> Tabitha L. James, France Bélanger, and Paul Benjamin Lowry (2021). "The mediating role of fitness technology enablement of psychological need satisfaction and frustration on the relationship between goals for fitness technology use and use outcome," ***Journal of the Association for Information Systems (JAIS)*** (accepted 17-Oct-2021).

If you have any questions, would like a copy of the final version of the article, or would like copies of other articles we've published, please contact any of us directly, as follows:

- ***Prof. Tabitha L. James**
  - Business Information Technology, Pamplin College of Business
  - Virginia Tech
  - **Email**: tajames@vt.edu
  - **Website**: https://sites.google.com/view/tabitha-l-james
- **Prof. France Bélanger,** University Distinguished Professor and R.B. Pamplin Professor
  - Accounting and Information Systems, Pamplin College of Business
  - Virginia Tech
  - Email: belanger@vt.edu
  - Website: https://acis.pamplin.vt.edu/directory/Belanger.html
- **Prof. Paul Benjamin Lowry,** Eminent Scholar and Suzanne Parker Thornhill Chair Professor
  - Business Information Technology, Pamplin College of Business
  - Virginia Tech
  - Email: Paul.Lowry.PhD@gmail.com
  - Website: https://sites.google.com/site/professorlowrypaulbenjamin/home
  - System to request Paul's articles: https://seanacademic.qualtrics.com/SE/?SID=SV_7WCaP0V7FA0GWWx

*corresponding author

The Mediating Role of Fitness Technology Enablement of Psychological Need Satisfaction and Frustration on the Relationship between Goals for Fitness Technology Use and Use Outcomes

Tabitha L. James, Virginia Tech, tajames@vt.edu
France Bélanger, Virginia Tech, belanger@vt.edu
Paul Benjamin Lowry, Virginia Tech, Paul.Lowry.PhD@gmail.com

Abstract

The aim of fitness technologies, a combination of wearables and associated applications, is to support users' health and fitness regimes. The market for fitness technologies continues to increase, and the technologies themselves are quickly advancing. However, it is unclear how effective fitness technologies are in generating wellness outcomes, and there is concern regarding frequent discontinuance behaviors. Accordingly, we develop a model to explain how the perception that fitness technologies satisfy or frustrate the users' basic psychological needs (BPNs) in exercise mediates the relationships between the users' goals for fitness technology use and psychological well-being and continuance. We find that users who start using fitness technologies for enjoyment, challenge, revitalization, affiliation, or to make positive improvements to their health or strength and endurance are more likely to report that the fitness technologies are satisfying their BPNs, whereas users who start using them for stress management, social recognition, competition, or weight management are more likely to report BPNs frustration. Notably, users who start using fitness technologies for enjoyment and to make positive improvements to their health or strength and endurance are less likely to report BPNs frustration, and use driven by social recognition goals can decrease BPNs satisfaction. BPNs satisfaction is associated with both increased psychological well-being and continuance, whereas BPNs frustration is negatively associated with both. Fitness technologies must thus be perceived by users to satisfy their BPNs (i.e., autonomy, competence, and relatedness) in exercise to ensure positive outcomes from use.

Keywords: continuance; fitness technologies; self-determination model of health behavior (SDMHB); self-determination theory (SDT); basic psychological needs (BPNs) theory; causality orientations theory; exercise goals; subjective vitality

Tabitha L. James is a Professor in the Pamplin College of Business at Virginia Tech. She holds a Ph.D. from the University of Mississippi in Management Information Systems. Her research interests include behavioral information privacy and security, psychological impacts of technology use, and analytics focused on the development of metaheuristics for combinatorial optimization problems. Her research has been published in leading information systems and operations research outlets such as *MIS Quarterly*, *Information Systems Research*, *Journal of Management Information Systems, Information Systems Journal, European Journal of Information Systems, European Journal of Operational Research*, *Information & Management*, and *IEEE Intelligent Systems*. She is a visiting professor at IÉSEG School of Management, France. She has served as an AE for ICIS and ECIS, as well as a mini-track chair and junior faculty consortium co-chair for AMCIS. She serves as an associate editor at the *European Journal of Information Systems* and *Decision Sciences Journal* and is also on the editorial review board of the *Journal of the Association for Information Systems*.

France Bélanger is University Disinguished Professor, R. B. Pamplin Professor, and Tom & Daisy Byrd Senior Faculty Fellow at Virginia Tech. Her research focuses on digital interactions between individuals, businesses, and governments and the related information security and privacy issues. Her award winning work has been published in leading journals, including *Information Systems Research, MIS Quarterly, European Journal for Information Systems, Journal of the Association for Information*

Systems, Journal of Strategic Information Systems, Information Systems Journal, and others. She received the 2008 IEEE Education Society Research Award, 2008 Hoeber Research Excellence Award, the 2013 INFORMS Design Science Award for Outstanding Research Stream, and the the 2020 Lifetime Academic Achievement Award from the International Institute for Applied Knowledge Management. She is or has been Senior Editor and Associate Editor for *MISQ, JAIS, ISR* and several others. Her work has been funded by agencies, research centers, institutes, and corporations, including the National Science Foundation. She was Fulbright Distinguished Chair in 2006 (Portugal), Erskine Fellow in 2009 (New Zealand), KoMePol-IT Fellow in 2017 (Germany), and Visiting Professorial Fellow from 2020 to 2023 (Australia).

Paul Benjamin Lowry is an Eminent Scholar and the Suzanne Parker Thornhill Chair Professor in Business Information Technology at the Pamplin College of Business at Virginia Tech. He received his Ph.D. in Management Information Systems from the University of Arizona and an MBA from the Marriott School of Management. He has published 140+ journal articles in *MISQ, ISR, JMIS, JAIS, ISJ, EJIS, Decision Sciences J.* and others. He is a department editor at *Decision Sciences J*. He also is an SE at *JMIS, JAIS* and *ISJ.* He has also served multiple times as track co-chair at *ICIS*, *ECIS*, and *PACIS*. His research interests include (1) organizational and behavioral security and privacy; (2) online deviance, online harassment, and computer ethics; (3) HCI, social media, and gamification; and (4) E-commerce, decision science, innovation and supply chains.

1. Introduction

Fitness technologies consist of a combination of wearables and applications (apps) designed to assist users' health and fitness regimes (James et al., 2019b). Typically, users buy a wearable (e.g., an Apple iWatch or Fitbit) and then pair the device with one or more health and fitness apps on their smartphones. For example, a user may pair an Apple iWatch with Apple's Activity app or a Fitbit with both the Fitbit app and Strava. The use of fitness technologies continues to increase; for example, the number of active Fitbit users has increased from just over a half-million in 2012 to more than 29 million in 2019 (Statista, 2020). Estimates suggest that the market for wearables will increase by 36 billion USD between 2019 and 2023, with this growth enabled in part by greater acceptance and demand resulting from an increasing number of apps that can be used in conjunction with the wearables (Brown, 2019). Fitness technologies provide exercisers with, among other features, the ability to collect and analyze their health and fitness data and integrate friends into their fitness routine through leaderboards, challenges, and data sharing.

With rising rates of obesity and obesity-related disease worldwide, compounded by increasingly sedentary lifestyles (World Health Organization, 2017), there is growing optimism that fitness technologies can be used to encourage people to increase positive health-related behaviors (e.g., exercise, diet) and thereby improve their well-being (Patel et al., 2015). Information systems (IS) researchers have only recently begun to study how fitness technologies are used and the effects of that use. A few recent IS studies examine how motivational drivers influence the use of fitness technology features (Hamari et al., 2018; James et al., 2019a). How fitness technology use (e.g., if exercise is socialized through the fitness technology) drives wellness outcomes (e.g., subjective vitality, life burnout) or IS continuance intentions is also a recently popular area of study (Hamari & Koivisto, 2015; James et al., 2019a; James et al., 2019b; Rockmann, 2019; Whelan & Clohessy, 2020). In these studies, fitness technology users are often differentiated based on their motivation toward exercise (e.g., obsessive or harmonious passion for exercise, intrinsic or extrinsic motivation to exercise) or by the features of the technology they employ (e.g., rewards, social competition, reminders).

These first IS studies on fitness technologies help researchers understand that users are not the same in

terms of motivational characteristics and thus their use and outcomes also differ. One explanation for these variations is that some features may be supportive of the users' basic psychological needs (BPNs) in exercise (autonomy, competence, and relatedness), whereas others are not (James et al., 2019a; James et al., 2019b; Rockmann, 2019). However, only limited empirical support shows that BPNs satisfaction or frustration can affect use outcomes; specifically, one study considers the role of the competence need in driving continuance (Rockmann, 2019). Moreover, studies that consider BPNs typically focus on how the functions fitness technologies offer map to them (e.g., James et al., 2019b; Rockmann, 2019). These studies do not consider that users' exercise goals for fitness technology use may affect whether users perceive fitness technologies to satisfy or frustrate their BPNs.

Because research continues to illuminate the many health benefits of exercise (e.g., Warburton & Bredin, 2017), it is increasingly encouraged. Consequently, the use of fitness technologies to assist exercise can be considered a health-related behavior. Motivational theorists suggest that to obtain better health outcomes, more attention needs to be paid to the motivations and experiences of people trying to follow recommended health behaviors (Ryan et al., 2008). Relatedly, they suggest that *self-determination theory* (SDT), a theory of human motivation, should be adapted to further understand health behaviors (Deci & Ryan, 2012b; Ryan et al., 2008). Drawing on SDT, Ryan et al. (2008) proposed the *self-determination model of health behavior* (SDMHB) for explaining health behaviors and outcomes. The conceptual SDMHB describes a general process through which people's environment, dispositional motivational orientations, and aspirations[1] influence the satisfaction of their BPNs, which is reflected in their health behaviors and outcomes (Ryan et al., 2008). We leverage the SDMHB as our theoretical foundation to propose and test a model to explain how human motivation assisted by fitness technologies influences continued use of fitness technologies (health behavior in our context) and the health outcome of well-being. Our model adopts the structure of the SDMHB but our operationalization for the fitness technology context differs from other models inspired by the SDMHB to study other health contexts (e.g., Ng et al., 2012).

[1] Aspirations are also referred to in the literature as goals, motives, and strivings.

Fitness technologies are environmental factors that users can employ to support their health and fitness regimes (James et al., 2019b). A core assumption of the SDMHB is that the motivational environment must support people's BPNs to achieve positive health behaviors and outcomes (Ryan et al., 2008). Specifically, the SDMHB posits that "environments that afford autonomy and support confidence are likely to enhance adherence and health outcomes" (Ryan et al., 2008). Supporting the need for relatedness is also crucial because environments that engender a sense of belongingness are likely to be perceived as supportive and can promote participation in activities (Frederick-Recascino, 2002). We thus surmise that for fitness technologies to successfully promote the well-being of their users, they must facilitate BPNs satisfaction. However, fitness technologies have only recently been employed in people's motivational environments and thus their effects on human motivation have not been well-studied.

Our premise is that users who adopt fitness technologies to help them work toward goals that lead to BPNs *satisfaction* will be more likely to adhere to positive health behaviors (e.g., continued use of fitness technologies) and derive health benefits (e.g., better psychological well-being). Conversely, users who adopt fitness technologies to help them work toward goals that lead to BPNs *frustration* will be less likely to report these positive outcomes from use. Although this premise draws heavily from the SDT literature, the logic is congruent with IS studies that explore how different types of motives can lead to improved continuance or increased behavioral intention to use technology, in some cases through satisfaction with the use experience (e.g., Bhattacherjee, 2001; Davis, 1989; Davis et al., 1992; Lee et al., 2005; Lowry et al., 2015; Lowry et al., 2013; Venkatesh, 2000). Our study is also consistent with IS research that has suggested that technology that is supportive of the BPNs may drive use and well-being outcomes (James et al., 2019a; James et al., 2019b; Karahanna et al., 2018; Rockmann, 2019).

People have varied goals they want to achieve through their exercise, from experiencing a challenge, making new friends, losing weight, to improving their health or appearance (Markland & Hardy, 1993; Markland & Ingledew, 1997). Fitness technologies can help with such goals by providing exercise challenges, connection to exercise friends or groups, and the tracking of personalized exercise and health information.

The SDMHB proposes that the intrinsic or extrinsic nature of people's goals can influence whether their BPNs are satisfied in a particular motivational environment (Ryan et al., 2008). We extend this premise by proposing that the intrinsic or extrinsic nature of the exercise goals that prompted the adoption of the fitness technologies can influence the BPNs satisfaction or frustration arising from fitness technology use. Although we use an existing set of exercise goals (Markland & Hardy, 1993; Markland & Ingledew, 1997), to the best of our knowledge, the influence of these goals on BPNs satisfaction and frustration has not been tested nor have the goals been used as a component of the SDMHB. Rather than studying the goals users hope to achieve from their exercise (e.g., exercise to improve health), we study the exercise goals that prompted the adoption of fitness technologies (e.g., started using fitness technologies to improve health).

We build on the SDMHB in two other notable ways to enhance our study of fitness technologies as environmental motivational supports. *First*, we explain how the users' exercise goals for fitness technology adoption relate to *both* BPNs satisfaction and frustration. The BPNs are defined in SDT, coopted in the SDMHB, and their satisfaction is essential for well-being (Deci & Ryan, 2012b; Ryan & Deci, 2002). Although BPNs satisfaction is central to SDT and understanding human motivation, a more recent development in SDT research is to consider BPNs frustration (Chen et al., 2015). Researchers argue that low BPNs satisfaction can undermine well-being by failing to foster people's growth potential, but that BPNs frustration can lead to more dire consequences such as ill-being or defensiveness (Chen et al., 2017; Vansteenkiste & Ryan, 2013). Consequently, exercise goals that increase BPNs frustration from fitness technology use are likely to be more problematic in terms of negatively shaping health behaviors and outcomes than those that decrease BPNs satisfaction. Fewer studies have considered both BPNs satisfaction and frustration (Bartholomew et al., 2011a; Bartholomew et al., 2011b; Chen et al., 2017; Rockmann, 2019; Vansteenkiste & Ryan, 2013) and none have done so using the SDMHB.

Second, we further leverage SDT to differentiate between groups of fitness technology users by causality orientations (Deci & Ryan, 1985; Deci & Ryan, 2012b). *Causality orientations* describe dispositional differences in the degree to which people experience or interpret their environment as informational, controlling, or amotivating (Deci & Ryan, 1985). People respond differently to controls

placed on their behavior and causality orientations help reveal these differences. Fitness technologies can be viewed as controls that users place in their motivational environment to help them manage their exercise goals. We propose that people with different causality orientations may experience fitness technology use differently. The three causality orientations map to the three types of motivational states described in SDT: autonomous, controlled, and impersonal (Deci & Ryan, 2012b). We thus separate users by their predominant causality orientation and test our model for each group.

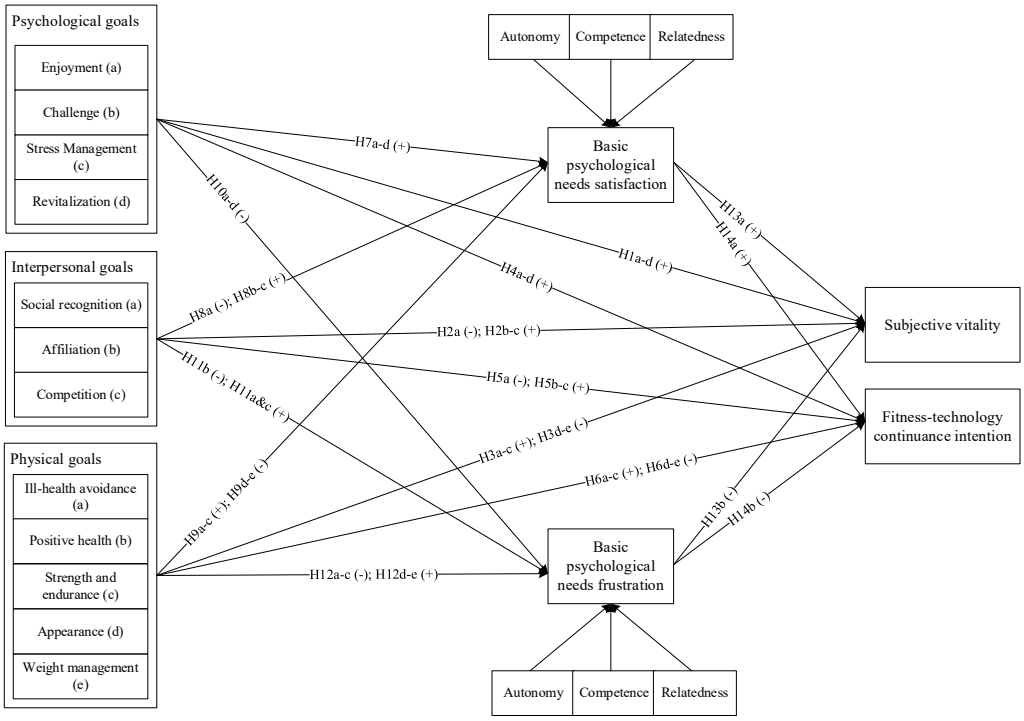
Fitness technologies have the potential to help individuals improve their lives, but only if how they do so can be identified and enhanced. Our model improves understanding of what users want fitness technologies to help them achieve and how those goals influence the effectiveness and longevity of the technology adoption through BPNs satisfaction and frustration. Specifically, three features of our model are unique: (1) it provides a robust set of exercise goals that prompt fitness technology adoption, (2) it explains how these goals influence both BPNs satisfaction and frustration from fitness technology use, and (3) it considers how the fitness technology adoption and use experience differs by causality orientation. Extending the work of IS researchers who introduced SDT concepts and subtheories to study fitness technologies (e.g., James et al., 2019a; James et al., 2019b; Rockmann, 2019), we focus on the understudied aspect of how the exercise goals for fitness technology adoption shape people's experience of BPNs satisfaction or frustration from fitness technology use.

2. Theoretical Foundation, Model, and Hypotheses

Figure 1 summarizes our model that leverages the SDMHB to study how exercise goals for fitness technology adoption influence continued use and well-being[2] for users through BPNs satisfaction and frustration. Next, we first formally introduce the SDMHB and the dependent variables (DVs): subjective vitality and fitness-technology continuance intention. We then hypothesize the relationships for our mediated SDMHB for fitness technologies.

[2] *Psychological well-being* is "a wide-ranging concept which embraces affective aspects of everyday experience" (Warr, 1978, p. 111). Motivation researchers commonly use subjective vitality as a measure of psychological well-being.

Figure 1. SDMHB Adapted to Study Fitness Technology Continuance and Well-being Outcomes



2.1. The Self-Determination Model of Health Behavior (SDMHB)

The SDMHB is a model developed by motivational theorists to leverage SDT research in health contexts, specifically to explain health behaviors and outcomes (Ryan et al., 2008). The SDMHB proposes that people's experiences of the BPNs are affected by (1) the supportiveness of the environment in which the activity takes place, (2) the intrinsic or extrinsic nature of the goals people want to achieve through performance of the activity, and (3) dispositional motivational differences. Furthermore, the SDMHB emphasizes that it is important that people's experiences of the BPNs are positive; that is, the BPNs are satisfied, because BPNs satisfaction is associated with better health behaviors and outcomes. Notably, Ng et al. (2012) found that the health studies they used in their meta-analysis rarely measured controlling environments, goals, or causality orientations. Instead, the studies primarily examined how autonomy supportive environments influenced BPNs satisfaction (e.g., Markland & Tobin, 2010; Vlachopoulos & Karavani, 2009).

