | the extent to which users employ features to evaluate behaviours by viewing current behaviours in relation to their goals |
| Incentivizing | Self-incentivizing | the extent to which users employ features to activate personal goals and attain self-satisfaction from personal accomplishments |
| | Extrinsically incentivizing | the extent to which users employ features to gain motivation through tangible rewards |
| Social interactions | Social comparison | the extent to which users employ features to evaluate and appraise personal standards in relation others |
| | Social support | the extent to which users employ features to adhere to personal standards and behaviours through praise, encouragement, and recognition |

*Table 2. mHealth Deep Structure Use Conceptualization*

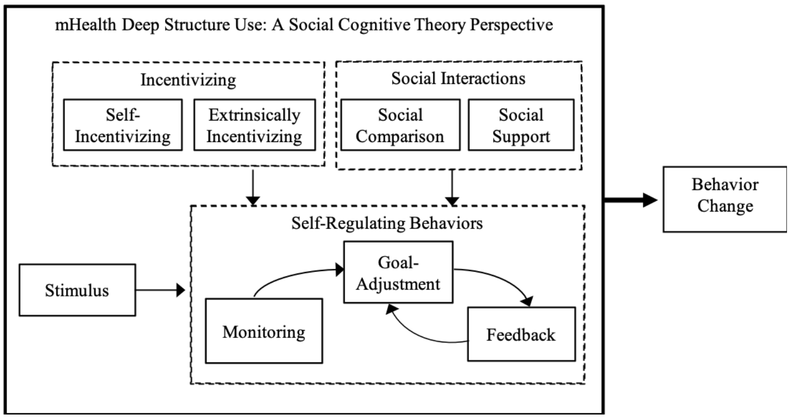


*Figure 1. mHealth Deep Structure Use Conceptualization*

## 3.1 Stimulus

### 3.1.1 Forethought

A stimulus with information about a behaviour or cues to perform a behaviour are important for forming intentions to change behaviour. This is regulated by forethought, in which people guide their actions by considering anticipatory future behaviours and their effects (Bandura, 1991). Over time forethought generates knowledge about the behaviour and contributes to self-efficacy or one's belief that they have the ability to change their behaviour (Bandura, 1989). We conceptualize forethought as the extent to which users employ features to obtain information about desired behaviours or to guide their actions towards performing a behaviour. Features of mHealth can provide stimuli with information on health behaviours, detailed descriptions of how to change behaviours, and cues to perform the behaviour. For example, a step-counting application can push information to the user about the benefits of taking more daily steps or cue individuals that it is a nice day for a walk. Moreover, given the mobility of mHealth, these stimuli can be sent directly to users anytime and anyplace. Attending to and using the information provided to a user through an mHealth stimulus allows conceptions to be formed about how to practice the desired behaviour and facilitates intentions to change behaviour. We propose that leveraging the capability of the information provided in such stimuli will facilitate forethought, increase knowledge about how to practice the desired behaviour, and contribute to self-efficacy.

However, SCT suggests that forethought alone is not enough to change behaviour. Providing a stimulus facilitates intentions to change behaviour, but executing the behaviour involves self-regulating mechanisms for transforming forethought into action (Bandura, 1989; Carroll and Bandura, 1990; Bandura, 1991).

## 3.2 Self-Regulating Behaviours

### 3.2.1 Monitoring

SCT of self-regulation explains that people cannot influence their motivations and actions if they do not monitor their behaviour (Bandura, 1991). Monitoring involves the deliberate attention to an aspect of one's behaviour and facilitates self-observation and self-motivation (Bandura, 1991). Individuals self-observe by monitoring the frequency, duration or intensity of a behaviour. This contributes to increased awareness of the behaviour and enables one to compare their current behaviour to their standards. In this way, monitoring behaviour also has a self-motivating effect, in which judging one's behaviour motivates individuals to set standards.

We conceptualize monitoring as the extent to which users employ features to attend to behaviours for self-observation and self-motivation. Advancements in mHealth technology allow users to improve the continuity and accuracy of monitoring behaviour. mHealth has automatic tracking and search functionalities that enable individuals to continually and more accurately record and monitor behaviours (Rusin, Årsand and Hartvigsen, 2013). For example, the integration of GPS in mHealth allows individuals to more accurately monitor their step-count. Thus, consistent with SCT, mHealth can enable the fidelity and consistency of monitoring behaviours (Bandura, 1991). Moreover, individuals can use mHealth to monitor the behaviour, the conditions under which the behaviour occurs (e.g. weather, context), and the immediate and distal effects the behaviour produces. We propose that leveraging the capability of monitoring features will facilitate these processes and, thus, with increasing use will facilitate behaviour change.

