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DON'T HURT ME ... NO MORE? AN EMPIRICAL STUDY ON THE POSITIVE AND ADVERSE MOTIVATIONAL EFFECTS IN FITNESS APPS

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DON'T HURT ME... NO MORE? AN EMPIRICAL STUDY ON THE POSITIVE AND ADVERSE MOTIVATIONAL EFFECTS IN FITNESS APPS

Research paper

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Abstract

Lacking regular physical activity is a prevailing issue of our society causing high costs in health care, productivity losses, and million deaths. To counteract this problem, fitness apps are increasingly considered as a means to motivate individuals towards more physical activity. However, many people discontinue their fitness app use. User stories point to a 'darker side' of fitness apps indicating adverse effects on users' competence feelings leading to fitness app discontinuance. To better understand the positive and detrimental motivational effects, this paper draws on self-determination theory and motivational affordances explicating how self-monitoring, rewards, and social recognition affordances of fitness apps affect competence needs and fitness app continuance decisions in consequence. Empirical validation with 283 fitness app user reveals the positive and negative motivational effects. Thereby, this study contributes to research with a motivation-based explanation of fitness app continuance, explicates the 'darker side' of fitness apps, and explains the need-relevant characteristics of motivational affordances. The results guide the application and tailoring of motivational affordances in fitness apps.

Keywords: Fitness apps, Motivational affordances, Self-determination theory, Basic psychological needs, Competence need, IS continuance, Motivation.

1 Introduction

'Why I Got Rid of My Fitbit' (Green 2015), 'I quit Strava' (November Project 2017), 'The Silly Self Importance of Strava' (Hargrave 2013), 'The Tale of a Fitness-Tracking Addict's Struggles With Strava' (Foss 2014). These are the headlines of peoples' critical encounters with popular fitness apps where individuals describe their harmful experiences and how they ended up quitting fitness app use.

Fitness apps, such as Strava, Fitbit, or Nike+ Running, are meant to enhance peoples' motivation towards physical activity and hence healthier behavior and well-being. The lack of regular physical activity is a pertaining issue in most societies (WHO 2018a). The worldwide costs of people's lacking physical activity are estimated to \$54 billion in direct health care and \$14 billion in lost productivity (WHO 2018a). Moreover, 1.6 million global deaths are caused by low physical activity (OECD 2017). Lacking physical activity is hence not only an issue for the individual but also for the society and therefore a challenge of public health promotion – since decades (WHO 2010). Fitness apps are gaining increasing attention to counteract the issue of physical inactivity. The WHO (2018b), for instance, is now partnering with Google in fitness app development, health insurance companies incentivize (AOK 2017) or even mandate the use of a fitness tracking device (BBC 2018) and companies make them part of their corporate wellness programs (Giddens et al. 2017). The global revenue for this market is amounted to 15 billion USD in 2017 and expected to increase to 20 billion USD in the next years (Statista 2018).

In the endeavor to promote healthier behavior, fitness apps aim to enhance physical competencies – people's abilities to perform and to achieve physical activity goals– that are essential for motivation, behavior change, and sustained engagement (Teixeira et al. 2012). To do so, fitness apps have a variety of motivational affordances incorporated including self-monitoring, rewards, and social recognition as a means to enhance physical competencies accordingly (Hamari et al. 2018; Rockmann and Gewald

2018; Stragier et al. 2018). However, user-stories mentioned above indicate a ‘darker side’ of fitness apps where people describe how their fitness app use made them feel incompetent, disappointed, and incapable to perform physical activity and hence quitted their fitness apps use.

So far, however, research not only neglects the adverse and demotivational effects (Schmidt-Kraepelin et al. 2019) but also lacks an understanding about the underlying motivation-psychological mechanisms of motivational affordances (Koivisto and Hamari 2019; Orji and Moffatt 2016). Despite few attempts that paid closer attention to the role of each motivational affordance accounting for fitness app continuance intentions (e.g., Hamari and Koivisto 2015; Suh 2018), how the motivational affordances affect users’ motivational need for physical competence –in both supporting and opposing ways– has not been examined yet. Therefore, this paper asks:

How do motivational affordances in fitness apps affect users’ competence feelings in positive and detrimental ways and account for fitness app continuance intentions?

To answer this research question, this paper draws on Self-determination Theory (Ryan and Deci 2017) to better understand the positive and adverse effects of motivational affordances in fitness apps. A model is derived that explicates how and why motivational affordances can both satisfy and thwart users’ competence needs influencing fitness app continuance decisions. Empirical evaluation with 283 users of a popular fitness app largely supports the arguments so that this paper contributes by 1) providing a motivation-theoretical explanation of fitness app continuance, 2) explicating the ‘darker side’ of fitness apps, and by 3) explaining the need-relevant characteristics of motivational affordances. Thereby, this study aids practice in developing and tailoring fitness apps by raising awareness about the negative and positive effects of motivational affordances employed.

The rest unfolds as follows. Next, the theoretical background on motivational affordances promoting continued use of fitness apps is outlined and the key tenets of Self-determination Theory are introduced. A research model is derived subsequently explaining the positive and adverse effects of motivational affordances influencing fitness app continuance intentions. Then, the research methodology and results are presented before findings, implications, limitations, and further research avenues are discussed.

2 Theoretical Background

2.1 Motivational affordances and continued use of fitness apps

Fitness apps –such as Strava or Nike+ Running– aim to enhance motivation and physical activity. As such, fitness apps belong to the class of ‘motivational information systems’ (Koivisto and Hamari 2019). As means to induce motivation, they offer ‘motivational affordances’ to the users, which are “*the properties of an object [i.e., software features] that determine whether and how it can support one’s motivational needs*” (Zhang 2008, p. 145). Popular motivational affordances in fitness apps include self-monitoring, rewards, and social recognition as shown in Table 1 (Hamari et al. 2018; Rockmann and Gewald 2018). In general, these three motivational affordance target peoples’ physical activity competencies by providing feedback in various ways to motivate physical activity as briefly explicated next.

Affordance	Definition: The possibility to...	Feature Examples
<i>Self-monitoring</i>	systematically document and observe one’s sport behavior.	Recording and logging of activity metrics (time, pulse, GPS)
<i>Rewards</i>	obtain cognitive or virtual rewards for physical activity.	Points, trophies, leaderboards
<i>Social recognition</i>	receive social feedback and respect from others.	‘Likes’ and comments

Table 1. Popular affordances of fitness apps (Rockmann and Gewald 2018)

The *self-monitoring affordance* provides users functionalities for systematic documentation and observation of their physical activities (Rockmann and Gewald 2018). When monitoring themselves, fitness app users seek to observe trends and patterns about their sports behavior. This includes among others whether they are making progress, to ensure that they are maintaining their physical activity or to increase self-awareness about (un)healthy behavior (Rockmann and Gewald 2018). The *rewards affordance* provides users the possibility to obtain rewards for physical activity such as through virtual

points or trophies (Rockmann and Gewald 2018) and reflects the gamification aspect of fitness apps (Stragier et al. 2018). Rewards can be given for achieving self-set activity goals and for making progress (e.g., running a certain distance) and in social network based fitness apps also on normative bases, such as by leaderboards and competitions where users obtain trophies for the best sports performance enabling social comparisons (Johnson et al. 2016). The *social recognition affordance* reflects the social feedback users receive for their sports behavior from other users such as support, respect, or approval (Hamari and Koivisto 2015; Rockmann and Gewald 2018). Such social feedback is usually provided through ‘likes’ and comments on posted sports activities.

Albeit fitness apps in general and the motivational affordances in particular are expected to provide motivational benefits (Johnson et al. 2016, p. 102), there are also indications for adverse motivational effects – and these may be decisive for users’ decision to continue using fitness apps (e.g., Foss 2014; November Project 2017). Self-monitoring, for example, can induce satisfaction and sports motivation when observing progress, such as performance increases, but can also be demotivating when the contrarian is the case (Barratt 2017; Lee and Drake 2013). The social recognition affordance can equip users with social approval and respect from others which motivates to exercise (Hamari and Koivisto 2015), but for other users, this social dimension in fitness apps can induce peer pressure, negative self-evaluations about physical abilities when not performing well (Barratt 2017; Kerner and Goodyear 2017).

Research has neglected such adverse, demotivational effects in fitness apps in almost all general so far (Schmidt-Kraepelin et al. 2019) and this neglect is partially the result of the larger inhibited understanding about the motivational effects these motivational affordances actually have (Koivisto and Hamari 2019; Orji and Moffatt 2016). So far, much of the available literature examined fitness apps as a ‘whole’ so that the actual role each motivational affordance plays is not well understood (Koivisto and Hamari 2019). Only a few attempts have been made in assessing how these affordances individually account for different outcomes such as fitness app usage continuance intentions (see Table 2).