What is not well-understood is how fitness technologies shape people's motivational experiences of their activities, which is the aim of our study. Our focus is on how employing fitness technologies as

environmental motivational supports shapes the motivational processes proposed in the SDMHB. To adapt the SDMHB for fitness technologies, we draw from the large body of SDT research to (1) explain the role of fitness technologies as environmental motivational supports for exercise, (2) discuss the set of exercise goals that drive adoption of fitness technologies we use in this study, and (3) introduce causality orientations that describe dispositional motivational differences. Moreover, we formally define and contextualize the BPNs and discuss the different effects of BPNs satisfaction and frustration. Our model differs from other studies in the health context (e.g., Ng et al., 2012) because we consider the effects of a technological motivational support added to the exercisers' environments. Our model also includes a broad set of exercise goals prompting fitness technology adoption, considers the role of both BPNs satisfaction and frustration resulting from fitness technology use, and examines the influence of causality orientations in shaping users' motivational experiences.

Factors in people's environments can support healthy functioning or they can undermine it (Ryan & Deci, 2002). Fitness technologies are factors that can be added to an exerciser's environment (James et al., 2019b) whose effect on motivation is not well understood. SDT proposes that environments that support people's BPNs can sustain activity engagement and support mastery versus those that frustrate people's BPNs, which tend to diminish motivation and well-being (Ryan & Deci, 2002). Fitness technologies are intended to provide motivational support to their users, and thus, James et al. (2019b) referred to fitness technologies as *environmental motivational supports*.[3] Fitness technologies are not needed to reach goals or perform exercise, but the exercisers are inserting the technologies into their exercise environment to help support their activity. There are three interdependent components to this context (1) the activity, which is the exercise; (2) the goals for that exercise (e.g., to lose weight or win a marathon); and (3) the fitness technologies, which are adopted to help manage the activity to achieve the goals.

According to SDT, the *goal content*[4] is the achievement that motivates people to perform an activity

[3] The *environment* consists of the factors (e.g., coach, Fitbit) intended to support the activity—in our case, exercise—toward specific goals. For example, users may be exercising toward goals of placing first in a marathon or losing five kilograms and use fitness technologies to support their progress toward such goals.

[4] Motivation researchers use the term *goal contents* to refer to *types of goals*. A specific achievement (e.g., losing weight) driving the performance of an activity (e.g., exercise) is the content of the goal. For clarity, we will use the term goal instead of goal content.

such as exercise (Frederick & Ryan, 1993; Markland & Ingledew, 1997; Ryan et al., 1997; Sebire et al., 2008). Researchers have studied how different goals affect well-being (e.g., vitality, self-actualization, depression, and undesirable physical symptoms), finding that extrinsic goals decrease it and intrinsic goals increase it (Kasser & Ryan, 1996). Kasser and Ryan (1993; 1996) studied general life goals such as financial success (money), social recognition (fame), and appealing appearance (image), which they classified as "extrinsic" because achievement of these goals is contingent on external rewards or approval. They classified goals such as affiliation (relatedness), physical fitness (health), and self-acceptance (growth) as "intrinsic" because such goals are "inherently valuable or satisfying to the individual, rather than being dependent on the contingent evaluations of others" (Kasser & Ryan, 1996, p. 281).

SDT explains that intrinsic goals lead to improved well-being because they satisfy people's BPNs (Deci & Ryan, 2012b; Ryan et al., 2008), which has been empirically supported (e.g., Sebire et al., 2009; Thøgersen-Ntoumani et al., 2010). Conversely, extrinsic goals tend to lead to "less well-being, more ill-being, and poorer performance, presumably because the extrinsic aspirations do not directly satisfy the basic needs, and indeed often crowd out or compromise their satisfaction" (Deci & Ryan, 2012b, p. 424). Researchers have also built on SDT to explore goals in the exercise context (Frederick & Ryan, 1993; Markland & Hardy, 1993; Markland & Ingledew, 1997; Ryan et al., 1997; Sebire et al., 2008). Exercise goals such as enjoyment, challenge, competition, positive health, weight management are appropriate for our context, but we are interested in the exercise goals that prompt the adoption of fitness technologies. We adopt the set of exercise goals developed by Markland & Ingledew (1997) in our model because they provide a comprehensive set of goals for exercise (see Table 1). We adapt the constructs slightly to determine the exercise goals that prompt the adoption of fitness technologies and call them *exercise goals for fitness technology use*.

Table 1 details exercise goals for fitness technology use and their definitions adapted to the fitness technology context, as well as the common expectation of their nature (intrinsic or extrinsic) drawn from the literature when available. Although attempts have been made to classify many goals as either intrinsic or extrinsic in nature, researchers have found it difficult to situate exercise goals accurately into this

Table 1. Summary of Exercise Goals* for Fitness Technology Use

Goal	*User started using his/her fitness technology to achieve the goal of…*	**Category**	**Nature**
Stress management	managing tension and stress	Psychological	Intrinsic
Revitalization	feeling invigorated or refreshed	Psychological	Unknown
Enjoyment	enjoyment and satisfaction	Psychological	Intrinsic
Challenge	meeting personal challenges, goals, and standards	Psychological	Intrinsic
Social recognition	demonstrating accomplishments, comparing abilities, & garnering recognition	Interpersonal	Extrinsic
Affiliation	socializing and making new friends	Interpersonal	Intrinsic***
Competition	competing with others	Interpersonal	Extrinsic
Health pressures	preventing or recovering from illness	Physical	Intrinsic
Ill-health avoidance	avoiding health problems	Physical	Intrinsic
Positive health	living a long and healthy life	Physical	Intrinsic
Strength and endurance	building strength and endurance	Physical	Intrinsic
Nimbleness**	staying or becoming more flexible & agile	Physical	Intrinsic
Appearance	improving appearance	Physical	Extrinsic
Weight management	controlling weight	Physical	Unknown

*We adapt the exercise goals developed in Markland & Ingledew (1997).
**Nimbleness is dropped due to scale issues and thus to simplify we do not include it in our hypotheses.
***Although some studies have described affiliation to be intrinsic in nature (e.g., Kasser & Ryan, 1996), Maltby & Day (2001) categorize it as extrinsic along with social recognition and affiliation.

dichotomous categorization (Markland & Ingledew, 1997).[5] Consequently, Markland & Ingledew (1997) grouped conceptually related exercise goals together into five categories based on the *focus* of the goal: psychological, interpersonal, health, body-related, and fitness goals. In Table 1, we provide Markland & Ingledew's (1997) categories but we group health, body-related, and fitness goals into an upper-level category we call *physical*.[6] We use these three goal categories to organize our hypotheses.

Working toward the achievement of intrinsic goals is thought to be BPNs satisfying (Kasser & Ryan, 1996) whereas working toward goals that require external approval and rewards to achieve are not likely to satisfy the BPNs and have been shown to decrease psychological health (Hope et al., 2019). We contextualize the BPNs to examine users' perceptions that their fitness technologies satisfy or frustrate their needs for autonomy, competence, and relatedness. The need for *autonomy* "refers to being the perceived origin or source of one's own behavior" (Ryan & Deci, 2002, p. 8). We thus consider if the users perceive

[5] The psychological goals are consistently described as intrinsic in the literature and found to result in positive outcomes (Maltby & Day, 2001; Markland & Ingledew, 1997; Sebire et al., 2009); however, interpersonal and physical goals for exercise have been, at least in part, considered both intrinsic and extrinsic and have resulted in mixed outcomes (Ednie & Stibor, 2017; Ingledew & Markland, 2008; Mailey et al., 2018; McLachlan & Hagger, 2010; Pope & Harvey, 2015; Rahman et al., 2018; Sibley & Bergman, 2016).
[6] There are slight variations in the goals considered and the groups created across exercise goal content studies (Frederick & Ryan, 1993; Markland & Ingledew, 1997; Ryan et al., 1997); our groups are created to encapsulate the similarities.

that their fitness technologies help provide an experience of self-determination and volition when performing their exercise activities (*autonomy satisfaction*). Conversely, we also examine if the users perceive that their fitness technologies make them feel like their exercise is being controlled through externally enforced measures (*autonomy frustration*). Our contextualized definitions for autonomy, competence, and relatedness satisfaction follow the generalized ones given by Chen et al. (2015) but we have modified them for a specific activity, exercise, and with a specific environmental factor, fitness technologies, as the source of the BPNs satisfaction or frustration.

The need for *competence* "refers to feeling effective in one's ongoing interactions with the social environment and experiencing opportunities to exercise and express one's capacities" (Ryan & Deci, 2002, p. 7). We thus consider if the users perceive that their fitness technologies help them feel capable of achieving their desired exercise outcomes (*competence satisfaction*), or conversely, cause feelings of failure or doubts of exercise efficacy (*competence frustration*). Finally, the need for *relatedness* "refers to feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one's community" (Ryan & Deci, 2002, p. 7). We thus consider if the users perceive that their fitness technologies help them feel cared for, respected, understood, and genuinely connected to others (*relatedness satisfaction*), or conversely, make them feel excluded or lonely (*relatedness frustration*).

Researchers acknowledge the importance of examining BPNs frustration rather than simply considering low need fulfilment (i.e., low reported BPNs satisfaction) (Bartholomew et al., 2011a; Chen et al., 2015; Ryan et al., 2006a; Vansteenkiste & Ryan, 2013). Although the role of BPNs satisfaction in motivational outcomes has been well-established in SDT (Ryan & Deci, 2002), the consideration of BPNs frustration is newer to the SDT literature (Chen et al., 2015). However, BPNs satisfaction leads to positive psychological and physical outcomes (e.g., vitality, life satisfaction) whereas BPNs frustration results in negative outcomes (e.g., depression, exhaustion, disordered eating) and can even decrease positive outcomes (e.g., life satisfaction) (Bartholomew et al., 2011a; Bartholomew et al., 2011b; Chen et al., 2015). Moreover, the addition of a controlling environmental factor (e.g., athletic coach) can result in BPNs frustration

(Bartholomew et al., 2011a). In our context, it is useful to consider the drivers of both BPNs satisfaction and frustration because the results could provide insight into circumstances that result in fitness technology use being counterproductive.

SDT posits that there are individual differences in how people respond to environmental factors and refer to these differences as causality orientations (Deci & Ryan, 2012b; Ryan & Deci, 2002). People who are oriented toward perceiving environmental factors as controlling or demanding may have different experiences with fitness technologies than those who are oriented toward perceiving environmental factors as autonomy-supporting or informational, for example. We study individual differences in how people respond to environmental factors for the three distinct groups of users: those with dominant autonomous, controlled, and impersonal causality orientations.

The *autonomous orientation* refers to "regulating behavior on the basis of interests and self-endorsed values; it serves to index a person's general tendencies toward intrinsic motivation and well integrated extrinsic motivation" (Ryan & Deci, 2002, p. 21). The *controlled orientation* "involves people's behavior being organized with respect to controls either in the environment or inside themselves" (Deci & Ryan, 1985, p. 112). Individuals who are control-oriented seek out extrinsic controls, rely on such controls to motivate their activity, and have a tendency to view events as controlling (Deci & Ryan, 1985). The *impersonal orientation* "involves focusing on indicators of ineffectance and not behaving intentionally; it relates to amotivation and lack of intentional action" (Ryan & Deci, 2002, p. 21). We categorize exercisers by their dominant causality orientation (Koestner & Zuckerman, 1994) and conduct an analysis of our model for each of the categories.

2.2. Well-Being and Continuance

Two primary outcomes are of interest to both developers and users of fitness technologies. First, the general aim of fitness technologies is to help improve the well-being of the people who use them. Thus, one of our DVs is *subjective vitality*, which is an indicator of psychological well-being (Ryan & Frederick, 1997). There are two different forms of psychological well-being described in the motivation literature: hedonic and eudaimonic. *Hedonic well-being* generally equates to happiness, whereas *eudaimonic well-being* refers

to an individual's functioning (Ryan & Deci, 2001; Ryan & Deci, 2002). SDT researchers often consider eudaimonic well-being, because prior research has established a link between it and BPNs satisfaction (Ryan & Deci, 2002). *Subjective vitality*, a common measure of eudaimonic well-being, is defined as "a positive feeling of aliveness and energy" (Ryan & Frederick, 1997). It results from BPNs satisfaction, is an important health indicator, and "provides the necessary energy for effective self-regulation and coping with challenges" (Deci & Ryan, 2012b, p. 427).

Second, for fitness technologies to successfully serve as environmental motivational supports, users must continue to use them. Thus, as a second DV, we leverage fitness-technology continuance intention, an outcome of key interest to IS researchers. Fitness motivation researchers have studied exercise participation and adherence using SDT and its subtheories (Ryan et al., 1997; Teixeira et al., 2012) and fitness-technology-continuance is a similar health-related behavior. IS researchers have also relied on motivation theory to explore system use and continuance (Lowry et al., 2015; Lowry et al., 2013; Roca & Gagné, 2008). We expand on this body of research to explain continuance in the fitness technology context.

2.3. Exercise Goals for Fitness Technology Use and Subjective Vitality

Intrinsic aspirations such as self-acceptance, affiliation, community feeling, and physical health are positively associated with psychological well-being, specifically subjective vitality (Kasser & Ryan, 1996; 2001; Kim et al., 2003). SDT researchers commonly explain that goals that are intrinsic in nature lead to the satisfaction of the BPNs, which results in positive well-being and behavioral outcomes (Deci & Ryan, 2012b; Kasser & Ryan, 2001; Sheldon & Kasser, 1998; Vansteenkiste et al., 2004b). Although research has not shown how exercise goals for fitness technology use influence subjective vitality or continuance, research provides insight into how traditional exercise goals drive such outcomes. Specifically, psychological goals for exercise are positively associated with psychological well-being (Maltby & Day, 2001). Using the exercise goals developed by Ryan et al. (1997), James et al. (2019a) found that individuals with enjoyment and competence goals for exercise report higher levels of subjective vitality. These findings suggest that the psychological goals for fitness technology use may be positively associated with subjective vitality. Given that the psychological goals have been consistently described as intrinsic in nature, we

propose a positive association between them and subjective vitality.

> H1. Psychological goals of fitness technology use—(a) *enjoyment*, (b) *challenge*, (c) *stress management*, and (d) *revitalization*—are positively associated with *subjective vitality*.

Goals that have external contingencies, such as recognition from others or material rewards, have a negative effect on well-being and are associated with negative behaviors such as drug use and watching more television (Kasser & Ahuvia, 2002; Kasser & Ryan, 1993; 1996; 2001). Aspiring to be wealthy, famous, admired, or attractive to others are all contingent on being socially or materially rewarded (Kasser & Ryan, 1996; 2001). Appearance and weight goals may similarly be undertaken to obtain social approval (Ingledew et al., 2009). Kasser & Ryan (1996) offer three explanations for the detrimental effect of extrinsically focused goals, including socioeconomic disadvantage, the possibility that extrinsic goals are harder to achieve, and that extrinsic goals cause people to focus on controlled, ego-involved behaviors.

The results of studies on the relationships between interpersonal exercise goals and well-being are mixed. Maltby & Day (2001) suggest the interpersonal exercise goals are extrinsic and found that they result in lower self-esteem and increased anxiety and depression. Conversely, interpersonal goals have also been associated with intrinsic regulation (Ingledew & Markland, 2008). Social interaction enabled through fitness technologies encourages exercise (Boratto et al., 2017) and positively interacts with some types of exercise motivations to enhance subjective vitality (James et al., 2019b). However, James et al. (2019a) found social exercise goals are not significantly associated with subjective vitality. Although the social exercise goals are not directly related to subjective vitality in their model, James et al. (2019a) found that the use of the social features of fitness technologies (e.g., competition, encouragement, and comparison) are positively associated with subjective vitality.

Physical exercise goals have also been difficult to characterize as intrinsic or extrinsic. For example, health, appearance, fitness, and weight have all been described as extrinsic (Ingledew & Markland, 2008; Mailey et al., 2018; McLachlan & Hagger, 2010; Pope & Harvey, 2015; Ryan et al., 1997). However, health and fitness goals have also been considered to be intrinsic (Kasser & Ryan, 1996; 2001; McLachlan & Hagger, 2011). In one study that tested the relationships been appearance and fitness exercise goals and

subjective vitality, the results were not significant (James et al., 2019a). In terms of their effect on behavioral outcomes, health, weight management, fitness, affiliation, competition, enjoyment, stress management have all been found to positively predict physical activity (Ednie & Stibor, 2017; Rahman et al., 2018; Sibley & Bergman, 2016).

In summary, there is support for the assertion that affiliation and competition (interpersonal goals), as well as ill-health avoidance, positive health, and strength and endurance (physical goals) are intrinsic in nature and thus may be positively associated with subjective vitality. Finally, social recognition (interpersonal goal), appearance, and weight management (physical goals) are often described as extrinsic in nature, and we propose a negative relationship between them and subjective vitality. In summary,

> H2. Interpersonal goals of fitness technology use—(a) *social recognition*, (b) *affiliation*, and (c) *competition*—are negatively (a) and positively (b & c) associated with *subjective vitality*.

> H3. Physical goals of fitness technology use—(a) *ill-health avoidance*, (b) *positive health*, (c) *strength and endurance*, (d) *appearance*, and (e) *weight management*—are negatively (d and e) and positively (a–c) associated with *subjective vitality*.

2.4. Exercise Goals for Fitness Technology Use and Continuance Intention

Using fitness technologies to support health and fitness can be considered a positive health-related behavior. Research on positive health-related behaviors such as physical activity or fitness technology feature use provides some insight into how goal content might affect fitness-technology continuance intention. Goals such as health, affiliation, and challenge increase exercise satisfaction, amount, and intention through autonomous regulation (i.e., intrinsic motivation) (Ingledew et al., 2014). Another study found that people focused on the goals of improved fitness and health are more likely to maintain weight loss than those focused on physical attractiveness or beauty (Vansteenkiste et al., 2005a). Sibley & Bergman (2016) similarly found health management and skill development to predict intrinsic regulation and indirectly, through intrinsic regulation, physical activity. Notably, this study also found that image and social recognition do not have an indirect effect on physical activity but are associated with *introjected regulation*, which is a motivational form characterized by guilt and ego-enhancement. Moreover, people who place more emphasis on extrinsic goals like wealth, image, fame than intrinsic goals like community,

relationships, growth have a tendency to engage in riskier health behaviors such as smoking and drug use (Williams et al., 2000).

The IS literature provides similar insight regarding intrinsic and extrinsic motives for use and continuance. Davis et al. (1992) described usefulness, which is a core component of the technology acceptance model in IS (Davis, 1989), as an extrinsic motive.[7] Similarly, Van der Heijden (2004) found enjoyment and usefulness to be predictors of behavioral intention to use hedonic information systems. Other IS researchers have also advocated for the consideration of both intrinsic and extrinsic motives in models of use or continuance (Lowry et al., 2015; Lowry et al., 2013; Venkatesh, 2000). Extending TAM for hedonic systems, Lowry et al. (2013) considered usefulness as an extrinsic motive but replaced enjoyment with cognitive absorption, which includes enjoyment but also control, curiosity, and immersion. Their findings revealed that joy and curiosity, in addition to usefulness, predict behavioral intention to use hedonic systems. These results further suggest that goals of an intrinsic nature are likely to predict continuance. However, they also suggest that extrinsic goals may drive continuance in some cases.