### 3.2.2 Goal-Adjustment

When people monitor behaviours, they are inclined to set goals for progressive improvement, even though they have not been encouraged to do so (Bandura, 1991). Goal-adjustment results from evaluative self-reactions that mobilize efforts toward goal attainment. For example, individuals who do not set goals for themselves achieve no change in effort. These individuals are surpassed by those who aim to match their previous level of effort who, in turn, are outperformed by those who set themselves the more challenging goal of improving their past endeavour (Bandura and Cervone, 1983). A judgment process facilitates goal-adjustment where new goals are set by judging past behaviours (Bandura, 1991).

We conceptualize goal-adjustment as the extent to which users employ features to judge their past behaviours to set realistic and attainable goals. Features of mHealth allow goal-adjustment through the technology (e.g. using records of past behaviours to set new goals) or through the user (e.g. further adjusting goals to make them more attainable or more challenging). For example, mHealth functionalities can assess users' past behaviours to automatically set step-count goals and users can further adjust their step-count goal if they perceive it as unattainable or want more of a challenge.

### 3.2.3 Feedback

Monitoring behaviours and goal-adjustment have little value without informative performance feedback and these aspects are interconnected (Bandura, 1998). Ambiguity about the effects of one's actions lessens the perception that one has improved (Bandura, 1991). Feedback allows the opportunity to evaluate one's progress and takes away this ambiguity. Monitoring behaviours and goal-adjustment act as proactive and primary methods of motivation, while feedback encourages further adjustments needed to accomplish desired goals through self-reactive mechanisms (Bandura & Cervone, 1983). Thus, the motivational effects do not stem from goals themselves, but from responding evaluatively to one's own behaviour. Change in motivation is best under conditions combining goals with feedback and decreases with goals alone and feedback alone (Bandura & Cervone, 1983; Bandura 1991).

We conceptualize feedback as the extent to which users employ features to evaluate behaviours by viewing current behaviours in relation to their goals. Features of mHealth allow feedback to be integrated into the application by graphics that represent monitoring activities and goals, thus illustrating how current behaviours compare to goals. For example, a user can evaluate their progress towards their goals by comparing their current step-count to their goal step-count. This feedback can be accumulated for days, weeks, months, or years to show the user how they are improving over time. Moreover, the user can continuously access this feedback and adjust goals as necessary.

## 3.3 Incentivizing

### 3.3.1 Self-Incentivizing

Self-regulatory control is achieved by creating incentives for one's own actions (Bandura, 1998). Self-incentives affect behaviour through motivation and by activating personal goals for progressive improvement (Locke, Bryan and Kendall, 1968; Bandura, 1989, 1991). Through this process, people anticipate self-satisfaction from progressive mastery of a behaviour and are motivated to continue to pursue that course of action (Bandura, 1991). We conceptualize self-incentivizing as the extent to which users employ features to activate personal goals and attain self-satisfaction from personal accomplishments. For example, trivial self-incentives, such as trophies and badges can motivate people to set their personal goals higher. Moreover, these self-incentives can encourage users to take a course of action towards this personal accomplishment. For example, the opportunity to earn virtual rewards, such as a badge or points, for meeting or exceeding a daily step-count goal seven days in a row, can drive individuals towards improvement through anticipated self-satisfaction of the achievement.

### 3.3.2 Extrinsically Incentivizing

Extrinsic incentives can further enhance motivation, especially once self-satisfaction is invested in the activity (Bandura, 1991). Thus, self-satisfaction stems from self-incentives, but extrinsic incentives further augment motivation towards progressive improvement. Such extrinsic incentives have even more value when they are combined with feedback performance because reward is linked with progress (Bandura & Cervone, 1983; Bandura 1991). We conceptualize extrinsically incentivizing as the extent to which users employ features to gain motivation through tangible rewards. For example, the Nike Run Club app rewards users with the possibility to win new shoes the more miles they run (Nike, 2019).

## 3.4 Social Interactions

SCT considers that people differ in the extent to which their actions are guided by personal standards or social standards (Bandura, 1991). While stimuli for forethought, self-regulating behaviours, and incentivizing represent ways in which personal standards influence behaviours, social standards also play an important role. SCT specifies multiple mechanisms in which social interactions impact behaviour change, which occurs in three ways: First, social interactions contribute to self-regulating behaviours. Second, social interactions provide partial support for adhering to personal standards. Third, social interactions facilitate selective activation and disengagement of moral self-regulation (Bandura, 1986; 1991). According to SCT there are two forms of social interactions, which include reacting to social situations (social comparison) and directly communicating in social situations (social support).