Study	Affordances	Outcome	Underlying mechanism
(Hamari and Koivisto 2015)	Social recognition	IS continuance intention, Word-of-mouth intention, Exercise continuance intention	Attitude towards the IS
(Suh 2018)	Tracking, Social sharing, Visualizing	IS continuance intention	IS usage motivations (utilitarian, hedonic, eudemonic)
(Hassan et al. 2019)	Quantified-self, Gamification, Social networking	IS continuance intention, Perceived benefits	Motivational feedback (affective, social, informational)
(James et al. 2019a; James et al. 2019b)	Data Management, Exercise Control, Social Interaction	Subjective vitality	Direct

Table 2. Literature on motivational affordances in the fitness app context

Yet these studies have taken mostly a technology-centric perspective linking the motivational affordances with outcomes of interest either directly (James et al. 2019a; James et al. 2019b) or through concepts such as IS attitude (Hamari and Koivisto 2015) or IS usage motivations (i.e., utilitarian, hedonic, eudemonic) (Suh 2018). Surprisingly few, however, looked at the motivational mechanisms targeted at the activity or behaviour of interest (i.e., physical activity competence) such as different forms of motivational feedback users receive from the affordances (Hassan et al. 2019). As such, the underlying motivation-psychological processes are mostly unexplored (Koivisto and Hamari 2019) and we miss an understanding how motivational affordances actually affect users’ motivational needs as implied in its definition (Zhang 2008) –in both positive and adverse ways– and how this accounts for users’ decisions to continue using the fitness app. Therefore, this paper aims to fill the outlined gaps concerning 1) the positive and adverse motivational effects of fitness apps, 2) the underlying motivation-psychological mechanisms of motivational affordances, and 3) the resulting consequences for continued fitness app use. To this end, this paper builds on Self-determination Theory (Ryan and Deci 2017), a theory fundamentally concerned with motivational needs, factors that affect these needs in positive and adverse ways, and resulting consequences, as introduced next.

2.2 Self-determination theory

Self-determination Theory (SDT; Deci and Ryan 2012; Ryan and Deci 2017) is concerned with human motivation, behavior, and well-being. Central to SDT is that all human beings have innate, basic psychological needs to be autonomous, competent, and related to others (Deci and Ryan 2012). These three needs –autonomy, competence, relatedness– need to be satisfied for optimal human functioning and well-being (Deci and Ryan 1985; 2000; 2012). The personal environment, including actors like coaches or peers and elements like feedback and rewards, can, however, equally satisfy and suppress an individual’s needs thereby causing various psychological and behavioral reactions (Ryan and Deci 2017; Vallerand and Losier 1999). These key tenets (Figure 1) are detailed next.

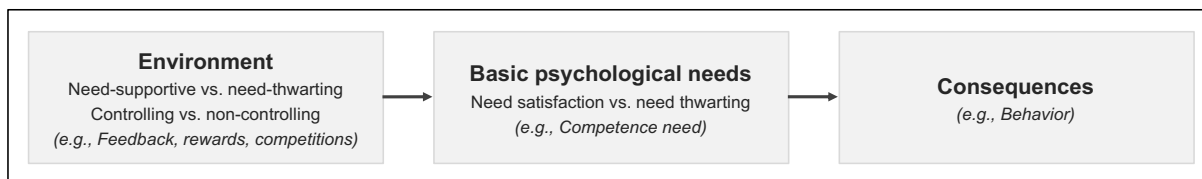


Figure 1. Key tenets of self-determination theory (Ryan and Deci 2017)

Basic psychological needs are described as the “nutrients that are essential for growth, integrity, and well-being” (Ryan and Deci 2017, p. 10) and three basic psychological needs are of centrality: autonomy, competence, and relatedness. *Autonomy* is the need for the self-regulation of one’s actions and experiences – acting volitional and congruent with one’s true interests and values; *competence* is the need of feeling able to operate effectively in life contexts, such as in physical activity, to feel effectance and mastery; *relatedness* is the need to feel socially connected, to feel cared for by others and to be a member of a social group (Ryan and Deci 2017). Albeit SDT posits that all three needs are essential for optimal human functioning, their relative salience and importance vary with the context (Ntoumanis et al. 2009). Within the context of physical activity, the **competence need** is central for peoples’ motivation, engagement, and persistence (see e.g., Ng et al. 2012; Teixeira et al. 2012).

The satisfaction of basic psychological needs is essential for human thriving and well-being, but when neglected or even thwarted –that is actively suppressed– people encounter motivational depletion, exhaustion, and ill-being (Bartholomew et al. 2011; Ryan and Deci 2017). Thus, there is a notable distinction between **need satisfaction and thwarting** (Bartholomew et al. 2011): whilst low competence need satisfaction can be the result of perceiving oneself as not having the necessary skills to perform, need thwarting describes feeling incompetent because others, such as coaches, are demeaning and critical (Bartholomew et al. 2011). Need thwarting assesses the ‘darker side’ of psychological experiences where needs are actively impeded or frustrated (Bartholomew et al. 2011; Gunnell et al. 2013).

The personal **environment** is central for one’s needs and SDT is particularly concerned how environmental factors cause competence need satisfaction and thwarting (Ntoumanis et al. 2009; Ryan and Deci 2017; Vallerand and Losier 1999). Within the physical activity context, environmental factors include, for instance, sports coaches’ behavior, competitions, or feedback about success and failure (Vallerand and Losier 1999). In general, such environmental factors can have need-supportive or need-thwarting characteristics and the key distinguishing characteristic is whether they are controlling or non-controlling as outlined in the following lines (Ryan and Deci 2017). **Need-supportive environments** encourage people to engage in behaviors, such as physical activity, in non-controlling ways so that people behave for their own reasons (Ng et al. 2012; Ryan and Deci 2017). Need-supportive environments promote empowerment, competence, and choice by minimizing pressure, providing optimal challenges as well as constructive and positive feedback and thereby contribute to successful behavior change, sustained engagement to improve oneself, higher intrinsic motivation, performance, and well-being (Ng et al. 2012; Ntoumanis et al. 2009; Ryan and Deci 2017). Sports coaches and their non-controlling coaching styles, for instance, create supportive atmospheres by providing choice and positive feedback about performance (Bartholomew et al. 2011; Mageau and Vallerand 2003). Peers, such as teammates, who work together to improve skills and encourage each other to keep trying, satisfy competence needs (Jøesaar et al. 2011). Fitness apps may provide a need-supportive environment that satisfies users’ competence need, for instance, when users obtain positive feedback about their sports performance, by

observing their progress, or receive ‘likes’ from other users. **Need-thwarting environments**, in contrast, are characterized as overly challenging and discouraging, critical and negative, impersonal and rejecting, and control individuals’ behaviors through surveillance, task-contingent rewards, negative feedback, and external pressures (Ng et al. 2012; Ntoumanis et al. 2009; Ryan and Deci 2017). Need-thwarting environments interfere with autonomous behavior causing perceptions of being incompetent resulting in lowered performance and ill-being (Ryan and Deci 2017). When sports coaches have a controlling coaching style, they often thwart athletes’ competence needs with severe consequences such as negative affect or burnout (Bartholomew et al. 2011). Similarly, when teammates emphasize interpersonal competition or make fun about one’s lacking abilities, they thwart competence needs alike (Jõesaar et al. 2011). Hence, fitness apps may also thwart users’ competence needs, where users are made to doubt themselves or feel insecure about their abilities, such as through too difficult challenges, prevailing negative feedback, or due to losing competitions.

In essence, SDT points at the importance of competence needs that need to be satisfied to enhance an individual’s motivation, engagement, and persistence in physical activity (Ng et al. 2012; Teixeira et al. 2012). One’s personal environment has a central role for the satisfaction of competence needs, yet the personal environment can be need-supportive and also need-thwarting, depending upon whether it is controlling opposed to non-controlling (Ryan and Deci 2017).

Hence, when interpreting the motivational affordances as the personal environment of fitness app users, SDT appears to be a suitable theoretical perspective to better understand the role of motivational affordances in causing positive and adverse motivational consequences. Recent literature indeed suggests that the affordances provided in digital environments can be linked to, and hence satisfy, basic psychological needs such as in the context of social media (Karahanna et al. 2018) or video games (Ryan et al. 2006). Within the strand of fitness app research, first evidence supports this contention alike (Suh et al. 2015). SDT also offers a concept to capture the adverse effects –need thwarting– and its resulting behavioral consequences (e.g., lowered fitness app continuance intentions). However, these aspects have not been examined so far, so that this paper seeks to examine the duality of competence need satisfaction and thwarting stemming from the motivational affordances which in turn may account for fitness apps usage continuance intentions.