As with the previous hypotheses, we follow the literature in the exercise domain to propose that goals for fitness technology use that are described as intrinsic (extrinsic) in nature are positively (negatively) associated with fitness-technology continuance intention. Specifically, we propose all the psychological goals, affiliation, competition, ill-health avoidance, positive health, and strength and endurance are positively associated with continuance, whereas social recognition, appearance, and weight management are negatively associated with it.

H4. Psychological goals of fitness technology use—(a) *enjoyment*, (b) *challenge*, (c) *stress management*, and (d) *revitalization*—are positively associated with fitness-technology *continuance intention*.

H5. Interpersonal goals of fitness technology use—(a) *social recognition*, (b) *affiliation*, and (c) *competition*—are negatively (a) and positively (b & c) associated with fitness-technology *continuance intention*.

[7] By defining *usefulness* as "a person's expectation that using the computer will result in improved job performance" (Davis et al., 1992, p. 1112), they argued that it could be considered an extrinsic motive because the user is pursuing a separable outcome that is valued (i.e., improved job performance). Davis et al. (1992) examined usefulness as an extrinsic motive and enjoyment as an intrinsic one and found both to positively predict intention to use business software.

H6. Physical goals of fitness technology use—(a) *ill-health avoidance*, (b) *positive health*, (c) *strength and endurance*, (d) *appearance*, and (e) *weight management*—are negatively (d & e) and positively (a–c) associated with fitness-technology *continuance intention*.

2.5. The Mediating Influence of Basic Psychological Needs (BPNs)

The SDMHB proposes that BPNs satisfaction is necessary for the (1) environment, (2) causality orientations, and (3) goals to lead to positive health-related behaviors and outcomes (Deci & Ryan, 2008). We follow the SDMHB in emphasizing the mediating role of BPNs satisfaction and frustration. Although the SDMHB has been operationalized in varying ways, studies provide support for the mediating role of BPNs satisfaction (Sebire et al., 2009; Thøgersen-Ntoumani et al., 2010). For example, individuals who have intrinsic goals for exercise have their BPNs satisfied and thus experience positive outcomes (Gunnell et al., 2014; Sebire et al., 2009).

The mediating role of BPNs satisfaction has been explored (Sebire et al., 2009; Thøgersen-Ntoumani et al., 2010), but BPNs frustration has received scant attention (Chen et al., 2015). However, BPNs frustration is associated with increased depressive symptoms and decreased life satisfaction (Bartholomew et al., 2011a; Chen et al., 2015), as well as positively associated with increased disordered eating (Bartholomew et al., 2011a). Studies in the sport context also found that need frustration is positively associated with exhaustion and negative affect and negatively associated with subjective vitality (Bartholomew et al., 2011b; Gunnell et al., 2013). Conversely, BPNs satisfaction is typically positively associated with well-being (i.e., life satisfaction, positive affect, and subjective vitality) (Bartholomew et al., 2011a; Chen et al., 2015; Gunnell et al., 2014; Gunnell et al., 2013; Gunnell et al., 2011). These results suggest that BPNs satisfaction and frustration are necessary elements in the etiology of positive health-related outcomes.

2.5.1. Exercise Goals for Fitness Technology Use and the BPNs

Goals that are intrinsic in nature result in BPNs satisfaction (Sebire et al., 2009).[8] These findings suggest

[8] For example, Sebire et al. (2009) considered health management, skill development, and social affiliation goals for exercise to be intrinsic in nature, whereas social recognition and image were considered extrinsic in nature. They created a measure of *intrinsic goal content* by subtracting the extrinsic exercise goals from the intrinsic ones and found it to be positively associated with BPNs satisfaction. Similarly, Gunnell et al. (2014) found intrinsic goals to be positively associated with BPNs satisfaction through autonomous motivation. The intrinsic goals of health management, skill development, and social affiliation have also been found

that the psychological goals for fitness technology use are likely to be positively associated with BPNs satisfaction because these goals (e.g., enjoyment, challenge) are described as having an intrinsic focus. Evidence suggests that the social recognition goal (interpersonal) and the appearance and weight management goals (physical) are negatively related to BPNs satisfaction because of their extrinsic focus. However, the other interpersonal and physical goals are more intrinsically focused (e.g., health, affiliation) and are likely to lead to BPNs satisfaction. We thus propose that all the goals for fitness technology use are positively associated with BPNs satisfaction except for social recognition, appearance, and weight management, which are negatively associated with BPNs satisfaction.

H7. Psychological goals of fitness technology use—(a) *enjoyment*, (b) *challenge*, (c) *stress management*, and (d) *revitalization*— are positively associated with users' exercise *BPNs satisfaction*.

H8. Interpersonal goals of fitness technology use—(a) *social recognition*, (b) *affiliation*, and (c) *competition*—are negatively (a) and positively (b & c) associated with users' exercise *BPNs satisfaction*.

H9. Physical goals of fitness technology use—(a) *ill-health avoidance*, (b) *positive health*, (c) *strength and endurance*, (d) *appearance*, and (e) *weight management*—are negatively (d & e) and positively (a–c) associated with users' exercise *BPNs satisfaction*.

Researchers have begun to explore how exercise goals and BPNs are linked to the use of specific features of fitness technologies. Using fitness technologies for self-monitoring purposes reduces competence frustration, whereas their use for rewards or social recognition increases it (Rockmann, 2019). These results reflect feature use rather than goals from fitness technology use but research has also found that the exercise goals users have determine the features they use (James et al., 2019a). Discussions in the SDT literature suggest that not all goals result in positive outcomes and moreover that goals can be framed in ways that produce better or worse outcomes. Ryan & Deci (2002, p. 8) state that "although people may formulate motives or strivings to satisfy [BPNs], it is clear that there are many motives that do not fit the criterion of being essential to well-being and may, indeed, be inimical to it." The SDT literature suggests

to be positively related to greater satisfaction of the competence and relatedness needs, but not the autonomy need (Sebire et al., 2008). Health goals were also found to be positively associated with BPNs satisfaction in a study of body image concerns (Thøgersen-Ntoumani et al., 2010), and intrinsic goals were found to be positively associated with BPNs satisfaction in a study of CrossFit athletes (Sibley & Bergman, 2018).

that *how* goals are framed affects outcomes. That is, focusing individuals on a goal of improving health produces better outcomes than focusing individuals on a goal of becoming more attractive to others (Vansteenkiste et al., 2005a). Becoming more attractive is framing the goal with an extrinsic focus, whereas a goal of improved health is intrinsic in nature.

It is suggested that "vigorous pursuit of extrinsic goal contents is theorized to be less directly satisfying of the [BPNs]" (Vansteenkiste et al., 2004a, p. 246). In their study, Vansteenkiste et al. (2004a) found that framing content or context of tasks in ways that are BPNs supportive leads to better learning-outcomes, and specifically, they used money and image as extrinsic goals and community, growth, and health as intrinsic. Together, these results suggest that the goals that drive user's adoption of fitness technologies could distinctly affect both BPNs satisfaction and frustration. Although the relationships between exercise goals and BPNs frustration has received less attention in the literature, it is within the scope of SDT to propose that goals that are intrinsic in nature may reduce the likelihood of BPNs frustration. The psychological goals are consistently considered to be intrinsic in nature and thus we propose that they are negatively associated with BPNs frustration.

H10. Psychological goals of fitness technology use—(a) *enjoyment*, (b) *challenge*, (c) *stress management*, and (d) *revitalization*—are negatively associated with users' exercise BPNs frustration.

Some researchers argue that investing in more extrinsically focused goals can frustrate a person's BPNs (Vansteenkiste & Ryan, 2013). Vansteenkiste et al. (2008, p. 388) state "although extrinsic goal pursuit might provide some satisfaction, this type of satisfaction is likely to be derivative and short lived, because extrinsic goal pursuits do not directly satisfy individuals' [BPNs]." Reis et al. (2000, p. 421) describe how people who are satisfied with their interpersonal relationships are healthier and happier, but that "it is unclear just what sort of social activities contribute to these perceptions." In setting up their study, they identified several types of social activities that could contribute to relatedness satisfaction, such as talking to others about meaningful topics, spending time with friends, participating in activities with others, feeling appreciated or understood by others, participating in enjoyable activities, and avoiding situations rife with conflict or that might stimulate self-consciousness or insecurity (Reis et al., 2000). This illustrates that

whether social interactions are helpful may depend on how they make a person feel, which suggests that if a person who is driven by interpersonal goals for fitness technology use feels the fitness technologies provide an affiliative environment, then positive outcomes may result. Alternatively, if a person adopts a fitness technology to compete with others and the competitions make him or her feel inadequate or insecure, then he or she may experience decreased psychological well-being or discontinue use.

Reis et al. (2000) found that enjoyable social activities, meaningful conversations, and feeling understood are positively related to the satisfaction of relatedness, whereas feeling insecure or self-conscious are negatively related. Therefore, interpersonal uses of fitness technologies can produce feelings of affiliation or belongingness (i.e., BPNs satisfaction), or alternatively, self-consciousness or insecurity (i.e., BPNs frustration). In distinguishing between low BPNs satisfaction and BPNs frustration, (Vansteenkiste & Ryan, 2013, p. 264) state that

> "one might feel low relatedness to colleagues in one's workplace and thus have less vitality and excitement for work. But one can also be actively rejected or excluded by coworkers, in which case one may suffer from depression or severe symptoms of stress."

This suggests that the interpersonal goals for fitness technology use such as affiliation can positively drive BPNs satisfaction, but that social recognition and competition could lead to BPNs frustration if the information provided by these activities is interpreted negatively (e.g., the user performs poorly in competitions). Social recognition is typically considered extrinsic in nature and therefore should be negatively related to BPNs satisfaction and positively related to BPNs frustration. Competition, however, may depend on the results and thus could result in BPNs satisfaction (e.g., if the user wins) and BPNs frustration (e.g., if the user loses).

Similar logic applies to the physical goals. For example, Ingledew et al. (2009, p. 337) state that: "health goals may have both intrinsic (attaining a positive state of well-being) and extrinsic qualities (avoiding health problems)." In fact, health goals are positively associated with BPNs satisfaction (Thøgersen-Ntoumani et al., 2010). Appearance and weight goals are typically argued to be extrinsic in nature (Ingledew et al., 2009), but image goals, which are closely related, are not significantly associated positively or negatively with BPNs satisfaction (Thøgersen-Ntoumani et al., 2010). Similarly, a study found that body-

related (i.e., physical) motives are not significantly related to perceptions of satisfaction or competence (Frederick & Ryan, 1993). Sebire et al. (2008) also found image and social recognition goals to be insignificantly related to BPNs satisfaction. These findings indicate that users who focus their fitness technology use on health-related goals may perceive fitness technologies to be BPNs satisfying; by contrast, users who focus their fitness technology use on appearing more physically attractive to others may perceive them as BPNs frustrating. We thus propose that the interpersonal goals of social recognition, competition, as well as the physical goals of appearance and weight management are positively related to BPNs frustration. We propose that affiliation (interpersonal goal), ill-health avoidance, positive health, and strength and endurance (physical goals) are less likely to result in BPNs frustration.

H11. Interpersonal goals of fitness technology use—(a) social recognition, (b) affiliation, and (c) competition—are negatively (b) and positively (a & c) associated with users' exercise *BPNs frustration*.

H12. Physical goals of fitness technology use—(a) ill-health avoidance, (b) positive health, (c) strength and endurance, (d) appearance, and (e) weight management—are negatively (a–c) and positively (d & e) associated with users' exercise *BPNs frustration*.

2.5.2. BPNs Satisfaction, Well-Being, & Continuance Outcomes

BPNs satisfaction is empirically linked to a host of positive outcomes such as increased engagement, self-esteem, physical self-worth, and psychological *well-being* (i.e., vitality, satisfaction with life, and positive affect) (Bartholomew et al., 2011a; Bartholomew et al., 2011b; Chen et al., 2015; Deci & Ryan, 2012a; Gunnell et al., 2014; Gunnell et al., 2013; Sebire et al., 2009; Sheldon & Niemiec, 2006). BPNs satisfaction is also related to reduced exercise anxiety, general anxiety, negative affect, burnout, and ill-being (Bartholomew et al., 2011a; Deci et al., 2001; Hodge et al., 2008; Perreault et al., 2007; Sebire et al., 2009; Unanue et al., 2014). For example, Deci et al. (2001) found BPNs satisfaction results in increases in engagement and self-esteem, and decreases in anxiety. Researchers also found that BPNs satisfaction is integral to daily well-being (Reis et al., 2000). Another study used diaries to study the relationship between well-being and the satisfaction of competence and autonomy needs and found that on the days individuals perceived that they were more autonomous and competent in their activities, they reported better well-being in terms of mood and vitality (Sheldon et al., 1996).

In exercise contexts that do not involve fitness technologies, BPNs satisfaction is positively associated with both positive affect and subjective vitality (Adie et al., 2012; Bartholomew et al., 2011b; Gunnell et al., 2014; Gunnell et al., 2013; Wilson et al., 2006; Wilson et al., 2008). BPNs satisfaction mediates the relationship between leisure time physical activity and eudaimonic well-being (Gunnell et al., 2011). Perceived support for autonomy and relatedness is associated with health and subjective vitality (Kasser & Ryan, 1999). Gunnell et al. (2014) found that satisfaction of the need for competence results in increases in physical activity, vitality, and positive affect, whereas satisfaction of the relatedness need results in increases in vitality and positive affect. SDT proposes, and research findings corroborate, that "the basic needs for competence, autonomy, and relatedness must be satisfied across the life span for an individual to experience an ongoing sense of integrity and well-being or 'eudaimonia'" (Ryan & Deci, 2000, p. 74-75).

In discussing how BPNs frustration can lead to ill-being, problems maintaining self-control, and other issues, Vansteenkiste & Ryan (2013, p. 274) state that "what is remarkable is that the same basic needs, the frustration of which portends pathology, are harbingers of wellness and eudaimonia when satisfied." Although BPNs frustration has not been extensively studied, some results indicate that detrimental outcomes can occur if BPNs are frustrated. For example, BPNs frustration can result in decreased life satisfaction and increased depressive symptoms (Chen et al., 2015). Moreover, BPNs frustration is positively associated with depression, eating disorders, burnout, and negative affect (Bartholomew et al., 2011a). In another study, results indicated that BPNs frustration is negatively related to subjective vitality and positively related to exhaustion (Bartholomew et al., 2011b). We thus propose that if users perceive the fitness technologies to be BPNs frustrating, they will report lower levels of subjective vitality, whereas if they are seen to be BPNs satisfying users will report higher levels of subjective vitality.

H13a. Users' exercise *BPNs satisfaction* is positively associated with *subjective vitality*.

H13b. Users' exercise *BPNs frustration* is negatively associated with *subjective vitality*.

Perceived autonomy, competence, and relatedness support have been linked to both technology continuance intention (Roca & Gagné, 2008) and exercise continuance (Vlachopoulos & Michailidou, 2006). A study in the exercise context found that competence is associated with effort, leisure time physical

activity, and intention to be more physically active (Taylor et al., 2010). McDonough & Crocker (2007) found that satisfaction of the competence need is associated with more physical activity and increased self-worth, whereas satisfaction of the relatedness need is associated with positive affect. Satisfaction of the relatedness need is a key predictor of persistence in exercise (Edmunds et al., 2007), and autonomy and competence are related to leisure walking behavior (Niven & Markland, 2016). Competence support is an important driver of physical activity (Milne et al., 2008; Vlachopoulos & Michailidou, 2006). Body image concerns that lead to unhealthy weight control behaviors can be reduced through BPNs satisfaction (Thøgersen-Ntoumani et al., 2010). Environments that are supportive of individuals' autonomy can reduce risky behaviors (Williams et al., 2000).

In the IS literature, BPNs satisfaction as an antecedent of a modified technology acceptance model is instrumental in the continued use of e-learning technology (Roca & Gagné, 2008; Sørebø et al., 2009). Ke & Zhang (2010) considered the role of the BPNs in how much effort and intensity open-source software developers exert, and they found the satisfaction of the BPNs moderates the relationships between different forms of extrinsic motivation and task effort. Autonomy and relatedness needs in an SDT-based model of the use of enterprise systems influence enterprise system exploratory usage and exploration satisfaction through two different intrinsic motivations (Ke et al., 2013). Other studies have linked similar concepts related to intrinsic motivation, such as joy and control, and extrinsic motivation to the intention to use video games or mixed-motive systems (Lowry et al., 2015; Lowry et al., 2013). The BPNs are associated with future video game play (Ryan et al., 2006b). Motivational concepts have also been studied in relation to knowledge sharing on social Q&A sites (Zhao et al., 2016), crowdsourcing participation (Leimeister et al., 2009), and engagement in corporate wikis (Arazy & Gellatly, 2012). BPNs are linked to knowledge sharing behaviors in virtual communities (Yoon & Rolland, 2012). Thus, motivation in general and the BPNs specifically are associated with technology use and continuance.

Accordingly, we posit that users who find their fitness technologies satisfy their BPNs will continue to use them. Likewise, users who find their fitness technologies frustrate their BPNs will discontinue use. There are fewer results linking BPNs frustration to health-related behaviors. However, one study found that

"perceived thwarting behaviors provided by significant others (i.e., fitness instructors) predicted higher levels of [BPNs] frustration," which suggests "that the contextual environment has the ability to predict how someone will experience [BPNs] satisfaction or frustration" (Rodrigues et al., 2019, p. 4). Moreover, Rodrigues et al. (2019) found that BPNs frustration directly and indirectly influences intention to exercise. Bartholomew et al. (2011a) also showed that BPNs frustration is positively associated with eating disorders, which is a negative health-related behavior. Another fitness technology study revealed that satisfaction of the competence need is positively associated with continuance intention, whereas competence frustration is not significantly related to it (Rockmann, 2019). These findings provide support for our proposition that BPNs frustration is negatively associated and BPNs satisfaction positively associated with fitness-technology continuance intention.

H14a. Users' exercise *BPNs satisfaction* is positively associated with fitness-technology *continuance intention*.

H14b. Users' exercise *BPNs frustration* is *negatively* associated with fitness-technology *continuance intention*.

3. Methodology

3.1. Scale Development and Pilot Testing

To develop our survey, we carefully adapted or used existing scales. To include goals driving adoption of fitness technologies, we adapted items from Markland & Ingledew (1997), who developed the exercise motivations inventory (EMI-2). We adapted the BPNs satisfaction and frustration scales from Chen et al. (2015) to measure these in contextualized form for users' fitness technologies. We used the subjective vitality scale from Bostic et al. (2000); Ryan & Frederick (1997) and the exercise causality orientations scale from Rose et al. (2001); Rose et al. (2005) without modification. To measure fitness-technology continuance intention, we modified the associated scale from Bhattacherjee (2001); Zhou et al. (2012). We followed accepted procedural methods for adapting the scales to increase the likelihood of content and construct validity (Churchill Jr, 1979; MacKenzie et al., 2011). The full survey is provided in Appendix A.

After the careful scale adaptation, we conducted a pilot test using 144 complete and valid responses from Amazon's Mechanical Turk (MTurk). Statistical analysis of the pilot data revealed that the

instrumentation provided the expected results, with minor corrections; thus, we proceeded with the full data collection.