### 3.4.1 Social comparison

Social comparison involves comparing one's own performance to the achievement of others (Bandura, 1998, 1991, 1986). This offers people a more distal source of motivation for holding to a moral system or standard in addition to the more proximal motivators for behaviour described in self-regulation (Bandura, 1991). Social comparison facilitates a judgement process, which begins by people comparing their performances to others or to standard norms based on representative groups. The information on others' behaviours initiates self-comparisons, where one's attainments are a measure of adequacy in comparison to others (Bandura, 1998). In this way, social comparison influences a judgement process by shaping the rules of moral judgement on personal standards and self-appraisal (Bandura, 1991). For example, people try to surpass their past accomplishments as well as the accomplishments of others and thus, strive for progressive improvements and higher goals. Comparative evaluations are an ongoing process involving variations in the level, rate, and direction of social comparisons (Bandura, 1991). For example, people can compare upwards to people performing better or downwards to people performing worse (Buunk et al., 1990) or to individuals similar to the referent or dissimilar to the referent (Bandura, 1991). Nonetheless, the opportunity to make social comparisons has been shown to be an important aspect for behaviour change (Wu, Kankanhalli and Huang, 2015).

We conceptualize social comparison as the extent to which users employ features to evaluate and appraise personal standards in relation others. mHealth has features that allow social comparison opportunities. Some use leader boards or score boards to show individuals their ranking among other users (Wu et al., 2015; Zhou, Kankanhalli and Huang, 2016) while others use standard norms to illustrate how users rank compared to the average user (Helander et al., 2014). mHealth thus, allows a mobile platform for users to compare their behaviours with a social collection of other users.

### 3.4.2 Social support

Social support includes both structural support from the quantitative existence of relationships and functional support from the quality of the relationships and the encouragement provided (Cohen and Wills, 1985). Social support influences behaviour change through at least two mechanisms. First, social support provides collective support for adherence to moral standards (Bandura 1991). For example, people with larger social support networks will receive more collective support and be more likely to adhere to their moral standards for behaviour change. Second, social support facilitates selective activation and disengagement from self-regulatory mechanisms, such as goal-setting and self-monitoring (Bandura, 1991; Anderson, Winett and Wojcik, 2007). Thus, social support encourages individuals to adhere to and maintain self-regulating behaviours through praise and social recognition (Bandura, 1986).

We conceptualize social support as the extent to which users employ features to adhere to personal standards and behaviours through praise, encouragement, and recognition. mHealth enables a platform for social support. For example, individuals can receive likes on their physical activity (Hamari and Koivisto, 2015) or words of encouragement and social recognition (Helander et al., 2014). Such types of social support in mHealth have been shown to increase health outcomes above and beyond apps without such social support features (Hales et al., 2016). mHealth thus allows a mobile platform for users to come together to reciprocally support and encourage others.

# 4 Conclusion and Future Research

In our literature review, we identified that current mHealth research uses superficial use concepts to explain effects on behaviour change. Following calls for richer and more context-specific technology use concepts in the health domain (Burton-Jones and Volkoff, 2017; Romanow et al., 2018), this paper used an SCT perspective to conceptualize an important aspect of effective use, deep structure use. The theoretically-driven concept developed in this paper provides a lens to understand how tasks represented in mHealth can be used to facilitate behaviour change. Future research can use this mHealth use concept to develop a more comprehensive model of how different aspects of deep structure use facilitate behaviour change. For example, information about health behaviours can be pushed to users through notifications and messages. This information can facilitate forethought and thus, the use of self-regulatory features. The use of social interaction features and incentives can moderate self-regulatory processes and further facilitate behaviour change. In future work, we will further develop a theory of mHealth effective use by empirically validating this use concept and examining how tasks interact to facilitate behaviour change. Moreover, we will integrate aspects of the user to better understand how different users effectively use mHealth. This can be accomplished through using a sequential multiple assignment randomized trial (SMART) (Lei et al., 2012). Such research may also provide valuable insights for mHealth app developers as well as physicians and other practitioners who currently have little guidance regarding what to base their recommendations of mHealth applications on (Riley et al., 2011; Conroy, Yang and Maher, 2014). Whereas our concept has been developed for behavior change through mHealth use, it is unclear if it is also useful in other contexts, such as online review systems. Future research could explore this further.

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