3 Research Model

The aim of this paper is to investigate the positive and adverse consequences of motivational affordances accounting for continuance intentions of fitness apps. Drawing on the key tenets of SDT, a research model is developed (Figure 2) explaining the effects of motivational affordances on competence need satisfaction and thwarting and resulting variations in fitness app continuance decisions.

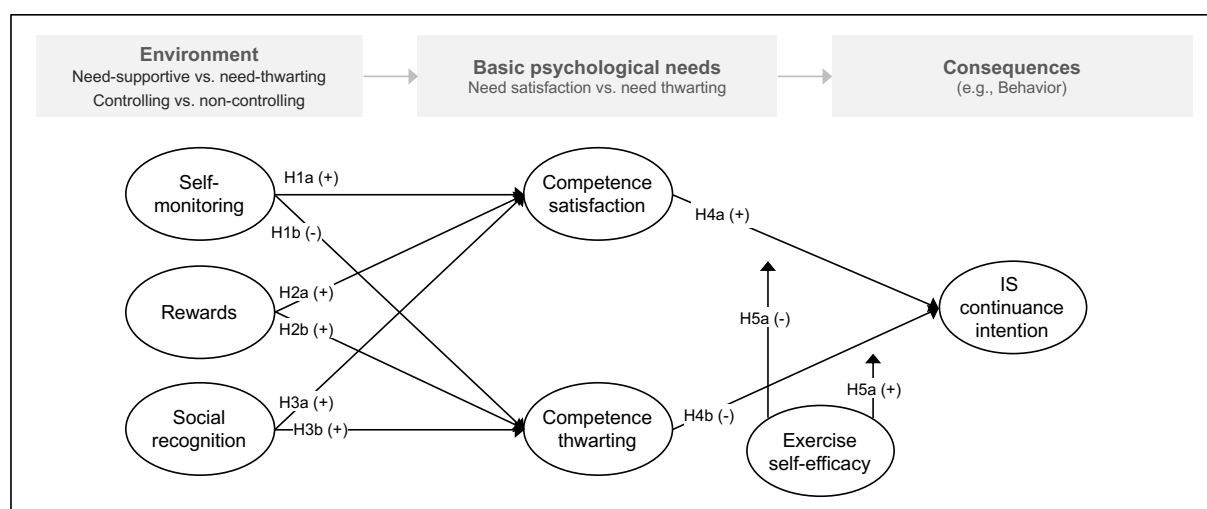


Figure 2. Research model

The **self-monitoring affordance** is at the heart of fitness apps and grants users the possibility to record and document their physical activity behavior and particularly to monitor their progress, skills, and performance (Lupton 2016). Self-monitoring is an essential behavior change technique targeting users' competence need by providing informational feedback on progress (Ryan and Deci 2017). When self-monitoring, fitness app users gain deeper insights about themselves and utilize the data to improve their fitness (Barratt 2017; Lee and Drake 2013; Suh 2018). However, users often encounter situations where improvements are observable, but also situations where not (Barratt 2017; Lee and Drake 2013) thereby producing negative feedback that is often accompanied by self-judgments and self-criticism (Ryan and Deci 2017). The central point is, however, that self-monitoring is nonevaluative and non-controlling: the user is both the doer and evaluator of her performance and is not externally judged by others (Ryan and Deci 2017). As such, the competence feedback gained from self-monitoring is solely informative targeting the behavior and not the person oneself (Ryan and Deci 2017). Although negative feedback is usually seen as detrimental to motivation, when negative feedback is nonevaluative and targets ones' efficacy, it can even enhance motivation and performance (Mouratidis et al. 2010). When self-monitoring, users determine their own goals and actions to pursue (Ryan and Deci 2017; Suh 2018), so that the self-monitoring affordance is essentially non-controlling and hence autonomy-supportive in nature. Empirical evidence lends support as fitness app users holding autonomous motivations to improve are more inclined to use such self-monitoring features in fitness apps (Hamari et al. 2018; Stragier et al. 2018). Thus, although competence satisfaction can vary, competence thwarting is rather unlikely given the non-controlling nature of this affordance (Ryan and Deci 2017).

H1: Self-monitoring increases a) competence need satisfaction and b) decreases need thwarting.

The **rewards affordance** reflects the gamification aspect of fitness apps. Rewards can be granted on self-referenced attainments when a user achieved her self-set goals such as running 5km, but in the context social network based apps, rewards are often provided on normative bases: being better than others as usually displayed within leaderboards (Johnson et al. 2016; Stragier et al. 2018). Inherent to rewards in such social fitness apps are hence social comparisons and competitions (Kerner and Goodyear 2017; Smith and Treem 2016). Rewards and competitions are, however, controversially discussed. They can be both supportive and adverse for competence needs as they generally center on 'winning or losing' and thereby have informational and controlling aspects (Ryan and Deci 2017). The informational aspect of rewards considers the rich feedback rewards provide about one's competence: receiving rewards leads to competence need satisfaction whereas not receiving a reward conveys the implicit message that one is not good enough, particularly compared to others (Ryan and Deci 2017). Fitness app users get a great deal out of such rewards. Seeing one's name on a leaderboard and outperforming others is an enjoyable experience and the received trophy signals competence to the self (Barratt 2017). In fact, rewards and competitions have been shown to satisfy users' competence needs (Suh et al. 2015). At the same time, though, rewards induce a controlling structure where users often feel pressurized to perform their sports in a certain way for the sake of receiving a reward (Barratt 2017; Kerner and Goodyear 2017). When fitness app users find themselves in competitions and perform worse than others, users report negative feelings of the self as a consequence (Kerner and Goodyear 2017). SDT posits that when challenges are designed as not too stressful and demanding (Ryan and Deci 2017), challenges satisfy competence needs (Peng et al. 2012) whereas too difficult challenges thwart competence needs (Przybylski et al. 2014). Leaderboards that are central in social fitness apps, however, provide only room for the best performing users and becoming better than them is readily overwhelming leaving other users with non-attainable challenges (Smith and Treem 2016). Moreover, SDT posits that when rewards are provided, people no longer perform for autonomous reasons but reasons originating outside the self (Deci and Ryan 1987). Fitness app research supports the notion that rewards provide a controlling structure as users pursuing non-autonomously motivated goals are more inclined towards rewards and competitions (Hamari et al. 2018; Stragier et al. 2018). As such, rewards can satisfy and thwart competence needs due to the controlling nature of rewards.

H2: Rewards increase competence need a) satisfaction and b) thwarting.

The **social recognition affordance** centers on the feedback users receive for their physical activities from other users (Hamari and Koivisto 2015). Social recognition is usually offered by 'likes' and comments on one's sports activities that provide praise, respect, approval, and encouragement (Babar et al. 2018). Others' praise and encouragement enhance individuals' sense of competence making them feel

good about themselves (Ryan and Deci 2000). Such social support boosts sports adherence and supportive peers are an important source of competence needs satisfaction (Jõesaar et al. 2011). Fitness app research alike has shown that social recognition encourages users to exercise (Hamari and Koivisto 2015; Stragier et al. 2016) and enhances physical activity (Babar et al. 2018). Fitness app users take the social feedback quite serious as it provides validation and confirmation about their competence and some users perform their sports for the sake of receiving ‘likes’ (Barratt 2017; Lee and Drake 2013; Smith and Treem 2016). However, when using fitness apps, users are aware that other users observe their physical activity thereby inducing feelings of peer surveillance and fear of being negatively judged by others which exerts pressure to perform (Barratt 2017; Smith and Treem 2016). Thus, when a user posts a physical activity with comparatively low performance and does not receive a ‘like’ or comment, it may signify her that she has poor abilities. Because of this, some users actively withhold posting activities that might reflect poor abilities (Smith and Treem 2016). Empirical studies support this contention as users fearing performing poorly avoid such social recognition features (Hamari et al. 2018). This is particularly the case when social peers emphasize interpersonal competition and relative ability or make fun about lacking skills and mistakes (Jõesaar et al. 2011). Due to these social contingencies, the social recognition affordance is evaluative and controlling in nature and therefore readily holds potentials to both satisfy and thwart competence needs.

H3: Social recognition increases competence need a) satisfaction and b) thwarting.

As a result, fitness app users can encounter both competence need satisfaction and thwarting which can be assumed to influence users’ **fitness app continuance intention**. Within the video game context, studies have shown that when video games satisfy competence needs, people have stronger intentions to continue playing the game (Peng et al. 2012; Ryan et al. 2006). The positive competence-relevant feedback gained from mastering the game is a satisfying experience that draws people back to play in search of repeating this pleasure (Russoniello et al. 2009; Ryan and Deci 2017). In contrast, evidence in social media research provides indications that competence need thwarting lowers continuance intentions. For example, when perceiving others as more successful than oneself, users feel frustrated and exhausted leading to higher discontinuance intentions (Maier et al. 2015; Wirth et al. 2015) which shows parallels to the consequences of need thwarting (Bartholomew et al. 2011). Research has also shown that competence-relevant feedback gained from fitness tracking provokes positive and negative emotional reactions which influence continuance intentions (Rockmann et al. 2018). Thus, competence need satisfaction and thwarting is likely to influence fitness app continuance decisions.