3.2. Final Data Collection

The survey was implemented using the Qualtrics™ online survey software. The responses were voluntarily obtained from MTurk, which has been found to be a reliable source of data, assuming that reasonable data-quality controls, such as those we took, are used (Buhrmester et al., 2011; Lowry et al., 2016a; Mason & Suri, 2012; Steelman et al., 2014). Respondents were paid a small amount for their time and were assured of their anonymity. Anonymity helped disincline the respondents from answering in ways biased by their perceptions of the researchers' expectations or in a socially desirable manner.

We collected 955 total responses for the full data collection, only allowing US-based respondents. There were 29 people who initiated the survey but did not pass the filter questions.[9] We also employed *attention traps* (also in Appendix A) to identify respondents who were not fully cognitively engaged in taking the survey. Prior studies have found that the proper use of this technique improves data quality (Lowry et al., 2016a; Oppenheimer et al., 2009). Individuals who did not pass the filter questions or incorrectly answered an attention trap item were not allowed to complete the survey, and therefore, their responses were removed. After applying these data-quality procedures, our final sample included 670 responses. The demographic and technical characteristics of the sample are provided in Tables 2 and 3.

Table 2. Demographic Information of the Sample (n = 670)

Age distribution		**Gender**		**Employment**		**Education**	
18–21 yrs.	6	Male	404	Employed full time	569	Grade school (K–8th grade)	2
22–24 yrs.	52	Female	266	Employed part time	58	High school or equivalent (e.g., GED)	49
25–27 yrs.	83			Not employed	43	Some college credit, no degree	94
28–30 yrs.	156					Trade/technical/vocational training	19
31–35 yrs.	156					Associate degree	72
36–40 yrs.	95					Bachelor's degree	326
41–50 yrs.	75					Master's degree	103
51–60 yrs.	32					Professional degree	5
61 + yrs.	15					Doctorate degree	0

Table 3. Technical Details of the Sample (n = 670)

Fitness technology proficiency		**Fitness technology length of use**		**Fitness technology frequency of use**		**Number of fitness technology friends**		**Exercise days**	
Novice	65	< 6 months	74	Multiple times per day	267	1-20	481	1	7
Intermediate	272	6 months–1 year	182	Once per day	162	21-40	106	2	26
Advanced	235	1–2 years	250	Multiple times per week	167	41-60	58	3	126

[9] The filter questions asked participants if they currently used fitness technologies and were at least 18 years of age.

Expert	98	2–4 years	139	Once per week	49	61-80	20	4	136
		> 5 years	25	Multiples times per month	19	81-100	2	5	210
				Once per month	5	101 or more	0	6	78
				Less than once per month	1			7	87

4. Analysis and Results

We used partial least squares (PLS) regression, using SmartPLS version 3.3.3, to analyze the model (Ringle et al., 2021). PLS is useful in analyzing complex models and its use is appropriate for exploratory causal modeling or theory development (Chin et al., 2003; Fornell & Larcker, 1981; Lowry & Gaskin, 2014; Peng & Lai, 2012). Consequently, PLS is commonly used for these reasons in leading behavioral IS research (e.g., Lowry et al., 2016b; Wasko & Faraj, 2005).

4.1. Pre-analysis and Factorial Validity

We carefully followed leading guidelines for using PLS in behavioral research (Chin et al., 2003; Gefen & Straub, 2005; Lowry & Gaskin, 2014). Specifically, we took the following steps to analyze our data prior to specifying the structural model: (1) we confirmed the discriminant and convergent validity of our model, (2) we confirmed that our scales were reliable, and (3) we ruled out multicollinearity and common method bias concerns. Details for all tests we conducted during the pre-analysis and data validation phase are provided in Appendix B, which indicate that our model conforms to the exacting validation standards required for PLS-based analysis (Cenfetelli & Bassellier, 2009; Diamantopoulos & Siguaw, 2006; Lowry & Gaskin, 2014; Peng & Lai, 2012; Petter et al., 2007).

4.2. Structural Model Specification

To preserve parsimony, we used second-order formative factors[10] to construct BPNs satisfaction and frustration.

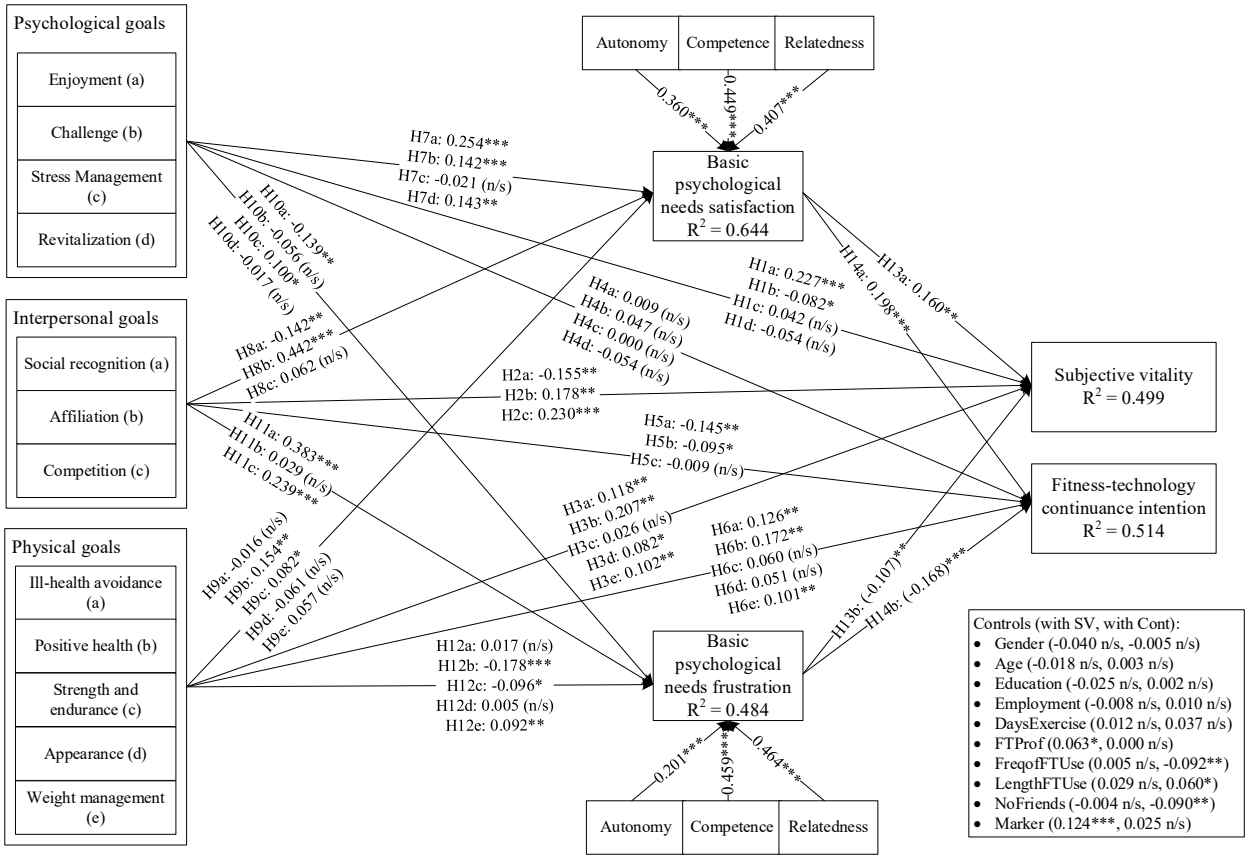
4.3. Results

Figure 2 summarizes the results for our structural model; full results are provided in Appendix C. Notably, the final R^2 results are as follows: BPNs satisfaction ($R^2 = 0.644$), BPNs frustration ($R^2 = 0.484$), subjective

[10] To model second-order formative factors in SmartPLS, a model is first generated in which each first-order factor is created containing only the items for that construct (e.g., the items measuring *autonomy satisfaction*). Next, a second order factor is specified that contains all the items for all the first-order factors (e.g., all the items for autonomy, competence, and relatedness satisfaction). Finally, all the first-order factors of the second-order construct are modeled as formative to the second-order factor. In specifying the model this way, the second-order factor will be perfectly predicted by its first-order factors. This model is used to obtain the latent variable scores for each construct, and the latent variables scores are used to specify a second model to use for structural analysis. This repeated indicator method for handling second-order factors is described in Lowry & Gaskin (2014).

vitality (R^2 = 0.499), and fitness technology continuance (R^2 = 0.514).

Figure 2. Depiction of Path Model Results



4.4. Mediation Testing

Our model proposed both BPNs satisfaction and BPNs frustration as partial mediators. Testing for this kind of complex mediation at the same time is not accurate with traditional techniques; however, this can be accurately tested using advanced bootstrapping tests on the construct confidence intervals of the mediation effects, as detailed in Appendix C. We followed the procedures outlined in Appendix C to bootstrap the effects of our mediating relationships. The results are shown in Table 4.[11]

[11] Every other model relationship, including all covariates, was retained in the model for proper model estimation; they are not reported here simply because we are interested only in theoretically proposed mediation effects.

Table 4. Bootstrapped Confidence Interval Tests for Full and Partial Mediation Model

Proposed relationship	Proposed full mediator	Mediation test (*ab*) (indirect effects)			Full/partial mediation test (*c′*)			Type of mediation relationship
		5% lower bound	95% upper bound	Include zero?	2.5% lower bound	97.5% upper bound	Include zero?	
E → Satis → SV	Satis	0.011	0.074	No	0.104	0.349	No	Partial
E → Satis → C	Satis	0.020	0.090	No	-0.112	0.119	Yes	Full
E → Frust → SV	Frust	0.003	0.033	No	0.104	0.349	No	Partial
E → Frust → C	Frust	0.007	0.046	No	-0.112	0.119	Yes	Full
CH → Satis → SV	Satis	0.005	0.044	No	-0.179	0.016	Yes	Full
CH → Satis → C	Satis	0.008	0.054	No	-0.050	0.154	Yes	Full
CH → Frust → SV	Frust	-0.003	0.017	Yes	-0.179	0.016	Yes	None
CH → Frust → C	Frust	-0.004	0.024	Yes	-0.050	0.154	Yes	None
SM → Satis → SV	Satis	-0.019	0.010	Yes	-0.062	0.147	Yes	None
SM → Satis → C	Satis	-0.022	0.012	Yes	-0.080	0.078	Yes	None
SM → Frust → SV	Frust	-0.025	-0.001	No	-0.062	0.147	Yes	Full
SM → Frust → C	Frust	-0.035	-0.003	No	-0.080	0.078	Yes	Full
R → Satis → SV	Satis	0.004	0.050	No	-0.173	0.069	Yes	Full
R → Satis → C	Satis	0.007	0.057	No	-0.152	0.050	Yes	Full
R → Frust → SV	Frust	-0.009	0.013	Yes	-0.173	0.069	Yes	None
R → Frust → C	Frust	-0.013	0.019	Yes	-0.152	0.050	Yes	None
SR → Satis → SV	Satis	-0.048	-0.004	No	-0.273	-0.036	No	Partial
SR → Satis → C	Satis	-0.056	-0.007	No	-0.256	-0.036	No	Partial
SR → Frust → SV	Frust	-0.076	-0.011	No	-0.273	-0.036	No	Partial
SR → Frust → C	Frust	-0.103	-0.031	No	-0.256	-0.036	No	Partial
AF → Satis → SV	Satis	0.020	0.125	No	0.056	0.294	No	Partial
AF → Satis → C	Satis	0.040	0.139	No	-0.193	0.002	Yes	Full
AF → Frust → SV	Frust	-0.015	0.008	Yes	0.056	0.294	No	None
AF → Frust → C	Frust	-0.023	0.011	Yes	-0.193	0.002	Yes	None
CP → Satis → SV	Satis	-0.005	0.030	Yes	0.124	0.336	No	None
CP → Satis → C	Satis	-0.006	0.037	Yes	-0.105	0.089	Yes	None
CP → Frust → SV	Frust	-0.051	-0.006	No	0.124	0.336	No	Partial
CP → Frust → C	Frust	-0.004	0.024	Yes	-0.105	0.089	Yes	None
IH → Satis → SV	Satis	-0.015	0.009	Yes	0.032	0.207	No	None
IH → Satis → C	Satis	-0.018	0.012	Yes	0.041	0.205	No	None
IH → Frust → SV	Frust	-0.012	0.006	Yes	0.032	0.207	No	None
IH → Frust → C	Frust	-0.016	0.009	Yes	0.041	0.205	No	None
PH → Satis → SV	Satis	0.004	0.055	No	0.073	0.333	No	Partial
PH → Satis → C	Satis	0.008	0.065	No	0.047	0.300	No	Partial
PH → Frust → SV	Frust	0.004	0.041	No	0.073	0.333	No	Partial
PH → Frust → C	Frust	0.010	0.055	No	0.047	0.300	No	Partial
SE → Satis → SV	Satis	-0.003	0.033	Yes	-0.075	0.138	Yes	None
SE → Satis → C	Satis	-0.004	0.039	Yes	-0.049	0.163	Yes	None
SE → Frust → SV	Frust	0.001	0.024	No	-0.075	0.138	Yes	Full
SE → Frust → C	Frust	0.002	0.035	No	-0.049	0.163	Yes	Full
AP → Satis → SV	Satis	-0.026	0.004	Yes	-0.175	0.010	Yes	None
AP → Satis → C	Satis	-0.030	0.004	Yes	-0.037	0.138	Yes	None
AP → Frust → SV	Frust	-0.009	0.008	Yes	-0.175	0.010	Yes	None
AP → Frust → C	Frust	-0.014	0.014	Yes	-0.037	0.138	Yes	None
WM → Satis → SV	Satis	-0.003	0.027	Yes	0.013	0.186	No	None
WM → Satis → C	Satis	-0.004	0.027	Yes	0.021	0.182	No	None
WM → Frust → SV	Frust	-0.022	-0.001	No	0.013	0.186	No	Partial
WM → Frust → C	Frust	-0.032	-0.003	No	0.021	0.182	No	Partial

E = enjoyment goal; CH = challenge goal; SM = stress management goal; R = revitalization goal; SR = social recognition goal; AF = affiliation goal; CP = competition goal; IH = ill-health avoidance goal; PH = positive health goal; SE = strength and endurance goal; AP = appearance goal; WM = weight management goal; Satis = BPNs satisfaction; Frust = BPNs frustration; SV = subjective vitality; C = continuance

4.5. Exploratory Group-Level Path Modeling

We explored our model for each of the three dominant exercise causality orientations to decipher the influence of the individual differences in how people respond to environmental factors. Specifically, we

performed a multigroup analysis to determine which of the paths are statistically different across the three causality orientation (i.e., cottype) models.

To derive cottype, we first used the exercise causality orientations scale from Rose et al. (2001); Rose et al. (2005) for measurement (see Appendix A). Following Koestner & Zuckerman (1994), we then classified exercisers by their dominant exercise causality orientation.[12]

To conduct the group-level path analysis, we used the multigroup analysis (MGA) procedure in SmartPLS. To use the MGA procedure, groups must be defined in SmartPLS. We defined three groups, one for each dominant causality orientation: autonomous (Auto; n = 246), controlled (Con; n = 165), and impersonal (Imp; n = 259). When the MGA procedure is run, path coefficients are provided for each path for each group. The differences between the path coefficients between groups is calculated and the significance is tested. Table 5 summarizes the results of this analysis.[13] The last four columns specify the p-values for the between groups tests and indicates whether the path is significantly different between the groups.

5. DISCUSSION

Our results provide rich insight into how people's exercise goals are associated with BPNs satisfaction and frustration in the fitness technology context. In Table 6, we summarize our results for the structural model, mediation, and multigroup analyses.

The psychological goals of enjoyment, challenge, stress management, and revitalization most closely map to intrinsic goals from the literature because they do not depend on external contingencies to achieve. Therefore, the most likely outcome is that these goals would be positively associated with BPNs satisfaction and negatively associated with BPNs frustration. However, our results show that only the enjoyment goal behaves as expected. Challenge and revitalization are positively associated with BPNs satisfaction but have

[12] To do this, we first averaged the respondents' answers for the autonomy items and then standardized that score (z-score). A respondent was classified as "autonomous" if the z autonomy > z control and the z autonomy > z impersonal. Similarly, a respondent was classified as "controlled" if the z control > z autonomy and the z control > z impersonal, or as "impersonal" if the z impersonal > z autonomy and the z impersonal > z control.

[13] We tested several between-group differences. The significant differences are useful to better understand the role causality orientations play in outcomes from fitness technology use. However, significant differences were found in only nine of the fourteen hypotheses. It is possible family-wise type 1 errors could represent an alternative explanation for some of the significant differences observed.