H4: Fitness app continuance intentions are a) increased by competence need satisfaction and b) decreased by competence need thwarting.

However, it is assumed that these responses to competence satisfaction and thwarting are not necessarily uniformly created. When people encounter demanding, stressful or threatening situations, people draw upon their personal resources to cope with the situation (Jerusalem and Schwarzer 1992). **Self-efficacy** is widely known as an important personal resource, that reflects one’s “belief in one’s capability to organize and execute the courses of action required to manage prospective situations” (Bandura 1997, p. 2). High self-efficacy buffers against distress experiences (Jerusalem and Schwarzer 1992). People with low self-efficacy, in contrast, are more prone to perceive situations as threatening and interpret negative performance and failure feedback as external evaluations of their personal value (Jerusalem and Schwarzer 1992). Within the physical activity context, exercise self-efficacy considers individuals’ confidence in regulating their exercise under different conditions (Marcus et al. 1992). As such, exercise self-efficacy is a central factor for persistence when confronted with obstacles in physical activity (Strecher et al. 1986). Yet people greatly differ in their exercise self-efficacy and people who have just begun with an exercise program usually have lower confidence in their ability to exercise in contrast to those who regularly exercise (Marcus et al. 1992). As such, it can be assumed that people with lower exercise self-efficacy are more likely to benefit and suffer from competence need satisfaction and thwarting respectively influencing fitness app continuance intentions.

H5: The effect of competence need a) satisfaction and b) thwarting on continuance intentions is stronger for users low in exercise self-efficacy compared to users high in exercise self-efficacy.

4 Research Method

4.1 Research context and data collection

To test the model and its hypotheses, quantitative empirical data with specific characteristics is needed. First, as the provision and actual implementation of the focal motivational affordances can differ between fitness apps (e.g., Higgins 2016), a single fitness app context was focused to mitigate outside effects (Hong et al. 2013). Second, this fitness app must provide social network features like comments or ‘likes’ to assess the ‘social recognition’ affordance. Third, this fitness app should target comparable physical activities (e.g., running) to have a shared ground for physical activity competencies. Lastly, a minimum sample size of 275 responses was calculated (Kock and Hadaya 2018).

In light of these requirements, the fitness app ‘Strava’ (www.strava.com) was chosen as the *research context*. Strava is a popular social-network based fitness app that predominantly targets cardio-intense physical activities such as running or cycling. Moreover, user stories indicate that using Strava can have adverse effects on users’ competence needs (e.g., Barratt 2017; Foss 2014; Hargrave 2013).

The *measurement instrument* (see Table 4 in the appendix) was based on established, valid, and reliable scales of prior research that were adapted to the Strava context whenever necessary. All items have been assessed with Likert-7 scales (‘strongly disagree’ to ‘strongly agree’). Items for need satisfaction and thwarting were assessed with Likert-7 scales anchored on ‘very untrue’ to ‘very true’.

Respondents were recruited using an online panel provided by Amazon Mechanical Turk (MTurk). MTurk gained attraction as a viable and reliable source for empirical research (Jia et al. 2017) including IS research (e.g., Lowry et al. 2016) and fitness tracking research (e.g., Pettinico and Milne 2017). Following recent guidelines on MTurk (Jia et al. 2017), responses were restricted to the United States as such responses provide reliable results similar to regular consumer panels (Steelman et al. 2014).

The *sampling strategy* was to survey only individuals who are users of the chosen fitness app Strava as this study seeks to better understand the psychological consequences of the enacted affordances potentially explaining fitness app use continuance intentions. To filter out non-users, a screening question was incorporated asking about whether they are currently using Strava. In total, 624 participants opened the survey whereby 110 individuals were directly terminated from the survey as they did not pass the screening criteria of being a Strava user (resulting N=514). To ensure unique responses from MTurk, IP addresses as well as Worker IDs were recorded (Lowry et al. 2016) leading to a removal of 89 responses as having non-unique IP addresses and/or Worker IDs (resulting N=435). As this study aims to analyze the effects of the ‘social recognition’ affordance, users need to be connected with other users (e.g., have ‘followers’). Asking participants accordingly whether they are connected with other users in Strava, 132 people indicated that they are not and were removed from the dataset (resulting N=293). To further safeguard data quality, 10 participants were removed due to failed attention checks or more than five missing answers across the survey.

This final dataset (N=283) is characterized as follows: 60.4% are male and the average age is 32.4 years (SD 7.96 years). On average, participants use Strava already for 11.5 months (SD 14.1 months) and when it comes to sports, 63.3% use Strava ‘often’ or ‘always’. Participants’ number of followers in Strava is at a median of 16 followers. Asking about their general frequency of performing sports, 78.4% answered with ‘several times a week’ or ‘almost every day’. Although official numbers of Strava are not available, the sample’s characteristics resonate with recent literature and studies assessing Strava or comparable apps (Hamari et al. 2018; Higgins 2016; Stragier et al. 2018). This, in turn, provides confidence in the adequateness of the sample under investigation.

4.2 Data analysis

The data was subsequently analyzed with structural equation modeling using partial least squares (Chin 1998) using the software SmartPLS 3.2.7 (Ringle et al. 2015). Data analysis first involved the evaluation of the measurement instrument and common method bias (Chin 1998).

All constructs have been assessed using reflective indicators so that evaluation involves assessment of indicator and construct reliability as well as discriminant validity (Chin 1998). Results are depicted in

Table 3 and explained as follows. *Indicator reliability* is ensured as all item loadings are above 0.707 and significant as reported in Table 4 in the appendix (Nunnally and Bernstein 1994). *Construct reliability* is given as values for Cronbach’s Alpha (α) and Composite Reliability (CR) are above the threshold of 0.707 and values for Average Variance Extracted (AVE) are above 0.5 (Nunnally and Bernstein 1994). *Discriminant validity* is ensured since all items load highest on their designated constructs and as the inter-variable correlations are smaller than the root of the corresponding AVE as demonstrated in the diagonal lines in Table 3 (Fornell and Larcker 1981). Additionally, the monotrait-heterotrait ratio is below the threshold of 0.9 with a highest value of 0.865 (Henseler et al. 2015).

Construct	M	SD	α	CR	AVE	1	2	3	4	5	6	7
1 Self-mon.	5.79	0.92	0.813	0.889	0.728	0.853						
2 Rewards	4.81	1.39	0.885	0.929	0.813	0.226	0.902					
3 Social rec.	4.60	1.48	0.880	0.926	0.807	0.151	0.519	0.898				
4 Need satis.	5.50	0.87	0.745	0.854	0.662	0.588	0.345	0.295	0.813			
5 Need thw.	3.42	1.64	0.918	0.948	0.859	-0.262	0.227	0.235	-0.269	0.927		
6 Self-eff.	5.24	1.12	0.845	0.895	0.681	0.321	0.073	0.164	0.404	-0.091	0.825	
7 Cont. Int.	5.61	0.98	0.825	0.895	0.740	0.671	0.208	0.167	0.690	-0.199	0.360	0.860

Table 3. Measurement model evaluation

Common method bias (CMB) can be a concern in self-reported data obtained through a single method (Podsakoff et al. 2003). To mitigate the potential influence, respondents’ anonymity, the academic purpose, and that there are no wrong or right answers were stressed and items were presented in random order (Podsakoff et al. 2003). To evaluate its presence in the data, two tests were conducted. First, examination of the correlation matrix (Table 3) did not indicate extremely high correlations ($r > 0.9$), which would be otherwise an indicator of CMB (Pavlou et al. 2007). Second, performing the test of Liang et al. (2007) by entering a CMB factor into the model containing all items and observing its influence on each item resulted in a ratio of 1:296 which is smaller compared to prior research (e.g., 1:42 in Liang et al. 2015; 1:154 in Maier et al. 2015). As such, CMB is not of great concern in the data.

4.3 Results

The structural model was subsequently analyzed by assessing the coefficient of determination (R^2) and the significance levels of the path coefficients using a bootstrapping procedure with 5000 iterations (Chin 1998). The standardized root mean square residual (SRMR) of 0.082 was close to the threshold of 0.08 and deemed as acceptable for a good model fit (Henseler et al. 2014; Hu and Bentler 1998).

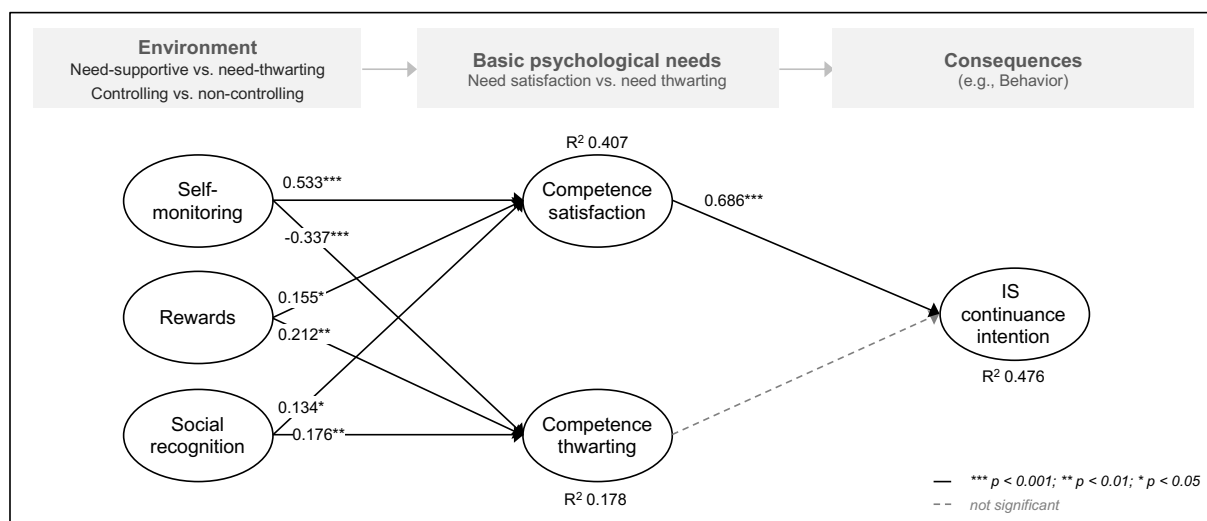


Figure 3. Results of the main effects model

For the main effects (Figure 3), R^2 values of 47.6% for continuance intention and 40.7% for satisfaction and 17.8% for thwarting of competence were obtained. Path analysis supports the positive (H1a) and negative (H1b) influence of self-monitoring on need satisfaction and thwarting respectively. The positive relationships of rewards (H2a/b) and social recognition (H3a/b) with need satisfaction and thwarting are also supported. In turn, competence need satisfaction exhibited the assumed relationship with fitness app continuance intention (H4a supported), but competence need thwarting did not (H4b not supported). However, as it was assumed that these relationships might be contingent of user's exercise self-efficacy (H5), these moderation effects were tested separately. For competence need satisfaction, a minor moderating effect appeared, significant only at the 10% level ($\beta=-0.072$; $p=0.076$) supporting H5a only slightly. For competence thwarting, a moderating effect ($\beta=0.128$; $p=0.050$) was found supporting H5b. To aid interpretation, the moderation effects are plotted in Figure 4 (Aiken and West 1991). The results are discussed in light of the study's findings and implications next.

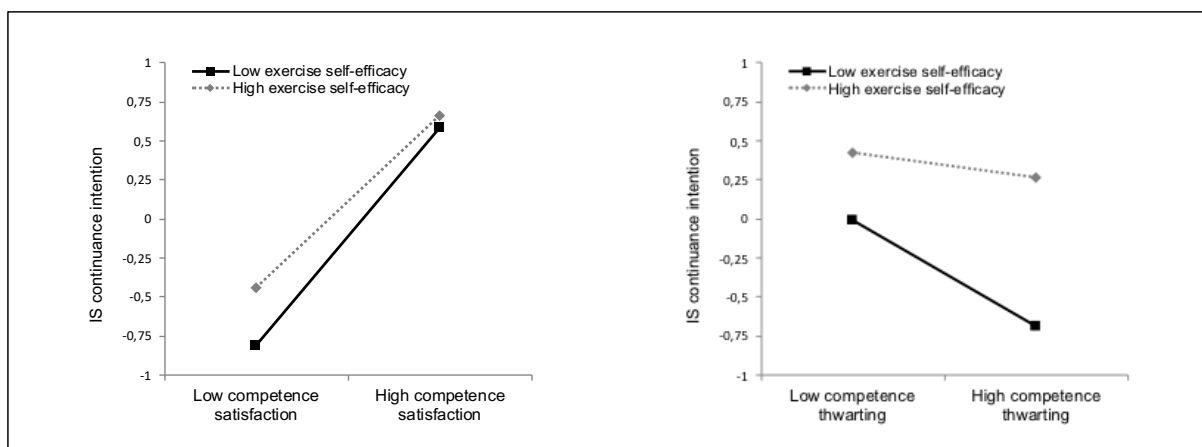


Figure 4. Moderating role of exercise self-efficacy on the relationship of competence satisfaction (left) and competence thwarting (right) on fitness app continuance intention

5 Discussion

This research was motivated by the lack of regular physical activity prevailing in our society (WHO 2010) and by the indications of a 'darker side' in fitness apps (Foss 2014; Green 2015; Hargrave 2013; November Project 2017) potentially accounting for users' decision to continue using them. A model was developed analyzing the motivational affordances of fitness apps –self-monitoring, rewards, and social recognition– and their (de-)motivational effects on competence need satisfaction and thwarting explaining variations in fitness app continuance intentions. The model was tested with 283 users of a popular fitness app. The findings are elaborated next before the contributions to research, implications for practice, and the limitations and further research opportunities are discussed.

5.1 Findings

The findings of the empirical data are highlighted by the influential role of competence need satisfaction and thwarting accounting for 47.6% of the variations in fitness app continuance intentions. Interestingly, competence need thwarting affects fitness app continuance intentions only for users with a low exercise self-efficacy meaning that competence need thwarting is a particular cause for those users, who are usually less regularly physically active or who just began to exercise (Marcus et al. 1992). Thus, particularly those who would benefit most from fitness apps to enhance their physical competence are those who suffer more strongly from the negative experiences lowering their decisions to continue using the fitness app. Yet, in general, the positive, need-satisfying experiences weigh out the negative ones. The result that competence need thwarting generally did not affect continuance intentions can be potentially explained by the high experience and usage frequency the users have. This might indicate that users have adapted and optimized their fitness app use by drawing on those motivational affordances that best

fit the satisfaction of their competence needs. In line with this, this paper aimed to get a better understanding of the role of motivational affordances causing competence need satisfaction and thwarting. Results indicate that while the self-monitoring provides mostly positive effects, rewards and social recognition can exert both positive and adverse effects for users' competence needs. As such, this provides evidence for the indications concerning the motivational and demotivational effects of fitness apps.

5.2 Contributions to literature

Based on the empirical findings discussed so far, a general solid support for the research model and assumptions was obtained so that this research provides the following contributions to literature.

First, this paper provides a *motivation-theoretical explanation of fitness app continuance*. Although fitness apps are expected to enhance physical activity and healthy behavior, high discontinuance rates are evident (Ledger and McCaffrey 2014). So far, only a few studies took the role of motivational affordances for continued use into perspective. These studies highlighted the role motivational affordances play to enhance perceptions about enjoyment and usefulness of fitness apps that in turn determine continuance intentions (Hamari and Koivisto 2015; Stragier et al. 2016; Suh 2018). However, these studies neglected the 'motivational effects' concerning competence needs that are central for motivation, engagement, and persistence in physical activity (Ng et al. 2012; Teixeira et al. 2012) and targeted by fitness apps as this research has shown. By drawing upon the key tenets of SDT and focusing on basic psychological needs (Ryan and Deci 2017), this paper provides a detailed understanding about the motivation-psychological causes (i.e., motivational affordances) and effects (i.e., need satisfaction and thwarting) that explain fitness app continuance intentions. This provides not only a viable theoretical explanation for fitness app continuance but also offers insights into what is 'user satisfaction' essentially about in fitness apps (DeLone and McLean 1992; 2003).

Second, this paper contributes to research by *explicating the 'darker side' of fitness apps*. So far, research and practice hold largely positive views about fitness apps as being beneficial for physical activity, health, and well-being, particularly those offering gamification and social network capabilities (e.g., Oinas-Kukkonen and Harjuma 2009; Peters et al. 2018; WHO 2018b). However, as several user stories point out, people have critical encounters and harmful experiences when using such fitness apps (Foss 2014; Green 2015; Hargrave 2013; November Project 2017). So far, research neglected these adverse effects albeit first indications exist in the literature (e.g., Kerner and Goodyear 2017). To better understand this phenomenon, this paper employed the notion of competence need thwarting that describes the 'darker side' of psychological experiences where needs are actively impeded or frustrated (Bartholomew et al. 2011; Gunnell et al. 2013). The concept of need thwarting hence assists capturing and explicating the adverse psychological effects of fitness apps and, as this study has shown, can be caused by information technology (IT) and its affordances provided. As such, this study also contributes beyond the fitness app context to the general strand of the 'dark side of IT use' (Tarafdar et al. 2015), particularly with respect to private and leisure settings (e.g., Maier et al. 2015; Wirth et al. 2015). This stream shows parallel lines with need thwarting concerning detrimental consequences such as emotional exhaustion, burnout, and ill-being across various life contexts (Ryan and Deci 2017) so that basic psychological need thwarting provides a noteworthy perspective to understand the detrimental psychological effects of IT use (D'Arcy et al. 2014). Hereto, this study provides empirical evidence and hence foundations for the relationship between affordances and need thwarting.