Table 5. Summary of Results of Multi-Group Analysis (MGA) on Causality Orientations

Tested Path among Three Groups	Auto. β	Con. β	Imp. β	p-value Auto. vs Con.	*p*-value Auto. vs Imp.	*p*-value Con. vs Imp.	Sig. diff.?
H1a. Enjoyment → SV	0.275	0.190	0.122	0.304	0.153	0.329	No/No/No
H1b. Challenge → SV	-0.056	-0.079	-0.076	0.426	0.443	0.492	No/No/No
H1c. Stress management → SV	-0.061	0.088	0.090	0.120	0.125	0.485	No/No/No
H1d. Revitalization → SV	0.011	-0.057	-0.087	0.320	0.258	0.402	No/No/No
H2a. Social recognition → SV	-0.097	-0.147	-0.112	0.353	0.456	0.405	No/No/No
H2b. Affiliation → SV	0.067	0.224	0.095	0.114	0.425	0.215	No/No/No
H2c. Competition → SV	0.127	0.247	0.244	0.178	0.209	0.498	No/No/No
H3a. Ill-health avoidance → SV	0.148	0.178	0.074	0.384	0.252	0.191	No/No/No
H3b. Positive health → SV	0.019	0.109	0.374	0.250	0.005	0.047	No/Yes/Yes
H3c. Strength & endurance → SV	0.039	0.022	0.050	0.450	0.463	0.426	No/No/No
H3d. Appearance → SV	-0.062	0.081	-0.122	0.101	0.304	0.057	No/No/No
H3e. Weight management → SV	0.054	0.072	0.144	0.438	0.203	0.290	No/No/No
H4a. Enjoyment → cont.	0.103	0.240	-0.256	0.222	0.016	0.002	No/Yes/Yes
H4b. Challenge → cont.	0.171	0.032	0.010	0.162	0.122	0.442	No/No/No
H4c. Stress management → cont.	-0.025	0.026	0.055	0.340	0.270	0.412	No/No/No
H4d. Revitalization → cont.	-0.177	0.098	-0.054	0.027	0.229	0.146	Yes/No/No
H5a. Social recognition → cont.	-0.074	-0.231	-0.125	0.127	0.360	0.245	No/No/No
H5b. Affiliation → cont.	-0.113	-0.273	-0.061	0.121	0.346	0.069	No/No/No
H5c. Competition → cont.	0.026	0.118	-0.068	0.230	0.262	0.115	No/No/No
H6a. Ill-health avoidance → cont.	0.163	-0.011	0.136	0.078	0.415	0.129	No/No/No
H6b. Positive health → cont.	0.124	0.070	0.078	0.351	0.381	0.477	No/No/No
H6c. Strength and endurance → cont.	0.096	0.028	0.010	0.306	0.280	0.451	No/No/No
H6d. Appearance → cont.	-0.053	-0.020	0.228	0.385	0.016	0.037	No/Yes/Yes
H6e. Weight management → cont.	0.095	0.312	0.119	0.035	0.419	0.055	Yes/No/No
H7a. Enjoyment → BPNs satis.	0.223	0.289	0.241	0.313	0.428	0.349	No/No/No
H7b. Challenge → BPNs satis.	0.099	0.042	0.077	0.294	0.417	0.369	No/No/No
H7c. Stress management → BPNs satis.	-0.024	-0.015	0.087	0.463	0.105	0.176	No/No/No
H7d. Revitalization → BPNs satis.	0.164	0.048	0.172	0.199	0.466	0.146	No/No/No
H8a. Social recognition → BPNs satis.	-0.193	-0.156	0.063	0.370	0.007	0.035	No/Yes/Yes
H8b. Affiliation → BPNs satis.	0.502	0.471	0.241	0.386	0.001	0.019	No/Yes/Yes
H8c. Competition → BPNs satis.	0.073	0.085	0.058	0.467	0.435	0.419	No/No/No
H9a. Ill-health avoidance → BPNs satis.	-0.034	-0.026	-0.034	0.476	0.494	0.479	No/No/No
H9b. Positive health → BPNs satis.	0.166	0.103	0.089	0.294	0.207	0.456	No/No/No
H9c. Strength & endurance → BPNs satis.	0.065	0.036	0.091	0.409	0.385	0.325	No/No/No
H9d. Appearance → BPNs satis.	-0.118	0.003	0.002	0.111	0.091	0.490	No/No/No
H9e. Weight management → BPNs satis.	0.165	0.018	-0.041	0.052	0.011	0.264	No/Yes/No
H10a. Enjoyment → BPNs frust.	-0.172	-0.152	-0.071	0.460	0.274	0.284	No/No/No
H10b. Challenge → BPNs frust.	-0.026	-0.045	-0.035	0.447	0.477	0.466	No/No/No
H10c. Stress management → BPNs frust.	0.096	0.107	0.004	0.475	0.221	0.212	No/No/No
H10d. Revitalization → BPNs frust.	0.111	-0.068	0.066	0.121	0.378	0.152	No/No/No
H11a. Social recognition → BPNs frust.	0.305	0.182	0.348	0.226	0.378	0.159	No/No/No
H11b. Affiliation → BPNs frust.	-0.234	0.077	0.238	0.012	0.000	0.105	Yes/Yes/No
H11c. Competition → BPNs frust.	0.014	0.248	0.212	0.061	0.081	0.410	No/No/No
H12a. Ill-health avoidance → BPNs frust.	0.031	0.067	0.028	0.386	0.487	0.362	No/No/No
H12b. Positive health → BPNs frust.	-0.198	-0.280	-0.018	0.302	0.107	0.025	No/No/Yes
H12c. Strength & endurance → BPNs frust.	-0.151	-0.130	-0.048	0.442	0.208	0.280	No/No/No
H12d. Appearance → BPNs frust.	0.200	0.017	-0.069	0.099	0.019	0.246	No/Yes/No
H12e. Weight management → BPNs frust.	-0.046	0.099	0.149	0.084	0.062	0.340	No/No/No
H13a. BPNs satis. → SV	0.343	0.044	0.072	0.017	0.024	0.414	Yes/Yes/No
H13b. BPNs frust. → SV	-0.111	-0.036	-0.078	0.208	0.363	0.339	No/No/No
H14a. BPNs satis. → cont.	0.144	0.153	0.458	0.473	0.024	0.033	No/Yes/Yes
H14b. BPNs frust. → cont.	-0.058	-0.179	-0.138	0.147	0.222	0.365	No/No/No

Satis. = satisfaction, Frust. = frustration, SV = subjective vitality, Cont. = continuance, Auto. = autonomous; Con. = controlled; Imp. = impersonal; Sig. diff. = significant difference (Auto. vs Con./Auto. vs Imp./Con. vs Imp.)

Table 6. Summary of Results by Goal for Fitness Technology Use‡

	BPNs†	DVs	Mediation	Causality Orientations
Psychological goals for fitness technology use				
Enjoyment	satis. (+) frust. (-)	SV (+)	with SV (partial by Satis. & frust.) with Cont. (full by Satis. & frust.)	Decreases likelihood of continuance for Imp. users
Challenge[14]	satis. (+)	SV (-)	with SV (full by Satis.) with Cont. (full by Satis.)	
Stress management	frust. (+)		with SV (full by Frust.) with Cont. (full by Frust.)	
Revitalization	satis. (+)		with SV (full by Satis.) with Cont. (full by Satis.)	Decreases likelihood of continuance for Auto. users
Interpersonal goals for fitness technology use				
Social recognition	satis. (-) frust. (+)	SV (-) Cont. (-)	with SV (partial by Satis. & frust.) with Cont. (partial by Satis. & frust.)	Negative effect on Satis. driven by Auto. and Con. users
Affiliation	satis. (+)	SV (+) Cont. (-)	with SV (partial by Satis.) with Cont. (full by Satis.)	Positive association with Satis. statistically stronger for Auto. and Con. users; AF → Frust. neg for Auto. and positive for Imp. users
Competition	frust. (+)	SV (+)	with SV (partial by Frust.)	
Physical goals for fitness technology use				
Ill-health avoidance		SV (+) Cont. (+)		
Positive health	satis. (+) frust. (-)	SV (+) Cont. (+)	with SV (partial by Satis. & frust.) with Cont. (partial by Satis. & frust.)	Positive association with SV driven by Imp. users; negative association with Frust. driven by Auto. and Con. users
Strength and endurance	satis. (+) frust. (-)		with SV (full by Frust.) with Cont. (full by Frust.)	
Appearance		SV (+)		Auto users with AP goals more likely to experience Frust.; AP goals increase continuance for Imp users
Weight management	frust. (+)	SV (+) Cont. (+)	with SV (partial by Frust.) with Cont. (partial by Frust.)	Positive association with continuance driven by Con. and Imp. users; positive association with Satis. for Auto. users.

‡ satis. = BPNs satisfaction; frust. = BPNs frustration; SV = subjective vitality; Cont. = continuance; Auto. = autonomy-oriented users; Con. = control-oriented users; Imp. = impersonal-oriented users

†Positive association between BPNs satis. and SV driven by Auto users. Positive association between BPNs satis. and continuance stronger for Imp. users.

no relationship with BPNs frustration. Stress management has no relationship with BPNs satisfaction but is positively associated with BPNs frustration.

These results are notable for two reasons. *First*, the results show that some goals for adopting fitness technologies may be better than others, and thus should be encouraged. Enjoyment not only leads to BPNs satisfaction, but also decreases BPNs frustration. This result is better than merely increasing BPNs satisfaction (challenge and revitalization) because BPNs frustration decreases well-being and continuance and thus is desirable to avoid. *Second*, stress management should be intrinsic in nature, but the results show

[14] The relationship between the challenge goals and subjective vitality is significant in the main model at $p = 0.048$. However, this result is not consistent across models (see Table C.1 in Appendix C). As can be seen in Table 4, when many resamples are taken (5,000) for the mediation testing, the main path is no longer significant and full mediation is indicated. These results suggest that the relationship between challenge goals and subjective vitality is fully mediated by BPNs satisfaction.

that it does not behave as expected. One explanation for this finding may be that fitness technologies are motivational controls, which means that they are telling the users what to do and when to do it. Namely, fitness technologies may act as external contingencies whose approval users feel needs to be obtained. It may be that a person who is exercising to reduce stress finds the fitness technology to be stress inducing (Kettner et al., 2017) when the exercise itself might be stress relieving if the control had not been added to the exerciser's environment.

The relationships between the psychological goals and well-being and continuance are mostly fully mediated by BPNs satisfaction or frustration. However, enjoyment goals directly increase subjective vitality, which further reinforces that adopting fitness technologies to accomplish enjoyment goals is one of the more beneficial reasons to do so.[15] Unexpectedly, challenge goals have a direct, negative association with subjective vitality. However, this result is borderline and thus inconsistent across models, see Table C.1. in Appendix C. Our mediation analysis indicates that the relationship between challenge goals and both subjective vitality and continuance is fully mediated by BPNs satisfaction. These results may indicate that it is critical for fitness technologies to satisfy the BPNs of users with challenge goals because otherwise such goals may decrease well-being. Table C.3 of Appendix C provides additional analysis showing that satisfying the competence need is key to positive outcomes from fitness technology use for those with challenge goals. Fitness technologies quantify challenge goals (e.g., take 10,000 steps today) and not meeting those challenges may be deflating. Consequently, for exercisers who adopt fitness technologies to help them work toward personal challenges, it may be critical that the fitness technologies provide evidence of goal achievement (i.e., that the exercisers are meeting their challenges) for positive outcomes to result.

Interpersonal goals are harder to classify as intrinsic or extrinsic in nature. Social recognition is contingent on others' approval and therefore is often considered extrinsic. Affiliation relies on others but is often considered intrinsic because it can satisfy the relatedness need. Competition should be extrinsic

[15] The total effects are provided in Table C.2 of Appendix C. The largest positive total effect, 0.283, between any of the latent variables and subjective vitality is for the enjoyment goal. The enjoyment goal also has the second largest positive (negative) total effect, 0.254 (-0.139) between any latent variable and BPNs satisfaction (frustration).

because there is a winner (i.e., a reward) but it is game-like and thus could be personally enjoyable. Our results underscore these subtle differences in the three interpersonal goals. The results for social recognition are exactly as expected for an extrinsic goal: negatively associated with BPNs satisfaction and positively associated with BPNs frustration. However, although affiliation is positively associated with BPNs satisfaction, it has no relationship with BPNs frustration. Finally, competition is positively associated with BPNs frustration and has no association with BPNs satisfaction.

If the results hold in other settings, this would indicate that most people should not use fitness technologies for social recognition or competition because doing so can cause BPNs frustration and through BPNs frustration decrease continuance and well-being. Adopting fitness technologies for affiliative goals can be beneficial. These results are notable because some studies on fitness technologies have indicated that the social features may be the most promising in promoting well-being for the most types of users (James et al., 2019b); by contrast, our results suggest that the specific interpersonal (i.e., social) goal is key to achieving positive outcomes. The social features of most fitness technologies emphasize competition and rewards (e.g., badges, points) and our results suggest that these may not be the features fitness technology makers should develop. Rather, given our results, it may be wise for fitness technology makers to prioritize features that engender community and affiliation.

BPNs satisfaction and frustration partially mediate the relationships between social recognition and both subjective vitality and continuance intention. Social recognition also directly decreases well-being and continuance intentions. This reinforces the detrimental influence of social recognition goals for fitness technology use.[16] Affiliation directly increases subjective vitality, and the relationship is partially mediated by BPNs satisfaction. However, affiliation directly decreases continuance, and the relationship is partially mediated by BPNs satisfaction. To ensure that affiliation goals lead to uniformly positive outcomes, users BPNs thus must be satisfied.

One explanation for this result may be that fitness technologies do not provide many avenues for

[16] Table C.2 in Appendix C shows that social recognition has the largest positive total effect on BPNs frustration (0.383) and the largest negative total effect on subjective vitality (-0.219) and continuance (-0.237).

affiliation: most social features emphasize competition or social recognition. Our results suggest that fitness technology makers may want to consider creating more features that encourage community. For example, features that encourage users to provide informational and emotional social support to others may help build community. Notably our results show that competition goals are directly and positively associated with subjective vitality. This result indicates that competition can improve well-being. One explanation for this result may be that winning provides users with energy boosts—a result that would seem to conflict with the finding that competition goals are associated with BPNs frustration. However, additional analysis provided in Table C.3 of Appendix C shows that competition goals are associated with relatedness frustration. These results suggest that users who find that competitions do not support a sense of community may not experience positive outcomes from their fitness technology use.

The physical goals of ill-health avoidance, positive health, and strength and endurance most closely map to intrinsic goals because they do not rely on praise or rewards. By contrast, appearance and weight management goals may be contingent on others' approval and thus are usually classified as extrinsic. Our results show that the story is more nuanced. We find that ill-health avoidance and appearance goals are not significantly associated with BPNs satisfaction or frustration. Positive health and strength and endurance goals behave as expected for intrinsic goals; that is, they are positively associated with BPNs satisfaction and negatively associated with BPNs frustration. However, the weight management goals are positively associated with BPNs frustration but have no significant relationship with BPNs satisfaction.

Although ill-health avoidance and appearance have no significant associations with BPNs satisfaction or frustration, we find both increase subjective vitality; and ill-health avoidance increases continuance intention. Weight management goals can lead to negative health behavior and outcomes through BPNs frustration; however, they also have a direct, positive association with continuance. One explanation for these findings may be that, for some users, the health benefits from achieving these goals are more important than being satisfied by the process of obtaining them. For example, if users are told by their physicians that they must exercise or face death, the fitness technologies may help them make progress toward becoming healthier even if the users are not happy about being forced to exercise. Another possible explanation can

be found in the SDT literature that suggests when people's BPNs are not satisfied they may try to compensate with need substitutes and that social approval or increased self-worth from improving one's appearance may be such substitutes (Deci & Ryan, 2000; Thøgersen-Ntoumani et al., 2011). Hence, users who receive social approval from appearance or weight management achievements may experience increased well-being even if their BPNs are not satisfied. The relationships between strength and endurance goals and subjective vitality and continuance are fully mediated suggesting that it is critical for the BPNs to be satisfied for fitness technology adoption prompted by these goals to be beneficial.

Finally, positive health goals directly increase both subjective vitality and continuance; and these relationships are partially mediated by BPNs satisfaction and frustration. These results suggest that adopting fitness technologies toward a goal of positive health is one of the most beneficial reasons to do so.[17] Fitness technology makers should focus efforts on developing features that help users achieve positive health outcomes, as well as analytics that illustrate users' progress toward such goals.

As expected, we find that users' BPNs satisfaction from fitness technology use resulted in higher reported levels of subjective vitality and continuance. Moreover, BPNs frustration has a negative influence on both subjective vitality and continuance. These results are consistent with findings in the motivation literature (Bartholomew et al., 2011a; Bartholomew et al., 2011b; Chen et al., 2015), and also reinforce the finding that competence satisfaction increases fitness technology continuance (Rockmann, 2019). However, we provide evidence in a different context that BPNs frustration can decrease positive health behaviors and outcomes. If fitness technologies frustrate users BPNs the results can be detrimental and the use of fitness technologies counterproductive. Our results indicate that to achieve continuance and improved well-being, it is critical that users perceive fitness technologies to be satisfying their BPNs. Users must carefully consider if their exercise goals will be well-supported by fitness technologies prior to adoption; and if their exercise goals result in BPNs frustration from fitness technology use, users may want

[17] Table C.2 in Appendix C shows that positive health has the largest negative total effect on BPNs frustration (-0.178) and the largest positive total effect on continuance (0.232). It also has the third largest positive total effect on BPNs satisfaction (0.154) and the second largest positive total effect on subjective vitality (0.251).

to consider discontinuing use.

Causality orientations have not been explored in the fitness technology literature and have infrequently been considered in the motivation literature even though they are a key component of SDT (Deci & Ryan, 2012b). We performed a multigroup analysis to test the differences in our model based on causality orientation. We find the strongest association between BPNs satisfaction and well-being in users whose primary causality orientation is autonomous, and the strongest association between BPNs satisfaction and continuance in users whose primary causality orientation is impersonal. Autonomy-oriented people are considered intrinsically motivated and tend to experience controls as informational (Deci & Ryan, 1985), whereas impersonal-oriented people are generally amotivated and experience information in their environment as signaling incompetence. Our results indicate that intrinsically motivated exercisers who experience their fitness technology use as BPNs satisfying are the most likely to see increases in well-being. Notably, people who are amotivated to exercise are the most likely to continue using their fitness technologies if their BPNs are satisfied.

We also find some differences in the drivers of BPNs satisfaction: the negative relationship between social recognition goals and BPNs satisfaction and the positive relationships between affiliation and weight management goals and BPNs satisfaction are driven by autonomy-oriented exercisers. The negative associations between affiliation and positive health and BPNs frustration, and the positive association between appearance and BPNs frustration, are also driven by the autonomy oriented. Autonomy-oriented people exercise for the joy it brings them rather than the approval of others and seeking affiliation through socializing their exercise could increase such exercisers' enjoyment. Conversely, social recognition and appearance emphasize social approval which autonomy-oriented people are unlikely to need or appreciate. The weight management and positive health goals results could signal that fitness technologies provide weight management and health information that is competence supporting to such users (i.e., shows the users they are making progress toward their health and weight goals). Autonomy-oriented exercisers are most likely to be those who regularly exercise despite any motivational aids so what is notable about our results is that they provide insight into what types of features may keep such exercisers engaged with fitness

technologies when they may not need it to prompt the exercise itself. Our results suggest that to attract autonomy-oriented exercisers, fitness technology makers should concentrate on features that help users find community and manage exercise-related goals such as weight and positive health.

Notably, many of the significant, direct paths between the goals for fitness technology use and the DVs are driven by the control and impersonal oriented exercisers. Control-oriented people seek out directives and controls on their behavior (Ryan & Deci, 2002), and we find such exercisers have the strongest positive associations between enjoyment and appearance goals and continuance. One interpretation of these results is that control-oriented users wish to have something, or somebody, tell them what to do and for some goals the fitness technologies are filling this desire. For example, control-oriented users may find keeping track (i.e., quantifying) their exercise fun and if their goal in adopting the fitness technologies was to help them enjoy their exercise experience, the fitness technologies may provide a fun component to the activity. The same cannot be said for the impersonal-oriented exercisers whom we show to have a negative association between enjoyment and continuance—suggesting that enjoyment goals for fitness technology use may not help motivate the unmotivated. However, we find the strongest positive associations between positive health and subjective vitality and appearance and continuance for the impersonal-oriented exercisers. This could indicate that it is the amotivated exercisers for whom the ends justify the unsatisfying means.

5.1. Contributions to Research and Theory

SDT, and the SDMHB, posit that goals that are intrinsic in nature should support people's BPNs (Deci & Ryan, 2012b; Ryan et al., 2008), and findings have generally supported this logic (e.g., Sebire et al., 2009; Thøgersen-Ntoumani et al., 2010). However, it has not been well established which goals are intrinsic or extrinsic in nature. Extrinsic goals have an external focus, which means to achieve them requires obtaining rewards or praise (i.e., external recognition). Whereas, intrinsic goals are "congruent with actualizing and growth tendencies natural to humans" (Kasser & Ryan, 1996, p. 280), which means that they can be achieved without recognition from others. Although intrinsic goals are thought to be "likely to satisfy basic and inherent psychological needs" (Kasser & Ryan, 1996, p. 280), this premise has rarely been tested in the literature, rather the relationship between the importance of a goal and the psychological outcomes is often

the focus of studies (e.g., Kasser & Ryan, 1996). For example, extrinsic goals are assumed to not be supportive of the BPNs because they negatively affect well-being (Kasser & Ryan, 1996; Maltby & Day, 2001) and SDT posits that BPNs satisfaction is a key antecedent of positive well-being (Deci & Ryan, 2012b; Ryan & Deci, 2002).

The types of goals that are salient may vary in different contexts, and research in the exercise context has not studied the direct relationship between the exercise goals we examine and BPNs satisfaction. Moreover, few studies have included both BPNs satisfaction and frustration, and we could identify none that had examined the influence of exercise goals we use on BPNs satisfaction and frustration. The few studies that have used BPNs frustration have focused on the difference in the severity of outcomes; for example, BPNs frustration is more likely than low satisfaction of the BPNs to lead to decreased well-being. We could not find studies that have considered how people's goals relate differently to BPNs satisfaction or frustration.