Third, and in line with this, this paper offers an *explanation of the need-relevant characteristics of motivational affordances*. Scholars point out that the underlying motivation-psychological processes of motivational affordances (Zhang 2008) are not well understood so far (Liu et al. 2017; Mekler et al. 2017). By drawing upon the key tenets of SDT (Ryan and Deci 2017) that links the characteristics of the personal environment (i.e., feedback, rewards) with basic psychological needs (i.e., competence) in explaining motivation, behaviour, and well-being, this paper developed a deeper understanding about the need-relevant characteristics of motivational affordances. The central theoretical contention developed here is that motivational affordances need to be understood as controlling and evaluative in contrast to non-controlling and autonomy-supportive structures within one's environment (Ryan and Deci 2017). As such, motivational affordances exert need-supportive and need-thwarting characteristics that, in turn, cause psychological need satisfaction and thwarting for the users.

5.3 Practical implications

Fitness apps aim to enhance people's motivation to be physically active and to induce this motivation, designers incorporate self-monitoring, rewards, and social recognition motivational affordances into fitness apps. Nonetheless, designers must be aware of the underlying motivation-psychological mechanisms of the affordances when designing such apps: people have basic psychological needs that need to be satisfied in order to enhance their motivation and within the physical activity and fitness app context, the need to feel competent is central for peoples' motivation, engagement, and persistence in physical activity. However, this paper suggests that the incorporation of particularly rewards and social recognition is a double-edged sword as they can be both beneficial and adverse for users' motivation.

Both motivational affordances can satisfy competence needs so that users gain confidence in their physical abilities – but also thwart their competence needs so that users feel incompetent when conducting physical activity. Particularly for users with lower exercise self-efficacy, these demotivational effects lower their intentions to continue using the fitness app. To mitigate these issues and to provide optimal motivational environments, fitness app designers need to incorporate means to adapt the motivational affordances to the individual user. For instance, the current user's exercise self-efficacy might be assessed using a brief questionnaire or might be even inferred from the activity recordings. When observing declines in using the fitness app, for example, the fitness app might adapt by muting the rewards and social recognition affordances and bringing the self-monitoring affordance to the foreground.

5.4 Limitations and further research avenues

Despite these contributions and implications, the following limitations must be acknowledged that serve as avenues for further research on fitness apps.

First, this study is bound by a single context (Hong et al. 2013) focusing on a single fitness app offering the focal affordances. As the fitness app research landscape is very diverse (Higgins 2016), other fitness apps provide other or additional motivational affordances, such as 'exercise guidance' (Rockmann and Gewald 2018), so that those need to be assessed alike in future research. Second, this study focused on the competence need given its importance for physical activity (Ng et al. 2012; Teixeira et al. 2012). However, the autonomy and relatedness need might be also affected by the motivational affordances in positive and adverse ways (Kerner and Goodyear 2017; Suh et al. 2015) so that research should assess these need dimensions and their consequences alike. Third, this paper focused on continuance intentions but discontinuance intentions might be caused differently (Buchwald et al. 2018). Future research needs to test whether the model exhibits different results when examining actual discontinuance decisions. In line with this, other motivational outcomes, such as perceived motivational benefits from using fitness apps (Hassan et al. 2019), impacts on well-being (James et al. 2019a; James et al. 2019b), or actual increased physical activity, provide fruitful areas for further investigations. Moreover, the relationships between motivational affordances and competence need satisfaction and thwarting may be influenced by contingency factors, such as user's social network size (Hamari and Koivisto 2015) or user's exercise goals and motivations (Hamari et al. 2018; James et al. 2019b), and future research needs to expand the model by taking such specifics into account. Lastly, future research might examine whether certain configurations or patterns of affordances cause need satisfaction and thwarting in distinct ways or for particular user types (e.g., different levels exercise self-efficacy or different exercise goals) by employing person-centered approaches with methods such as qualitative comparative analysis (QCA) or Latent Profile Analysis (LPA) (see, e.g., Liu et al. 2015; Mattke et al. 2018).

6 Appendix

Construct	Items	Loading	Sources
Affordance	<i>When I use Strava, I use features that allow me...</i>		
Self-monitoring	... to monitor my sport behavior.	0.866***	(Rockmann and Gewald 2018)
	... to document information about my sport activities.	0.871***	
	... to keep track of my exercise activities.	0.821***	
Rewards	... to get more rewards if I try harder.	0.908***	
	... to obtain virtual rewards (badges, trophies) for my physical activity.	0.900***	
	... to earn virtual rewards as a token for my efforts in physical activity.	0.897***	
Social recognition	... to earn respect of others for my physical activity.	0.916***	
	... to get recognized from others for my sport behavior.	0.909***	
	... to get noticed by others for my physical activity.	0.869***	
Needs	<i>When using Strava, ...</i>		
Competence satisfaction	... I feel confident that I can do sports well.	0.786***	(Chen et al. 2015)
	... I feel capable at what I do.	0.855***	
	... I feel competent to achieve my exercise goals.	0.798***	
Competence thwarting	... I have serious doubts about whether I can do sports well.	0.923***	
	... I feel disappointed with my sports performance.	0.932***	
	... I feel insecure about my sport abilities.	0.926***	
Self-efficacy	<i>I am confident I can be physically active on most days...</i>		
Exercise self-efficacy	... even if I am tired.	0.879***	(Marcus et al. 1992)
	... when I am in a bad mood.	0.837***	
	... even if I feel I don't have the time	0.781***	
	... when it is hot, raining or snowing.	0.799***	
Intention			
Continuance intention	I predict I would continue using Strava.	0.903***	(Bhattacharjee and Lin 2015; Brown et al. 2014)
	I plan to continue using Strava when doing sports.	0.859***	
	I intend to continue using Strava rather than discontinue its use.	0.818***	

Table 4. Measurement instrument (***) $p < 0.001$

References

- Aiken, L.S. and S.G. West (1991). *Multiple Regression: Testing and Interpreting Interactions*. Newbury Park, CA: Sage.
- AOK (2017). *AOK-Gesundheitskonto*. URL: <https://nordost.aok.de/inhalt/aok-gesundheitskonto/#248728> (visited on April 24th 2017).
- Babar, Y., J. Chan, and B. Choi (2018). ““Run Forrest Run!”: Measuring the Impact of App-Enabled Performance and Social Feedback on Running Performance.” In: *Proceedings of the International Conference on Information Systems*. San Francisco.
- Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York: Freeman.
- Barratt, P. (2017). “Healthy Competition: A Qualitative Study Investigating Persuasive Technologies and the Gamification of Cycling.” *Health & Place* 46, 328-336.
- Bartholomew, K.J., N. Ntoumanis, R.M. Ryan, and C. Thøgersen-Ntoumani (2011). “Psychological Need Thwarting in the Sport Context: Assessing the Darker Side of Athletic Experience.” *Journal of Sport and Exercise Psychology* 33 (1), 75-102.
- BBC (2018). *John Hancock Adds Fitness Tracking to All Policies*. BBC. URL: <https://www.bbc.com/news/technology-45590293> (visited on 2018-09-21).