We thus contribute to the SDT and SDMHB literature in four notable ways. *First*, we study the role of fitness technologies, an environmental factor, in shaping exercisers motivational experiences by developing an SDMHB for fitness technologies. *Second*, we use a robust set of goals for exercise and contextualize these to the environment to examine users' exercise goals for their fitness technology use. *Third*, we examine the influence of the exercise goals that prompted users' adoptions of their fitness technologies on the BPNs satisfaction and frustration from the use of those fitness technologies and how BPNs satisfaction and frustration differentially relate to a health outcome (subjective vitality) and behavior (continuance intention). *Fourth*, we test our model for the three primary causality orientations, which illustrates how people with dispositional motivational differences experience the use of fitness technologies. We extend the SDMHB to study the fitness technology context. However, we not only contextualize the model, but we also develop a unique SDMHB to understand the role of goals that prompt the adoption of the fitness technologies on outcomes from use through BPNs satisfaction and frustration. Our results add richness to the study of controls on exercise to the SDT literature.

We also contribute to the IS literature on fitness technologies. Previous studies of fitness technologies

focused on how the motivational processes regulating exercise or exercise goals related to the features of fitness technologies that people employed (James et al., 2019a; James et al., 2019b). Other studies have considered how elements of fitness technology use (e.g., recognition, rewards) influences outcomes such as life burnout or continuance through people's passion for exercise or satisfaction or frustration of their competence need (Rockmann, 2019; Whelan & Clohessy, 2020). These studies reveal how people's motivation for exercise influences fitness technology use or how fitness technology use influences motivation to exercise.

We build on these studies by proving a fully operationalized motivational model, the SDMHB, on fitness technologies. That is, we integrate the fitness technology environmental factor into the motivational constructs to explain how exercise goals for fitness technology adoption influence whether users' find fitness technologies to be BPNs satisfying or frustrating. We thus extend IS research by developing a model, grounded in SDT, that fully integrates the technological control on the user's activity into the model. This approach provides insight into how the technological control shapes users' motivational environments that complements prior studies on how motivation shapes technology use. Our unique SDMHB for fitness technologies helps us understand how the goals prompting fitness technology use ultimately shape users' fitness technology-assisted motivational experiences and such knowledge is important because these experiences determine if people benefit from fitness technology use or abandon them.

Our results provide notable insights that will be useful as research on fitness technologies continues. We find that the exercise goals for fitness technology use do not always produce the results that would be expected given what is known about their intrinsic or extrinsic nature. This is a notable result for two reasons: (1) researchers in the exercise context have found it difficult to classify exercise goals as purely intrinsic or extrinsic and our results confirm this challenge which indicates that goals may be context dependent and (2) we consider exercise goals for fitness technology use and the addition of the environmental factor may explain why some exercise goals have different associations with the BPNs than expected. For example, stress management is positively associated with BPNs frustration, and it is possible that the characteristics of the fitness technologies make them unfit for such a goal. That is, the addition of

a technological control that commands users to stand, walk, or breathe may be stress inducing.

5.2. Implications for Society and Practice

Our findings have key implications for the design of fitness technologies. Per Ryan & Deci (2000, p. 74), "the fact that psychological-need deprivation appears to be a principal source of human distress suggests that the assessments and interventions would do well to target these primary foundations of mental health." Our findings confirm this general idea because BPNs frustration is negatively and significantly related to both subjective vitality and fitness-technology continuance intention. This means that to ensure continued use, and crucially, for that use to improve well-being, designers should ensure that fitness technologies satisfy, not frustrate, users' BPNs.

Our findings provide insights into which types of features fitness technology makers should concentrate their efforts on to improve user outcomes. It may be helpful to design fitness technology features to be customizable, especially for goals that our results suggest may not be supported well by the current generation of fitness technologies. For example, the weight management goal can directly lead to positive outcomes but may also lead to BPNs frustration for some users. Moreover, autonomy-oriented users may experience BPNs satisfaction when a weight management goal drives their adoption. Such findings suggest that the fitness technologies should be designed to be adaptable so that some users can avoid BPNs frustration by, for example, setting up their informational displays to be more competence supporting. Moreover, adopting fitness technology for social recognition goals does not appear to lead to positive outcomes. Fitness technology makers may want to consider removing features that encourage such goals.

The goals in the physical group provided several nuanced findings that could guide both the development of future generations of fitness technologies, as well as the use of current generations. Positive health and strength and endurance goals for fitness technology use followed the expected paths through the SDMHB, which suggests that features that support these goals should be emphasized. Ill-health avoidance was positively associated with subjective vitality and continuance, but not through the BPNs. Fitness technology makers could consider framing information about health goals in ways that focus users on positive health achievements because emphasizing progress toward better health may deemphasize ill-

health avoidance goals. The appearance and weight management goals yielded the most nuanced results. These goals are often considered extrinsic in nature (Kasser & Ryan, 1996), but our results suggest that whether they lead to positive outcomes depends heavily on the user's causality orientation.

Our results, in conjunction with insights from the SDT literature,[18] suggest that fitness technology makers may want to consider how to integrate features into the fitness technologies that may help users transition from more extrinsic goals such as weight management or appearance to more sustainable intrinsic ones such as enjoyment or affiliation. This may be accomplished by slowly deemphasizing data from the former (e.g., diet or weight loss information) while emphasizing features or data for the latter (e.g., fun or affiliative exercise activities). Users may want to adapt their use to change their focus over time as well.

Our results provide important insights for fitness technology makers because they explain why findings for the social features of fitness technologies have been mixed (James et al., 2019b). Social gamification features have been associated with BPNs satisfaction (Rockmann, 2019; Ryan et al., 2006b; Xi & Hamari, 2019), but our results extend these studies to consider both satisfaction and frustration of all three BPNs in the fitness technology context.

Moreover, we studied three interpersonal goals for fitness technology use that have been characterized differently as intrinsic or extrinsic in the literature. We find that fitness technology use driven by social recognition goals consistently leads to negative results. Fitness technology makers should thus avoid features that emphasize social recognition. Affiliation goals result in positive outcomes but are not enough to drive continuance directly. Adding more features that promote community and belongingness to fitness technologies may be more effective. Care should be taken with features that promote competition and more research is necessary in this area. Our results suggest that competition can result in BPNs frustration but also increase subjective vitality. This means that competition may energize some users but may also lead

[18] Results in the exercise context with SDT have not consistently found that image or appearance goals have a strong negative influence on BPNs satisfaction (e.g., Sebire et al., 2008; Thøgersen-Ntoumani & Ntoumanis, 2007; who found image goals were not significantly associated with BPNs satisfaction). Notably, Wasserkampf et al. (2014, p. 949) state, "Ingledew et al. (2009) reported that while weight and appearance management motives were present during early stages of behavioral change; motives like revitalization and enjoyment were more prominent regarding the progression to and sustainment of the activity."

to negative outcomes from use through BPNs frustration, specifically, relatedness frustration. For example, it may be that competition through fitness technologies stimulates unflattering social comparisons and envy rather than helping to build a supportive exercise community. In general, fitness technology makers should practice caution in designing interpersonal features that may encourage ego-driven and controlled behaviors.

Our results also have interesting implications for healthcare professionals. Researchers have found that better outcomes can be achieved if activities and contexts are framed in ways that encourage intrinsic goal content (Vansteenkiste et al., 2004a; Vansteenkiste et al., 2005b). Moreover, studies have found that focusing on future intrinsic goals is useful in promoting adherence to exercise (Vansteenkiste et al., 2004c). Coupled with our findings, this means that healthcare professionals could encourage and frame the use of fitness technologies for intrinsic goals, and that doing so may improve outcomes from their use. However, for users and anyone recommending the use of fitness technologies, it is important to acknowledge that individual differences in how people react to environmental controls may modify users' experiences with them. Also, our finding that affiliation is negatively associated with fitness technology continuance might indicate trouble finding community through the current generation of fitness technologies.

Finally, we found evidence that individuals with different causality orientations may respond to fitness technologies that serve as environmental factors in different ways, which could lead to different outcomes. The physical goal results for impersonal-oriented users are notable because there is some indication that these users can benefit directly from fitness technology use spurred by positive health, appearance, and weight management goals. However, impersonal-oriented users may be more sensitive to any types of social comparisons because even the affiliation goal is positively related to BPNs frustration for them. Autonomy-oriented users are more likely to reap benefits from use prompted by affiliation. Autonomy-oriented users may also be better suited for fitness technology use driven by positive health and weight management goals. In general, the results suggest that autonomy-oriented users may be able to interpret the information fitness technologies provide in a more positive way that generates better outcomes in some cases. The differences between the autonomous, controlled, and impersonal causality orientations revealed

in our findings suggests that it may be worthwhile to design for users that view controls on their activity in separate ways or to design more flexibility into current fitness technologies so that users can tailor their motivational environments to their own individual characteristics.

5.3. Limitations and Future Research

Our results provide several opportunities for future investigation. First, our study employed a cross-sectional survey design methodology, which limited our data collection to one point in time. Future research could include longitudinal experiments to study the same phenomenon. Longitudinal field studies could explore how goals for fitness technology use and BPNs satisfaction and frustration evolve. Researchers could manipulate how the fitness technologies are deployed (e.g., which features are turned on or off, required use of specific features) to explore which configurations are best for various types of exercisers. It would likely be useful to study whether the fitness technologies change people's goals once they start using them; for example, a person may have had a goal to walk some each day, but the fitness technology may turn that goal into "walk 10,000 steps" each day. It is also possible that other goals become salient after users adopt fitness technologies, or that fitness technologies facilitate goals that users had not considered prior to adoption. For example, users may have adopted a fitness technology because they wanted to challenge themselves, but after adoption, they may find that building an affiliative exercise community becomes an important goal. Longitudinal studies could focus on how fitness technologies change people's goals over time, or alternatively, how fitness technologies could be used to reframe people's goals.

Second, our model is complex and thus provides many nuanced insights, each of which could be the basis for future studies. For example, our study shows which exercise goals for fitness technology use prompted their adoption and how those goals are associated with BPNs satisfaction and frustration from fitness technology use. What we are unable to explain in our model is how the specific uses of the fitness technologies resulted in BPNs satisfaction or frustration for users with different goals. Fitness technologies enable quantification; that is, their use generates metrics for comparison against oneself or others to help the user gauge performance over time. Therefore, fitness technologies highlight both success and failure in achieving one's goals, which may be more prominent for some goals (e.g., losing a competition or not

losing weight). Future research could leverage our findings to further study what happens when fitness technologies make salient the fact that users are not achieving their goals.

As another example, our study participants were asked to report the goals that prompted their fitness technology adoption. In our case, the goals are determined by the user, and we show how they influence outcomes from use through BPNs satisfaction and frustration. However, it may be possible to use fitness technologies to emphasize goals that are more likely to result in positive outcomes. In the motivation literature, goal framing suggests that people's extrinsic goals can be reframed to other similar goals that are intrinsic in nature and hence more likely to lead to positive outcomes (Vansteenkiste et al., 2005b; Vansteenkiste et al., 2008). Future research could consider designing fitness technology interventions that encourage people to focus on enjoyment, positive health, or affiliation goals rather than goals such as weight loss or competition.

Third, the benefit of our granular examination of exercise goals for fitness technology use is that our findings can stimulate in-depth examinations of particular fitness technology uses. For example, the results for the challenge and competition goals for fitness technology use and the BPNs and DVs are notable and warrant further investigation. Because fitness technologies can emphasize winning or goal attainment, or conversely losing and not reaching one's goals, these quantifiable outcomes may affect the fitness technology motivational experience. We also find that people with different causality orientations have different motivational experiences with fitness technologies. This suggests that for fitness technologies to be maximally useful for all people their use and features may need to be adapted to consider people's motivational characteristics. Future studies could build on our insights to explain how to design features to better facilitate challenge and competition goals, as well as different motivational characteristics.

Fourth, our results regarding interpersonal goals for fitness technology use illustrate how complex socializing exercise through fitness technologies to achieve positive outcomes may be. In non-technology exercise contexts, some researchers argue that relatedness may not be as important as the other BPNs (Sibley & Bergman, 2018; Wilson et al., 2003). However, studies in the fitness technology and gamification contexts have demonstrated that social features of fitness technologies may be beneficial, but that positive

outcomes from use may depend on the friends one adds to the fitness technologies and how the user's performance compares to those friends' performances (James et al., 2019a; James et al., 2019b; Zhang et al., 2018; Zhou et al., 2016). More research may be necessary to explore how community, belongingness, or social support through fitness technologies may benefit users. We suggest that more research is also warranted to tease out how social features can be developed that are BPNs satisfying and can assist positive outcomes. It is going to be important to specifically identify what aspects of technology-enabled socialization result in negative outcomes or diminish positive ones, so that fitness technologies can be designed to prevent such outcomes.

Finally, there is a need for more studies of the personal effects of ubiquitous technologies. As wearables, smartphones, and apps continue to invade our daily lives, investigating both the positive and negative influence of their use is critical. Not only should their usefulness, or lack thereof, be investigated, but also accuracy (McPhate, 2016), privacy, and a host of other associated concerns. Many of the quantified-self technologies are relatively new to the marketplace, and their designs are quickly and continuously evolving. Our study is limited by the characteristics of the current generation of fitness technologies. Subsequent generations of fitness technologies will have more features and improved designs. However, this is also an exciting time for research on the effects of technology on individual, group, and social behavior.

6. Conclusion

Our study investigated the mediated relationships between exercisers' goals for fitness technology use and two outcomes: psychological well-being and fitness-technology continuance intention. We found that the reasons users adopt their fitness technologies are critical for ensuring positive well-being and continuance outcomes. Specifically, enjoyment, challenge, revitalization, affiliation, competition, ill-health avoidance, positive health, strength and endurance, appearance, and weight management goals can all result in some positive outcomes from use, but not always both well-being and continuance, and in some cases mediated through BPNs satisfaction. Moreover, some of these goals could also result in negative outcomes. Challenge, stress management, social recognition, affiliation, and weight management goals could all result in negative outcomes in at least some cases. Our results confirmed that in this context, BPNs satisfaction is

positively and BPNs frustration negatively associated with both psychological well-being and fitness technology continuance. Our findings also revealed that in the fitness technology context, the relationship between many of the goals and psychological well-being is mediated by BPNs satisfaction or frustration. We also uncovered distinctions in the results for the models for exercisers with different dominant causality orientations. Overall, our study provides valuable insights for fitness technology makers and users that can be leveraged to achieve more beneficial well-being and continuance outcomes.

7. References

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2012). Perceived coach-autonomy support, basic need satisfaction and the well-and ill-being of elite youth soccer players: A longitudinal investigation. *Psychology of Sport and Exercise,* 13(1), 51-59.

Arazy, O. & Gellatly, I. R. (2012). Corporate wikis: The effects of owners' motivation and behavior on group members' engagement. *Journal of Management Information Systems,* 29(3), 87-116.

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011a). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin,* 37(11), 1459-1473.

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011b). Psychological need thwarting in the sport context: Assessing the darker side of athletic experience. *Journal of Sport and Exercise Psychology,* 33(1), 75-102.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly,* 25(3), 351-370.

Boratto, L., Carta, S., Fenu, G., Manca, M., Mulas, F., & Pilloni, P. (2017). The role of social interaction on users motivation to exercise: A persuasive web framework to enhance the self-management of a healthy lifestyle. *Pervasive and Mobile Computing,* 36(1), 98-114.

Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the subjective vitality scale using structural equation modeling. *Social Indicators Research,* 52(3), 313-324.

Brown, B. (2019). Global wearable technology market to accelerate 15%. Retrieved September 30, 2019, from https://healthtechinsider.com/2019/05/22/global-wearable-technology-market-to-accelerate-15/

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science,* 6(1), 3-5.

Cenfetelli, R. T. & Bassellier, G. (2009). Interpretation of formative measurement in information systems research. *MIS Quarterly,* 33(4), 689-707.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Duriez, B., et al. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion,* 39(2), 216-236.

Chen, K., Zdorova, M., & Nathan-Roberts, D. (2017). *Implications of wearables, fitness tracking services, and quantified self on healthcare.* Paper presented at the Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Los Angeles, CA, 1066-1070.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research,* 14(2), 189-217.

Churchill Jr, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research,* 16(1), 64-73.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information

technology. *MIS Quarterly,* 13(3), 319-340.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology,* 22(14), 1111-1132.
Deci, E. L. & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality,* 19(2), 109-134.
Deci, E. L. & Ryan, R. M. (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. & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology,* 49(3), 182-185.
Deci, E. L. & Ryan, R. M. (2012a). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory, In R. M. Ryan (Ed.), *The Oxford Handbook of Human Motivation* (85-107). Oxford, UK: Oxford University Press.
Deci, E. L. & Ryan, R. M. (2012b). Self-determination theory, In P. A. M. Van Lange, A. W. Kruglanski & E. T. Higgins (Eds.), *Handbook of Theories of Social Psychology* (Vol. 1). London: Sage.
Deci, E. L., Ryan, R. M., Gagné, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former eastern bloc country: A cross-cultural study of self-determination. *Personality and Social Psychology Bulletin,* 27(8), 930-942.
Diamantopoulos, A. & Siguaw, J. A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management,* 17(4), 263-282.
Edmunds, J., Ntoumanis, N., & Duda, J. L. (2007). Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective. *Psychology of Sport and Exercise,* 8(5), 722-740.
Ednie, A. & Stibor, M. (2017). Influence and interpretation of intrinsic and extrinsic exercise motives. *Journal of Human Sport and Exercise,* 12(2), 414-425.
Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research,* 18(1), 39-50.
Frederick, C. M. & Ryan, R. M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. *Journal of Sport Behavior,* 16(3), 124-146.
Frederick-Recascino, C. M. (2002). Self-determination theory and participation motivation research in the sport and exercise domain, In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (Vol. 277, 277-294). Rochester, NY: The University of Rochester Press.
Gefen, D. & Straub, D. W. (2005). A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example. *Communications of the Association for Information Systems,* 16(5), 91-109.
Gunnell, K. E., Crocker, P. R., Mack, D. E., Wilson, P. M., & Zumbo, B. D. (2014). Goal contents, motivation, psychological need satisfaction, well-being and physical activity: A test of self-determination theory over 6 months. *Psychology of Sport and Exercise,* 15(1), 19-29.
Gunnell, K. E., Crocker, P. R., Wilson, P. M., Mack, D. E., & Zumbo, B. D. (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.
Gunnell, K. E., Mack, D. E., Wilson, P. M., & Adachi, J. (2011). Psychological needs as mediators? The relationship between leisure-time physical activity and well being in people diagnosed with osteoporosis. *Research Quarterly for Exercise and Sport,* 82(4), 794-798.
Hamari, J., Hassan, L., & Dias, A. (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. & Koivisto, J. (2015). "Working out for likes": An empirical study on social influence in exercise gamification. *Computers in Human Behavior,* 50(1), 333-347.
Hodge, K., Lonsdale, C., & Ng, J. Y. (2008). Burnout in elite rugby: Relationships with basic psychological needs fulfilment. *Journal of Sports Sciences,* 26(8), 835-844.

Hope, N. H., Holding, A. C., Verner-Filion, J., Sheldon, K. M., & Koestner, R. (2019). The path from intrinsic aspirations to subjective well-being is mediated by changes in basic psychological need satisfaction and autonomous motivation: A large prospective test. *Motivation and Emotion,* 43(2), 232-241.

Ingledew, D. K. & Markland, D. (2008). The role of motives in exercise participation. *Psychology and Health,* 23(7), 807-828.

Ingledew, D. K., Markland, D., & Ferguson, E. (2009). Three levels of exercise motivation. *Applied Psychology: Health and Well-Being,* 1(3), 336-355.

Ingledew, D. K., Markland, D., & Strömmer, S. T. (2014). Elucidating the roles of motives and gains in exercise participation. *Sport, Exercise, and Performance Psychology,* 3(2), 116-131.

James, T. L., Deane, J., & Wallace, L. (2019a). An application of goal content theory to examine how desired exercise outcomes impact fitness technology feature set selection. *Information Systems Journal,* 29(5), 1010-1039.

James, T. L., Wallace, L., & Deane, J. (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.

Karahanna, E., Xu, S. X., Xu, Y., & Zhang, N. A. (2018). The needs–affordances–features perspective for the use of social media. *MIS Quarterly,* 42(3), 737-756.

Kasser, T. & Ahuvia, A. (2002). Materialistic values and well-being in business students. *European Journal of Social Psychology,* 32(1), 137-146.

Kasser, T. & Ryan, R. M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. *Journal of Personality and Social Psychology,* 65(2), 410-422.

Kasser, T. & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin,* 22(3), 280-287.

Kasser, T. & Ryan, R. M. (2001). Be careful what you wish for: Optimal functioning and the relative attainment of intrinsic and extrinsic goals, In P. Schmuck & K. M. Sheldon (Eds.), *Life goals and Well-being: Towards a Positive Psychology of Human Striving* (116-131). Ashland, OH: Hogrefe & Huber.

Kasser, V. G. & Ryan, R. M. (1999). The Relation of psychological needs for autonomy and relatedness to vitality, well-being, and mortality in a nursing home. *Journal of Applied Social Psychology,* 29(5), 935-954.

Ke, W., Tan, C.-H., Sia, C.-L., & Wei, K.-K. (2013). Inducing intrinsic motivation to explore the enterprise system: The supremacy of organizational levers. *Journal of Management Information Systems,* 29(3), 257-289.

Ke, W. & Zhang, P. (2010). The effects of extrinsic motivations and satisfaction in open source software development. *Journal of the Association for Information Systems,* 11(12), 784-808.

Kettner, R., Bader, P., Kosch, T., Schneegass, S., & Schmidt, A. (2017). *Towards pressure-based feedback for non-stressful tactile notifications.* Paper presented at the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services, Vienna, Austria, 1-8.

Kim, Y., Kasser, T., & Lee, H. (2003). Self-concept, aspirations, and Well-being in South Korea and the United States. *Journal of Social Psychology,* 143(3), 277-290.

Koestner, R. & Zuckerman, M. (1994). Causality orientations, failure, and achievement. *Journal of Personality,* 62(3), 321-346.

Lee, M. K., Cheung, C. M., & Chen, Z. (2005). Acceptance of Internet-based learning medium: The role of extrinsic and intrinsic motivation. *Information & Management,* 42(8), 1095-1104.

Leimeister, J. M., Huber, M., Bretschneider, U., & Krcmar, H. (2009). Leveraging crowdsourcing: Activation-supporting components for IT-based ideas competition. *Journal of Management Information Systems,* 26(1), 197-224.

Lowry, P. B., D'Arcy, J., Hammer, B., & Moody, G. D. (2016a). "Cargo Cult" science in traditional organization and information systems survey research: A case for using nontraditional methods of data collection, including Mechanical Turk and online panels. *Journal of Strategic Information*

Systems, 25(3), 232-240.
Lowry, P. B. & Gaskin, J. (2014). Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE Transactions on Professional Communication,* 57(2), 123-146.
Lowry, P. B., Gaskin, J., & Moody, G. D. (2015). Proposing the multi-motive information systems continuance model (MISC) to better explain end-user system evaluations and continuance intentions. *Journal of the Association for Information Systems,* 16(7), 515-579.
Lowry, P. B., Gaskin, J., Twyman, N., Hammer, B., & Roberts, T. (2013). Taking 'fun and games' seriously: Proposing the hedonic-motivation system adoption model (HMSAM). *Journal of the Association for Information Systems,* 14(11), 617-671.
Lowry, P. B., Zhang, J., Wang, C., & Siponen, M. (2016b). 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.
MacKenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques. *MIS Quarterly,* 35(2), 293-334.
Mailey, E. L., Dlugonski, D., Hsu, W.-W., & Segar, M. (2018). Goals matter: Exercising for well-being but not health or appearance predicts future exercise among parents. *Journal of Physical Activity and Health,* 15(11), 857-865.
Maltby, J. & Day, L. (2001). The relationship between exercise motives and psychological well-being. *Journal of Psychology,* 135(6), 651-660.
Markland, D. & Hardy, L. (1993). The exercise motivations inventory: Preliminary development and validity of a measure of individuals' reasons for participation in regular physical exercise. *Personality and Individual Differences,* 15(3), 289-296.
Markland, D. & Ingledew, D. K. (1997). The measurement of exercise motives: Factorial validity and invariance across gender of a revised exercise motivations inventory. *British Journal of Health Psychology,* 2(4), 361-376.
Markland, D. & Tobin, V. J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise,* 11(2), 91-99.
Mason, W. & Suri, S. (2012). Conducting behavioral research on Amazon's Mechanical Turk. *Behavior Research Methods,* 44(1), 1-23.
McDonough, M. H. & Crocker, P. R. (2007). Testing self-determined motivation as a mediator of the relationship between psychological needs and affective and behavioral outcomes. *Journal of Sport and Exercise Psychology,* 29(5), 645-663.
McLachlan, S. & Hagger, M. S. (2010). Associations between motivational orientations and chronically accessible outcomes in leisure-time physical activity: are appearance-related outcomes controlling in nature? *Research Quarterly for Exercise and Sport,* 81(1), 102-107.
McLachlan, S. & Hagger, M. S. (2011). Do people differentiate between intrinsic and extrinsic goals for physical activity? *Journal of Sport and Exercise Psychology,* 33(2), 273-288.
McPhate, M. (2016). *Just how accurate are Fitbits? The jury is out*. Retrieved May 27, 2016, from http://www.nytimes.com/2016/05/26/technology/personaltech/fitbit-accuracy.html?_r=0
Milne, H. M., Wallman, K. E., Guilfoyle, A., Gordon, S., & Courneya, K. S. (2008). Self-determination theory and physical activity among breast cancer survivors. *Journal of Sport and Exercise Psychology,* 30(1), 23-38.
Ng, J. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J. L., et al. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science,* 7(4), 325-340.
Niven, A. G. & Markland, D. (2016). Using self-determination theory to understand motivation for walking: Instrument development and model testing using Bayesian structural equation modelling. *Psychology of Sport and Exercise,* 23(1), 90-100.

Oppenheimer, D. M., Meyvis, T., & Davidenko, N. (2009). Instructional manipulation checks: Detecting satisficing to increase statistical power. *Journal of Experimental Social Psychology,* 45(4), 867-872.

Patel, M. S., Asch, D. A., & Volpp, K. G. (2015). Wearable devices as facilitators, not drivers, of health behavior change. *Journal of the American Medical Association,* 313(5), 459-460.

Peng, D. X. & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management,* 30(6), 467-480.

Perreault, S., Gaudreau, P., Lapointe, M.-C., & Lacroix, C. (2007). Does it take three to tango? Psychological need satisfaction and athlete burnout. *International Journal of Sport Psychology,* 38(1), 437-450.

Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly,* 31(4), 623-656.

Pope, L. & Harvey, J. (2015). The impact of incentives on intrinsic and extrinsic motives for fitness-center attendance in college first-year students. *American Journal of Health Promotion,* 29(3), 192-199.

Rahman, R., Thatcher, J., & Flint, S. (2018). Understanding exercise behavior and drop-out through metamotivational dominance, exercise identity and motives. *Journal of Motivation, Emotion, and Personality,* 7(1), 9-24.

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin,* 26(4), 419-435.

Ringle, C. M., Wende, S., & Becker, J.-M. (2021, April 1, 2021). *SmartPLS 3*

Roca, J. C. & Gagné, M. (2008). Understanding e-learning continuance intention in the workplace: A self-determination theory perspective. *Computers in Human Behavior,* 24(4), 1585-1604.

Rockmann, R. (2019). *Don't hurt me… no more? An empirical study on the positive and adverse motivational effects in fitness apps.* Paper presented at the 27th European Conference on Information Systems, Stockholm-Uppsala, Sweden, 1-17.

Rodrigues, F., Teixeira, D. S., Cid, L., Machado, S., & Monteiro, D. (2019). The role of dark-side of motivation and intention to continue in exercise: A self-determination theory approach. *Scandinavian Journal of Psychology,* 60(6), 585-595.

Rose, E. A., Markland, D., & Parfitt, G. (2001). The development and initial validation of the exercise causality orientations scale. *Journal of Sports Sciences,* 19(6), 445-462.

Rose, E. A., Parfitt, G., & Williams, S. (2005). Exercise causality orientations, behavioural regulation for exercise and stage of change for exercise: exploring their relationships. *Psychology of Sport and Exercise,* 6(4), 399-414.

Ryan, R. M. & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist,* 55(1), 68-78.

Ryan, R. M. & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology,* 52(1), 141-166.

Ryan, R. M. & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective, In E. L. Deci & R. M. Ryan (Eds.), *Handbook of Self-Determination Research* (3-33). Rochester, NY: The University of Rochester Press.

Ryan, R. M., Deci, E. L., Grolnick, W. S., & La Guardia, J. G. (2006a). The significance of autonomy and autonomy support in psychological development and psychopathology, In D. Cicchetti & D. Cohen (Eds.), *Developmental Psychopathology: Theory and Methods, 2nd Edition* (Vol. 1, 795-849). New York: Wiley.

Ryan, R. M. & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality,* 65(3), 529-565.

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology,* 28(4), 335-354.

Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2008). Facilitating health behaviour change and its maintenance: Interventions based on self-determination theory. *European Health Psychologist,*

10(1), 2-5.
Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006b). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion,* 30(4), 344-360.
Sebire, S. J., Standage, M., & Vansteenkiste, M. (2008). Development and validation of the goal content for exercise questionnaire. *Journal of Sport and Exercise Psychology,* 30(4), 353-377.
Sebire, S. J., Standage, M., & Vansteenkiste, M. (2009). Examining intrinsic versus extrinsic exercise goals: Cognitive, affective, and behavioral outcomes. *Journal of Sport and Exercise Psychology,* 31(2), 189-210.
Sheldon, K. M. & Kasser, T. (1998). Pursuing personal goals: Skills enable progress, but not all progress is beneficial. *Personality and Social Psychology Bulletin,* 24(12), 1319-1331.
Sheldon, K. M. & Niemiec, C. P. (2006). It's not just the amount that counts: Balanced need satisfaction also affects well-being. *Journal of Personality and Social Psychology,* 91(2), 331-341.
Sheldon, K. M., Ryan, R., & Reis, H. T. (1996). What makes for a good day? Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin,* 22(12), 1270-1279.
Sibley, B. A. & Bergman, S. M. (2016). Relationships among goal contents, exercise motivations, physical activity, and aerobic fitness in university physical education courses. *Perceptual and Motor Skills,* 122(2), 678-700.
Sibley, B. A. & Bergman, S. M. (2018). What keeps athletes in the gym? Goals, psychological needs, and motivation of CrossFit™ participants. *International Journal of Sport and Exercise Psychology,* 16(5), 555-574.
Sørebø, Ø., Halvari, H., Gulli, V. F., & Kristiansen, R. (2009). The role of self-determination theory in explaining teachers' motivation to continue to use e-learning technology. *Computers & Education,* 53(4), 1177-1187.
Statista. (2020). *Number of active users of Fitbit from 2012 to 2019 (in millions)*, July 6, 2020, from https://www.statista.com/statistics/472600/fitbit-active-users/
Steelman, Z. R., Hammer, B. I., & Limayem, M. (2014). Data collection in the digital age: Innovative alternatives to student samples. *MIS Quarterly,* 38(2), 355-378.
Taylor, I. M., Ntoumanis, N., Standage, M., & Spray, C. M. (2010). Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical activity: A multilevel linear growth analysis. *Journal of Sport and Exercise Psychology,* 32(1), 99-120.
Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity,* 9(78), 1-30.
Thøgersen-Ntoumani, C. & Ntoumanis, N. (2007). A self-determination theory approach to the study of body image concerns, self-presentation and self-perceptions in a sample of aerobic instructors. *Journal of Health Psychology,* 12(2), 301-315.
Thøgersen-Ntoumani, C., Ntoumanis, N., Cumming, J., & Chatzisarantis, N. L. (2011). When feeling attractive matters too much to women: A process underpinning the relation between psychological need satisfaction and unhealthy weight control behaviors. *Motivation and Emotion,* 35(4), 413-422.
Thøgersen-Ntoumani, C., Ntoumanis, N., & Nikitaras, N. (2010). Unhealthy weight control behaviours in adolescent girls: A process model based on self-determination theory. *Psychology and Health,* 25(5), 535-550.
Unanue, W., Dittmar, H., Vignoles, V. L., & Vansteenkiste, M. (2014). Materialism and well-being in the UK and Chile: Basic need satisfaction and basic need frustration as underlying psychological processes. *European Journal of Personality,* 28(6), 569-585.
Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS Quarterly,* 28(4), 695-704.
Vansteenkiste, M. & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration,* 23(3), 263-280.
Vansteenkiste, M., Simons, J., Braet, C., Bachman, C., & Deci, E. L. (2005a). *Promoting maintained weight*

loss through healthy lifestyle changes among severely obese children: An experimental test of the self-determination theory (Research Report). Leuven, Belgium: University of Leuven. Retrieved September 29, 2021, from https://lirias.kuleuven.be/retrieve/517636, 1-43.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004a). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology,* 87(2), 246-260.

Vansteenkiste, M., Simons, J., Lens, W., Soenens, B., & Matos, L. (2005b). Examining the motivational impact of intrinsic versus extrinsic goal framing and autonomy-supportive versus internally controlling communication style on early adolescents' academic achievement. *Child Development,* 76(2), 483-501.

Vansteenkiste, M., Simons, J., Lens, W., Soenens, B., Matos, L., & Lacante, M. (2004b). Less is sometimes more: Goal content matters. *Journal of Educational Psychology,* 96(4), 755-764.

Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004c). How to become a persevering exerciser? Providing a clear, future intrinsic goal in an autonomy-supportive way. *Journal of Sport and Exercise Psychology,* 26(2), 232-249.

Vansteenkiste, M., Timmermans, T., Lens, W., Soenens, B., & Van den Broeck, A. (2008). Does extrinsic goal framing enhance extrinsic goal-oriented individuals' learning and performance? An experimental test of the match perspective versus self-determination theory. *Journal of Educational Psychology,* 100(2), 387-397.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research,* 11(4), 342-365.

Vlachopoulos, S. P. & Karavani, E. (2009). A cross-gender situational test of the needs universality hypothesis. *Hellenic Journal of Psychology,* 6(1), 207-222.

Vlachopoulos, S. P. & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The basic psychological needs in exercise scale. *Measurement in Physical Education and Exercise Science,* 10(3), 179-201.

Warburton, D. E. & Bredin, S. S. (2017). Health benefits of physical activity: A systematic review of current systematic reviews. *Current Opinion in Cardiology,* 32(5), 541-556.

Warr, P. (1978). A study of psychological well-being. *British Journal of Psychology,* 69(1), 111-121.

Wasko, M. M. & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly,* 29(1), 35-57.

Wasserkampf, A., Silva, M., Santos, I., Carraça, E., Meis, J., Kremers, S., et al. (2014). Short-and long-term theory-based predictors of physical activity in women who participated in a weight-management program. *Health Education Research,* 29(6), 941-952.

Whelan, E. & Clohessy, T. (2020). How the social dimension of fitness apps can enhance and undermine wellbeing. *Information Technology & People,* 34(1), 68-92.

Williams, G. C., Hedberg, V. A., Cox, E. M., & Deci, E. L. (2000). Extrinsic life goals and health-risk behaviors in adolescents. *Journal of Applied Social Psychology,* 30(8), 1756-1771.

Wilson, P. M., Longley, K., Muon, S., Rodgers, W. M., & Murray, T. C. (2006). Examining the contributions of perceived psychological need satisfaction to well-being in exercise. *Journal of Applied Biobehavioral Research,* 11(3-4), 243-264.

Wilson, P. M., Mack, D. E., Gunnell, K., Oster, K., & Gregson, J. P. (2008). Analyzing the measurement of psychological need satisfaction in exercise contexts: Evidence, issues, and future directions, In M. P. Simmons & L. A. Foster (Eds.), *Sport and Exercise Psychology Research Advances* (361-391). New York: Nova Science.

Wilson, P. M., Rodgers, W. M., Blanchard, C. M., & Gessell, J. (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes, and physical fitness. *Journal of Applied Social Psychology,* 33(11), 2373-2392.

World Health Organization. (2017). Obesity and overweight. Retrieved July 5th, 2018, from http://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Xi, N. & Hamari, J. (2019). Does gamification satisfy needs? A study on the relationship between

gamification features and intrinsic need satisfaction. *International Journal of Information Management,* 46(1), 210-221.

Yoon, C. & Rolland, E. (2012). Knowledge-sharing in virtual communities: Familiarity, anonymity and self-determination theory. *Behaviour & Information Technology,* 31(11), 1133-1143.

Zhang, J., Jian, Q., Lowry, P. B., & Li, Y. (2018). *Gamified double-edged sword: Exploring the different social comparison motives of mobile fitness app users.* Paper presented at the Special Interest Group on Human-Computer Interaction 2018, San Francisco, CA, 1-5.

Zhao, L., Detlor, B., & Connelly, C. E. (2016). Sharing knowledge in social Q&A sites: The unintended consequences of extrinsic motivation. *Journal of Management Information Systems,* 33(1), 70-100.

Zhou, Y., Kankanhalli, A., & Huang, K.-W. (2016). *Effects of fitness applications with SNS: How do they influence physical activity.* Paper presented at the 37th International Conference on Information Systems, Dublin, Ireland, 1-11.

Zhou, Z., Fang, Y., Vogel, D. R., Jin, X.-L., & Zhang, X. (2012). Attracted to or locked in? Predicting continuance intention in social virtual world services. *Journal of Management Information Systems,* 29(1), 273-306.

APPENDIX A. Documentation of Measurement Items

Table A.1. Construct Definitions

Construct (Source)	Factors	Definition
Basic psychological need satisfactions and frustrations (Chen et al., 2015; Ng et al., 2012)	The following definitions answer the extent to which the following is true: "The users' perceptions that the fitness technologies they use…"	
	Autonomy satisfaction	…help provide an experience of self-determination, full willingness, and volition when carrying out exercise-related activities.
	Autonomy frustration	…make them feel like the exercise is being controlled through externally enforced measures.
	Competence satisfaction	…help them feel effective and capable of achieving their desired exercise outcomes.
	Competence frustration	…cause feelings of failure or doubts of exercise efficacy.
	Relatedness satisfaction	… help feeling cared for, respected, understood, and genuinely connected to others.
	Relatedness frustration	…use make them feel excluded or lonely.
Exercise motivations (Markland & Hardy, 1993; Markland & Ingledew, 1997)	The following definitions answer the extent to which the following is true: "The users' reasons for adopting the fitness technologies is to…"	
	Stress management	…help manage tension and stress.
	Revitalization	…feel invigorated or refreshed.
	Enjoyment	…for enjoyment and satisfaction.
	Challenge	…meet personal challenges, goals, and standards.
	Social recognition	…demonstrate accomplishments, compare abilities, and garner recognition.
	Affiliation	…help with socializing and making new friends.
	Competition	…help compete with others.
	Health pressures	…prevent or recover from illness.
	Ill-health avoidance	…avoid health problems.
	Positive health	…live a long and healthy life.
	Weight management	…control weight.
	Appearance	…improve appearance.
	Strength and endurance	…build strength or endurance.