- Bhattacharjee, A. and C.-P. Lin (2015). "A Unified Model of IT Continuance: Three Complementary Perspectives and Crossover Effects." *European Journal of Information Systems* 24 (4), 364-373.
- Brown, S.A., V. Venkatesh, and S. Goyal (2014). "Expectation Confirmation in Information Systems Research: A Test of Six Competing Models." *MIS Quarterly* 38 (3), 729-756.
- Buchwald, A., A. Letner, N. Urbach, and M. von Entreeß-Fürsteneck (2018). "Insights into Personal Ict Use: Understanding Continuance and Discontinuance of Wearable Self-Tracking Devices." In: *Proceedings of the European Conference on Information Systems*. Portsmouth, UK.
- Chen, B., M. Vansteenkiste, W. Beyers, L. Boone, E.L. Deci, J. Van der Kaap-Deeder, B. Duriez, W. Lens, L. Matos, and A. Mouratidis (2015). "Basic Psychological Need Satisfaction, Need Frustration, and Need Strength across Four Cultures." *Motivation and Emotion* 39 (2), 216-236.
- Chin, W.W. (1998). "The Partial Least Squares Approach to Structural Equation Modeling." In: *Modern Methods for Business Research*. Ed. by G.A. Marcoulides. Lawrence Erlbaum Associates Publishers. Mahwah, NJ, US. pp. 295-336.
- D'Arcy, J., A. Gupta, M. Tarafdar, and O. Turel (2014). "Reflecting on the "Dark Side" of Information Technology Use." *Communications of the Association for Information Systems* 35, 109-118.
- Deci, E.L. and R.M. Ryan (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press.
- Deci, E.L. and R.M. Ryan (1987). "The Support of Autonomy and the Control of Behavior." *Journal of Personality and Social Psychology* 53 (6), 1024-1037.
- Deci, E.L. and R.M. Ryan (2000). "The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior." *Psychological Inquiry* 11 (4), 227-268.
- Deci, E.L. and R.M. Ryan (2012). "Motivation, Personality, and Development within Embedded Social Contexts: An Overview of Self-Determination Theory." In: *The Oxford Handbook of Human Motivation*. Ed. by R.M. Ryan. Oxford University Press. New York. pp. 85-107.
- DeLone, W.H. and E.R. McLean (1992). "Information Systems Success: The Quest for the Dependent Variable." *Information Systems Research* 3 (1), 60-95.
- DeLone, W.H. and E.R. McLean (2003). "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update." *Journal of Management Information Systems* 19 (4), 9-30.
- Fornell, C. and D.F. Larcker (1981). "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error." *Journal of Marketing Research*, 39-50.
- Foss, J. (2014). *The Tale of a Fitness-Tracking Addict's Struggles with Strava*. Wired. URL: <https://www.wired.com/2014/10/my-strava-problem/> (visited on 11th April 2017).
- Giddens, L., D. Leidner, and E. Gonzalez (2017). "The Role of Fitbits in Corporate Wellness Programs: Does Step Count Matter?" In: *Proceedings of the Hawaii International Conference on System Sciences*.
- Green, D. (2015). *Why I Got Rid of My Fitbit*. URL: <http://www.douglas-green.com/why-i-got-rid-of-my-fitbit/> (visited on 2017-03-17).
- Gunnell, K.E., P.R. Crocker, P.M. Wilson, D.E. Mack, and B.D. Zumbo (2013). "Psychological Need Satisfaction and Thwarting: A Test of Basic Psychological Needs Theory in Physical Activity Contexts." *Psychology of Sport and Exercise* 14 (5), 599-607.
- Hamari, J., L. Hassan, and A. Dias (2018). "Gamification, Quantified-Self or Social Networking? Matching Users' Goals with Motivational Technology." *User Modeling and User-Adapted Interaction* 28 (1), 35-74.
- Hamari, J. and J. Koivisto (2015). "Working out for Likes": An Empirical Study on Social Influence in Exercise Gamification." *Computers in Human Behavior* 50, 333-347.
- Hargrave, J. (2013). *The Silly Self Importance of Strava*. Utah Adventure Journal. URL: <http://utahadvjournal.com/index.php/the-silly-self-importance-of-strava> (visited on May 3th 2017).
- Hassan, L., A. Dias, and J. Hamari (2019). "How Motivational Feedback Increases User's Benefits and Continued Use: A Study on Gamification, Quantified-Self and Social Networking." *International Journal of Information Management* 46, 151-162.
- Henseler, J., T.K. Dijkstra, M. Sarstedt, C.M. Ringle, A. Diamantopoulos, D.W. Straub, D.J. Ketchen Jr, J.F. Hair, G.T.M. Hult, and R.J. Calantone (2014). "Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013)." *Organizational Research Methods* 17 (2), 182-209.

- Henseler, J., C.M. Ringle, and M. Sarstedt (2015). "A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling." *Journal of the Academy of Marketing Science* 43 (1), 115-135.
- Higgins, J.P. (2016). "Smartphone Applications for Patients' Health and Fitness." *The American Journal of Medicine* 129 (1), 11-19.
- Hong, W., F.K. Chan, J.Y. Thong, L.C. Chasalow, and G. Dhillon (2013). "A Framework and Guidelines for Context-Specific Theorizing in Information Systems Research." *Information Systems Research* 25 (1), 111-136.
- Hu, L.-t. and P.M. Bentler (1998). "Fit Indices in Covariance Structure Modeling: Sensitivity to Underparameterized Model Misspecification." *Psychological Methods* 3 (4), 424-453.
- James, T.L., J.K. Deane, and L. Wallace (2019a). "An Application of Goal Content Theory to Examine How Desired Exercise Outcomes Impact Fitness Technology Feature Set Selection." *Information Systems Journal* forthcoming.
- James, T.L., L. Wallace, and J.K. Deane (2019b). "Using Organismic Integration Theory to Explore the Associations between Users' Exercise Motivations and Fitness Technology Feature Set Use." *MIS Quarterly* 43 (1), 287-312.
- Jerusalem, M. and R. Schwarzer (1992). "Self-Efficacy as a Resource Factor in Stress Appraisal Processes." In: *Self-Efficacy: Thought Control of Action*. Ed. by R. Schwarzer. Hemisphere. Washington, DC. pp. 195-213.
- Jia, R., Z.R. Steelman, and B.H. Reich (2017). "Using Mechanical Turk Data in IS Research: Risks, Rewards, and Recommendations." *Communications of the Association for Information Systems* 41 (1), 301-318.
- Jõesaar, H., V. Hein, and M.S. Hagger (2011). "Peer Influence on Young Athletes' Need Satisfaction, Intrinsic Motivation and Persistence in Sport: A 12-Month Prospective Study." *Psychology of Sport and Exercise* 12 (5), 500-508.
- Johnson, D., S. Deterding, K.-A. Kuhn, A. Staneva, S. Stoyanov, and L. Hides (2016). "Gamification for Health and Wellbeing: A Systematic Review of the Literature." *Internet Interventions* 6, 89-106.
- Karahanna, E., S.X. Xu, and A.N. Zhang (2018). "The Needs-Affordances Features (Naf) Perspective for the Use of Social Media." *MIS Quarterly* 42 (3), 737-756.
- Kerner, C. and V.A. Goodyear (2017). "The Motivational Impact of Wearable Healthy Lifestyle Technologies: A Self-Determination Perspective on Fitbits with Adolescents." *American Journal of Health Education* 48 (5), 287-297.
- Kock, N. and P. Hadaya (2018). "Minimum Sample Size Estimation in Pls-Sem: The Inverse Square Root and Gamma-Exponential Methods." *Information Systems Journal* 28 (1), 227-261.
- Koivisto, J. and J. Hamari (2019). "The Rise of Motivational Information Systems: A Review of Gamification Research." *International Journal of Information Management* 45, 191-210.
- Ledger, D. and D. McCaffrey (2014). *Inside Wearables: How the Science of Human Behavior Change Offers the Secret to Long-Term Engagement*. URL: <http://endeavourpartners.net/assets/Wearables-and-the-Science-of-Human-Behavior-Change-EP4.pdf> (visited on June 13th 2017).
- Lee, V.R. and J. Drake (2013). "Digital Physical Activity Data Collection and Use by Endurance Runners and Distance Cyclists." *Technology, Knowledge and Learning* 18 (1), 39-63.
- Liang, H., Z. Peng, Y. Xue, X. Guo, and N. Wang (2015). "Employees' Exploration of Complex Systems: An Integrative View." *Journal of Management Information Systems* 32 (1), 322-357.
- Liang, H., N. Saraf, Q. Hu, and Y. Xue (2007). "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management." *MIS Quarterly* 31 (1), 59-87.
- Liu, D., R. Santhanam, and J. Webster (2017). "Towards Meaningful Engagement: A Framework for Design and Research of Gamified Information Systems." *MIS Quarterly* 41 (4), 1011-1034.
- Liu, Y., J. Mezei, V. Kostakos, and H. Li (2015). "Applying Configurational Analysis to IS Behavioural Research: A Methodological Alternative for Modelling Combinatorial Complexities." *Information Systems Journal* 27 (1), 59-89.
- Lowry, P.B., J. Zhang, C. Wang, and M. Siponen (2016). "Why Do Adults Engage in Cyberbullying on Social Media? An Integration of Online Disinhibition and Deindividuation Effects with the Social Structure and Social Learning Model." *Information Systems Research* 27 (4), 962-986.
- Lupton, D. (2016). *The Quantified Self*. Malden, MA: Polity Press.

- Mageau, G.A. and R.J. Vallerand (2003). "The Coach–Athlete Relationship: A Motivational Model." *Journal of Sports Science* 21 (11), 883-904.
- Maier, C., S. Laumer, C. Weinert, and T. Weitzel (2015). "The Effects of Technostress and Switching Stress on Discontinued Use of Social Networking Services: A Study of Facebook Use." *Information Systems Journal* 25 (3), 275-308.
- Marcus, B.H., V.C. Selby, R.S. Niaura, and J.S. Rossi (1992). "Self-Efficacy and the Stages of Exercise Behavior Change." *Research Quarterly for Exercise and Sport* 63 (1), 60-66.
- Mattke, J., C. Maier, L. Müller, and T. Weitzel (2018). "Typology of User Resistance Behavior: A Study Explaining Why Individuals Resist Using Bitcoin." In: *Proceedings of the International Conference on Information Systems*. San Francisco.
- Mekler, E.D., F. Brühlmann, A.N. Tuch, and K. Opwis (2017). "Towards Understanding the Effects of Individual Gamification Elements on Intrinsic Motivation and Performance." *Computers in Human Behavior* 71, 525-534.
- Mouratidis, A., W. Lens, and M. Vansteenkiste (2010). "How You Provide Corrective Feedback Makes a Difference: The Motivating Role of Communicating in an Autonomy-Supporting Way." *Journal of Sport & Exercise Psychology* 32 (5), 619-637.
- Ng, J.Y., N. Ntoumanis, C. Thøgersen-Ntoumani, E.L. Deci, R.M. Ryan, J.L. Duda, and G.C. Williams (2012). "Self-Determination Theory Applied to Health Contexts: A Meta-Analysis." *Perspectives on Psychological Science* 7 (4), 325-340.
- November Project (2017). *I Quit Strava*. URL: <https://november-project.com/i-quit-strava-den> (visited on 2018-04-21).
- Ntoumanis, N., J. Edmunds, and J.L. Duda (2009). "Understanding the Coping Process from a Self-Determination Theory Perspective." *British Journal of Health Psychology* 14 (2), 249-260.
- Nunnally, J.C. and I. Bernstein (1994). *Psychometric Theory*. 3. New York: McGraw-Hill.
- OECD (2017). *Health at a Glance 2017: Oecd Indicators*. OECD Publishing. Paris. URL: http://dx.doi.org/10.1787/health_glance-2017-en (visited on 2018-09-20).
- Oinas-Kukkonen, H. and M. Harjumaa (2009). "Persuasive Systems Design: Key Issues, Process Model, and System Features." *Communications of the Association for Information Systems* 24, 485-500.
- Orji, R. and K. Moffatt (2016). "Persuasive Technology for Health and Wellness: State-of-the-Art and Emerging Trends." *Health Informatics Journal* 24 (1), 66-91.
- Pavlou, P.A., H. Liang, and Y. Xue (2007). "Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal-Agent Perspective." *MIS Quarterly* 31 (1), 105-136.
- Peng, W., J.-H. Lin, K.A. Pfeiffer, and B. Winn (2012). "Need Satisfaction Supportive Game Features as Motivational Determinants: An Experimental Study of a Self-Determination Theory Guided Exergame." *Media Psychology* 15 (2), 175-196.
- Peters, D., R.A. Calvo, and R.M. Ryan (2018). "Designing for Motivation, Engagement and Wellbeing in Digital Experience." *Frontiers in Psychology* 9 (797), 1-15.
- Pettinico, G. and G.R. Milne (2017). "Living by the Numbers: Understanding the "Quantification Effect"." *Journal of Consumer Marketing* 34 (4).
- Podsakoff, P.M., S.B. MacKenzie, J.-Y. Lee, and N.P. Podsakoff (2003). "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies." *Journal of Applied Psychology* 88 (5), 879-903.
- Przybylski, A.K., E.L. Deci, C.S. Rigby, and R.M. Ryan (2014). "Competence-Impeding Electronic Games and Players' Aggressive Feelings, Thoughts, and Behaviors." *Journal of Personality and Social Psychology* 106 (3), 441-457.
- Ringle, C.M., S. Wende, and J.-M. Becker (2015). "Smartpls 3", SmartPLS GmbH, Boenningstedt.
- Rockmann, R. and H. Gewald (2018). "Activity Tracking Affordances: Identification and Instrument Development." In: *Proceedings of the Pacific Asia Conference on Information Systems*. Yokohama, Japan.
- Rockmann, R., T. Salou, and H. Gewald (2018). "If You Are Happy and Don't Know IT: Continuance? Analyzing Emotion Carry-over Effects in Activity Tracking Continuance Decisions." In: *Proceedings of the Pacific Asia Conference on Information Systems*. Yokohama.
- Russoniello, C.V., K. O'Brien, and J.M. Parks (2009). "The Effectiveness of Casual Video Games in Improving Mood and Decreasing Stress." *Journal of CyberTherapy and Rehabilitation* 2 (1), 53-66.

- Ryan, R.M. and E.L. Deci (2000). "Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being." *American Psychologist* 55 (1), 68-78.
- Ryan, R.M. and E.L. Deci (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York, NY: The Guilford Press.
- Ryan, R.M., C.S. Rigby, and A. Przybylski (2006). "The Motivational Pull of Video Games: A Self-Determination Theory Approach." *Motivation and emotion* 30 (4), 344-360.
- Schmidt-Kraepelin, M., S. Thiebes, S. Stepanovic, T. Mettler, and A. Sunyaev (2019). "Gamification in Health Behavior Change Support Systems - a Synthesis of Unintended Side Effects." In: *Proceedings of the International Conference on Wirtschaftsinformatik*. Siegen, Germany.
- Smith, W.R. and J. Treem (2016). "Striving to Be King of Mobile Mountains: Communication and Organizing through Digital Fitness Technology." *Communication Studies* 68 (2), 135-151.
- Statista (2018). *Eservices Report 2018 – Fitness*. URL: <https://de.statista.com/statistik/studie/id/36673/dokument/fitness-outlook/> (visited on 2018-07-23).
- Steelman, Z.R., B.I. Hammer, and M. Limayem (2014). "Data Collection in the Digital Age: Innovative Alternatives to Student Samples." *MIS Quarterly* 38 (2), 355-378.
- Stragier, J., M.V. Abeele, P. Mechant, and L. De Marez (2016). "Understanding Persistence in the Use of Online Fitness Communities: Comparing Novice and Experienced Users." *Computers in Human Behavior* 64, 34-42.
- Stragier, J., M. Vanden Abeele, and L. De Marez (2018). "Recreational Athletes' Running Motivations as Predictors of Their Use of Online Fitness Community Features." *Behaviour & Information Technology* 37 (8), 815-827.
- Strecher, V.J., B. McEvoy DeVellis, M.H. Becker, and I.M. Rosenstock (1986). "The Role of Self-Efficacy in Achieving Health Behavior Change." *Health Education Quarterly* 13 (1), 73-92.
- Suh, A. (2018). "Sustaining the Use of Quantified-Self Technology: A Theoretical Extension and Empirical Test." *Asia Pacific Journal of Information Systems* 28 (2), 114-132.
- Suh, A., C. Wagner, and L. Liu (2015). "The Effects of Game Dynamics on User Engagement in Gamified Systems." In: *Proceedings of the Hawaii International Conference on System Sciences*. pp. 672-681.
- Tarafdar, M., A. Gupta, and O. Turel (2015). "Special Issue on 'Dark Side of Information Technology Use': An Introduction and a Framework for Research." *Information Systems Journal* 25 (3), 161-170.
- Teixeira, P.J., E.V. Carraça, D. Markland, M.N. Silva, and R.M. Ryan (2012). "Exercise, Physical Activity, and Self-Determination Theory: A Systematic Review." *International Journal of Behavioral Nutrition and Physical Activity* 9 (1), 78.
- Vallerand, R.J. and G.F. Losier (1999). "An Integrative Analysis of Intrinsic and Extrinsic Motivation in Sport." *Journal of Applied Sport Psychology* 11 (1), 142-169.
- WHO (2010). *Global Recommendations on Physical Activity for Health*. URL: <http://www.who.int/dietphysicalactivity/publications/9789241599979/en/> (visited on 2018-08-14).
- WHO (2018a). *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*. Geneva. URL: <http://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf> (visited on 2018-09-20).
- WHO (2018b). *WHO and Google Fit Announcement*. URL: <http://www.who.int/behealthy/digital-health/promoting-health-in-the-21st-century> (visited on 2018-09-20).
- Wirth, J., C. Maier, S. Laumer, and T. Weitzel (2015). "Drivers and Consequences of Frustration When Using Social Networking Services: A Quantitative Analysis of Facebook Users." In: *Proceedings of the Americas Conference on Information Systems*. Puerto Rico.
- Zhang, P. (2008). "Motivational Affordances: Reasons for Ict Design and Use." *Communications of the ACM* 51 (11), 145-147.