	Nimbleness	…stay or become more flexible and agile.
Exercise Causality Orientations; (Deci & Ryan, 2012)	Autonomous orientation	"Refers both to orienting toward internal and external cues in a way that gives them an autonomy supportive or informational significance and also to being more autonomous in general across domains and time" (Deci & Ryan, 2012, p. 420).
	Controlled orientation	"Refers to interpreting cues as controls and demands and to being controlled in general at the person level" (Deci & Ryan, 2012, p. 420).
	Impersonal orientation	"Refers to orienting toward cues as indicators of incompetence and to be generally amotivated" (Deci & Ryan, 2012, p. 420).
Fitness-technology continuance intention (Bhattacherjee, 2001; Zhou et al., 2012)		The users' intentions to continue to use the fitness technologies they are currently using.
Subjective vitality (Ryan & Frederick, 1997)		"A positive feeling of aliveness and energy" (Ryan & Frederick, 1997).

Table A.2. Measurement Item Details and Sources

Construct (Source)		Construct indicator	Item	Mean	Std. Dev.
Basic psychological need satisfaction and frustration scale; adapted from (Chen et al., 2015)		**Prompt:** Below, we are going to ask about how your current fitness technologies make you feel. Please read each of the following items carefully. You can choose from 1 to 7 to indicate the degree to which the statement is true for you at this point in your life. "My current fitness technologies make me feel…": 7-point Likert-type scales from 1 = "Not true at all" to 7 = "Completely true"			
	Autonomy satisfaction	AUS1	a sense of choice and freedom in the exercise activities I undertake	5.464	1.247
		AUS2	that my exercise decisions reflect what I really want	5.257	1.346
		AUS3	my exercise choices express who I really am	5.096	1.399
		AUS4	I have been exercising in ways that really interest me	5.307	1.326
	Autonomy frustration	AUF1	like "I have to" exercise	4.512	1.752
		AUF2	forced to perform exercise I otherwise wouldn't choose to do*	-	-
		AUF3	pressured to exercise	4.212	1.785
		AUF4	obligated to exercise	4.636	1.664
	Relatedness satisfaction	RES1	my exercise friends care about me	4.715	1.619
		RES2	connected with my exercise friends	4.633	1.667
		RES3	close and connected with my exercise friends	4.594	1.672
		RES4	warm feelings towards my exercise friends	4.896	1.524
	Relatedness	REF1	excluded from my exercise friends	3.185	2.051

	frustration	REF2	that my exercise friends are cold and distant toward me	3.197	2.031
		REF3	like my exercise friends dislike me	3.042	2.101
		REF4	the relationships I have with my exercise friends are superficial	3.749	1.957
	Competence satisfaction	CPS1	confident that I can exercise well	5.425	1.197
		CPS2	like a capable exerciser	5.401	1.258
		CPS3	competent to achieve my exercise goals	5.503	1.187
		CPS4	I can successfully complete difficult exercise tasks	5.416	1.217
	Competence frustration	CPF1	serious doubts about whether I can exercise well	3.451	1.973
		CPF2	disappointed with my exercise performance	3.497	1.829
		CPF3	insecure about my exercise abilities	3.496	1.973
		CPF4	like a failure because of the exercise mistakes I make	3.230	1.982
Exercise Motivations Inventory; (Markland & Ingledew, 1997)		**Prompt:** I started using my current fitness technologies to help me exercise in order to accomplish the following goals: 7-point Likert-type scales from 1 = "Not at all true for me" to 7 = "Very true for me"			
	Stress management	SM1	To give me space to think	4.812	1.697
		SM2	To reduce tension	5.181	1.505
		SM3	To manage stress	5.287	1.453
		SM4	To release tension	5.233	1.486
	Revitalization	RV1	To feel good	5.669	1.247
		RV2	To feel invigorated	5.255	1.442
		RV3	To feel refreshed	5.290	1.436
		RV4	To recharge myself	5.231	1.442
	Enjoyment	EJ1	To enjoy the feeling of exerting myself	5.282	1.454
		EJ2	To find exercising satisfying	5.439	1.291
		EJ3	To enjoy the experience of exercising	5.431	1.405
		EJ4	To feel at my best when exercising	5.376	1.377
	Challenge	CH1	To give me goals to work toward	5.746	1.176
		CH2	To help me explore the limits of my body	5.118	1.553
		CH3	To give me personal challenges to face	4.812	1.697
		CH4	To develop personal skills*	-	-
		CH5	To measure myself against personal standards*	-	-
	Social recognition	SR1	To show my worth to others	3.815	2.048
		SR2	To compare my abilities with other peoples'	4.060	1.938
		SR3	To gain recognition for my accomplishments	4.064	1.993
		SR4	To accomplish things that others are incapable of	4.018	2.061
	Affiliation	AF1	To spend time with friends	4.119	1.949
		AF2	To enjoy the social aspects of exercising	4.321	1.955
		AF3	To have fun being active with other people	4.440	1.888
		AF4	To make new friends	3.864	2.011

	Competition	CP1	To win in physical competitions	3.670	2.082
		CP2	To compete with others	3.937	2.029
		CP3	For physical competition	4.116	1.934
		CP4	To engage in physical activities that are competitive	4.330	2.005
	Health pressures	HP1	To comply with my doctor's advice to exercise*	-	-
		HP2	To help prevent an illness that runs in my family*	-	-
		HP3	To help recover from an illness/injury*	-	-
	Ill-health avoidance	IH1	To avoid heart disease	5.421	1.506
		IH2	To prevent health problems	5.763	1.226
		IH3	To avoid ill-health	5.678	1.276
		IH4	To stay healthy*	-	-
	Positive health	PH1	To help me live a longer, more healthy life	5.819	1.230
		PH2	To have a healthy body	5.973	1.122
		PH3	To maintain good health	5.969	1.083
		PH4	To feel more healthy	5.991	1.141
	Weight management	WM1	To stay slim	5.388	1.435
		WM2	To lose weight	5.385	1.667
		WM3	To help control my weight	5.612	1.502
		WM4	To burn calories	5.654	1.420
	Appearance	AP1	To help me look younger	5.000	1.727
		AP2	To have a good body	5.724	1.257
		AP3	To improve my appearance	5.640	1.333
		AP4	To look more attractive	5.525	1.421
	Strength and endurance	SE1	To build up my strength	5.794	1.268
		SE2	To increase my endurance	5.685	1.308
		SE3	To get stronger	5.818	1.224
		SE4	To develop my muscles	5.678	1.292
	Nimbleness	NB1	To get faster*	-	-
		NB2	To stay/become more agile*	-	-
		NB3	To maintain flexibility*	-	-
		NB4	To stay/become flexible*	-	-
Fitness Tracker Continuance; adapted from (Bhattacherjee, 2001; Zhou et al., 2012)		**Prompt:** For each of the following, keep in mind your current fitness technologies. Specify your agreement with the following statements: 7-point Likert-type scales from 1 = "Strongly disagree" to 7 = "Strongly agree"			
		Cont1	I expect my use of my current fitness technologies to continue in the next few months.	5.912	1.240
		Cont2	I intend to continue using my current fitness technologies regularly in the next few months.	5.900	1.217
		Cont3	I intend to continue using my current fitness technologies rather than discontinue	5.779	1.326

			their use in the next few months.		
Subjective vitality (Bostic et al., 2000; Ryan & Frederick, 1997)		**Prompt:** Please respond to each of the following statements by indicating the degree to which the statement is true for you when engaged in exercise: 7-point Likert-type scales from 1 = "Not at All True for Me" to 7 = "Completely True for Me"			
		SV1	I feel alive and vital.	5.370	1.387
		SV2	I don't feel energetic.*	4.525	1.707
		SV3	Sometimes I feel so alive I just want to burst.	5.387	1.426
		SV4	I have energy and spirit.	5.257	1.449
		SV5	I look forward to each new day.	5.112	1.521
		SV6	I nearly always feel alert and awake.	5.369	1.469
		SV7	I feel energized.	5.370	1.387
Exercise Causality Orientations Scale; from (Rose et al., 2001; Rose et al., 2005)		**Prompt:** Below are a series of situations that people can find themselves in with regard to exercising. Below each situation are three responses. Please imagine yourself in each situation and indicate how likely you would be to react with that particular response in that situation. 7-point Likert-type scales from 1 = "Extremely Unlikely" to 7 = "Extremely Likely"			
		You are beginning a new exercise program. You are likely to:			
		Control1	Attend a structured exercise class where an exercise leader is telling you what to do.	4.094	2.008
		Auto1	Decide for yourself which type of exercise you would like to complete.	5.821	1.296
		Imperson1	Tag along with your friends and do what they do.	4.667	1.739
		You are asked to keep a record of all the weekly exercise you have completed in an exercise diary (log). You are likely to view the diary (log):			
		Imperson2	As a reminder of how incapable you are at fulfilling the task.	3.687	2.095
		Auto2	As a way to measure your progress and to feel proud of your achievements.	5.767	1.298
		Control2	As a way of pressuring yourself to exercise.	5.249	1.483
		In order to monitor how well you are doing in an exercise program you are likely to want to:			
		Control3	Be given a lot of praise and encouragement from others.	4.485	1.799
		Auto3	Evaluate your own performance and provide yourself with positive feedback.	5.821	1.187
		Imperson3	Just hope that what you are doing is correct.	4.828	1.743
		You have been exercising regularly for 6 months but recently you have been missing sessions and are finding it hard to get motivated to exercise. You are likely to:			
		Control4	Approach someone to help motivate you.	4.287	1.931
		Imperson4	Ignore the problem, nothing can be done to improve your motivation.	3.434	2.005
		Auto4	Employ your own strategies to motivate yourself.	5.912	1.042
		You have been told that setting goals is a good way to motivate yourself to exercise. You would likely:			
		Auto5	Set your own realistic but challenging goals.	5.936	1.068
		Control5	Make someone important to you set goals for you to aim for.	4.043	2.070
		Imperson5	Not set goals because you may not be able to live up to them.	3.315	2.023

		During a discussion with an exercise counsellor he/she presents many options on the best way for you to exercise to achieve fitness and health benefits. It is likely that your first thought would be:			
		Control6	What do you (the exercise leader) think I should do?	4.966	1.570
		Auto6	What do I think is the best option for me?	5.606	1.203
		Imperson6	What has everyone else done in the past?	4.539	1.788
		During an exercise session how, hard you are working out is likely to be governed by:			
		Control7	The intensity you have been told to exercise at.	4.770	1.631
		Imperson7	What everyone around you is doing.	4.272	1.919
		Auto7	How you are feeling while exercising at the intensity you choose.	5.846	1.184
Marker	Symbolic patriotism (Parker, 2010)	SP1	When I see my country's flag flying, I feel extremely good. (7-point scale from not very good to extremely good)		
		SP2	My love for my country is extremely strong. (7-point scale from not very strong to extremely strong).	5.212	1.671
Attention traps		At1	Please answer "Rarely true" to this question.	5.245	1.758
		At2	The United States is on the continent of Asia.		
		At3	If two plus three is equal to five, select the second choice from the left or if taking the survey on a mobile phone the second from the top.		
		At4	Answer "Frequently" to this question.		

(R) = reverse scaled; *item was dropped during pilot or to improve convergent or divergent validity

Controls and demographic items:

- Days exercise (DayExer): “How many days a week do you exercise?”
- Length of use (Luse): “How long have you used your current fitness technologies?”
- Frequency of use (Fuse): “How often do you use your current fitness technologies?”
- Proficiency (Tprof): “How would you rate / your proficiency with your fitness technologies?”
- Number of exercise friends: “How many friends to you have in your current fitness app that you indicated at the start of the survey you use most often?”
- Age: “What is your age?”
- Gender: “What is your Gender?”
- Level of education (Edu): “What is the highest level of school you have completed?”
- Level of employment (Empl): “Select which of the following best describes your employment status.”

APPENDIX B. Details on Factorial Validity and Data Quality

Convergent and Discriminant Validity to Establish Factorial Validity

In this appendix, we detail our application of statistical techniques to examine our model for convergent and discriminant validity. We followed recognized criteria for establishing factorial validity (Gefen et al., 2000; Lowry & Gaskin, 2014; Straub et al., 2004). Convergent and discriminant validity should coexist because they are related concepts. The reason to apply convergent validity techniques is to determine that all items "thought to reflect a construct converge, or show significant, high correlations with one another, particularly when compared to the items relevant to other constructs" (Straub et al., 2004, p. 391). Discriminant validity techniques are applied to validate that "measurement items posited to reflect (i.e., "make up") that construct differ from those that are not believed to make up the construct" (Straub et al., 2004, p. 389). We used the output provided by SmartPLS to establish factorial validity by taking the steps detailed as follows.

First, we examined the outer model loadings provided in Table B.1. Relatively high outer model loadings help establish convergent validity. Although outer model loadings equal to or exceeding 0.700 are preferred, those greater than 0.300 are acceptable for larger sample sizes (Hair et al., 2006). The outer model loadings for all items for our primary constructs exceed 0.700 with the exception of AUF2, AUS1, CH4, and CH5. AUF2, CH4, and CH5 were dropped from further analyses, AUS1 with a loading of 0.694 is adequate and was retained. Moreover, Table B.1 shows that all of the outer model loadings are significant at $p <= 0.05$ and have t-values above 1.96.

Second, we examined the cross-loading matrix shown in Table B.2, which can also assist in establishing convergent validity. Each item should load highest on its corresponding latent variable in the cross-loading matrix. All of the items in Table B.2, with the exception of IH4, met this criterion. IH4 was dropped from further analysis. We further examined the cross-loading matrix to determine if the loading on the proper latent variable was higher by an order of magnitude than any other loading for that item (i.e., the difference between the two loadings should be > 0.10) (Lowry & Gaskin, 2014). All of our items loaded on their expected latent variables; however, the items CP1 and CP2 partially cross-loaded on the social recognition latent variable and were thus dropped.

Third, the cross-loading matrix can also be used to help establish discriminant validity. To do so, the cross-loading matrix is examined to ascertain if each item loaded highest on its respective latent variable and that significant cross-loadings did not occur. We removed IH4 from the model because it loaded higher on positive health. We also removed CP1 and CP2 due to significant cross-loadings with social recognition. All other items have a difference between the two loadings that is greater than 0.10, which is the rule of thumb suggested in the literature (Lowry & Gaskin, 2014), and were retained.

Fourth, we calculated the square root of the average variance extracted (AVE) statistic for each latent variable, which are shown in bold-face along the diagonal of the correlation matrix in Table B.3, to perform a final discriminant validity check. The guideline for this technique is that the square root of the AVE for a latent variable should be greater than any of the correlations below it (Fornell & Larcker, 1981; Staples et al., 1999). Table B.3 shows that this guideline is met for all our latent variables. Overall, the results from the application of the four techniques described above support the convergent and discriminant validity of the instrumentation used in our study.

Table B.1. Outer Loadings, t-statistics, and p-values

Item	Outer Loading	t-statistic	p-value	Item	Outer Loading	t-statistic	p-value
AUF1	0.913	4.604	<0.001	RV1	0.780	32.634	<0.001
AUF2*	0.623	2.376	0.018	RV2	0.771	28.370	<0.001
AUF3	0.740	2.968	0.003	RV3	0.845	56.942	<0.001
AUF4	0.833	4.338	<0.001	RV4	0.841	53.958	<0.001
AUS1	0.694	21.302	<0.001	SM1	0.745	27.929	<0.001
AUS2	0.716	19.331	<0.001	SM2	0.806	33.396	<0.001
AUS3	0.776	32.973	<0.001	SM3	0.821	45.566	<0.001
AUS4	0.783	33.638	<0.001	SM4	0.851	49.632	<0.001
CPF1	0.851	10.450	<0.001	CH1	0.698	21.844	<0.001
CPF2	0.904	10.953	<0.001	CH2	0.794	39.624	<0.001
CPF3	0.899	11.871	<0.001	CH3	0.816	46.506	<0.001
CPF4	0.869	12.398	<0.001	CH4*	0.633	17.693	<0.001
CPS1	0.827	53.120	<0.001	CH5*	0.651	15.786	<0.001
CPS2	0.807	40.468	<0.001	AP1	0.715	23.172	<0.001
CPS3	0.795	39.749	<0.001	AP2	0.767	29.599	<0.001
CPS4	0.797	39.556	<0.001	AP3	0.819	34.948	<0.001
REF1	0.886	4.508	<0.001	AP4	0.850	42.426	<0.001
REF2	0.906	4.588	<0.001	WM1	0.783	31.477	<0.001
REF3	0.874	3.991	<0.001	WM2	0.791	28.737	<0.001
REF4	0.850	5.259	<0.001	WM3	0.841	38.643	<0.001
RES1	0.865	61.479	<0.001	WM4	0.853	57.376	<0.001
RES2	0.872	66.729	<0.001	SE1	0.856	48.700	<0.001
RES3	0.887	85.420	<0.001	SE2	0.740	22.184	<0.001
RES4	0.848	52.231	<0.001	SE3	0.854	59.727	<0.001
Cont1	0.902	78.283	<0.001	SE4	0.827	34.728	<0.001
Cont2	0.903	76.086	<0.001	IH1	0.775	30.302	<0.001
Cont3	0.808	25.309	<0.001	IH2	0.831	38.403	<0.001
AF1	0.901	89.893	<0.001	IH3	0.830	45.881	<0.001
AF2	0.883	78.686	<0.001	IH4	0.740	27.165	<0.001
AF3	0.886	80.055	<0.001	PH1	0.851	54.264	<0.001
AF4	0.866	66.957	<0.001	PH2	0.836	43.314	<0.001
CP1	0.868	56.580	<0.001	PH3	0.825	34.371	<0.001
CP2	0.842	43.501	<0.001	PH4	0.809	37.452	<0.001
CP3	0.872	67.815	<0.001	SV1	0.851	63.441	<0.001
CP4	0.863	66.647	<0.001	SV3	0.724	30.957	<0.001
SR1	0.878	60.563	<0.001	SV4	0.887	80.208	<0.001
SR2	0.867	63.989	<0.001	SV5	0.856	64.192	<0.001
SR3	0.849	44.499	<0.001	SV6	0.825	45.717	<0.001
SR4	0.830	45.531	<0.001	SV7	0.868	64.021	<0.001
EJ1	0.838	50.245	<0.001	SP1	0.970	277.831	<0.001
EJ2	0.841	46.814	<0.001	SP2	0.974	317.842	<0.001
EJ3	0.869	63.917	<0.001				
EJ4	0.802	36.037	<0.001				

Table B.2. Cross-loadings

	AF	AP	AUF	AUS	CH	CPF	CPS	CP	Cont.	EJ	IL	SP	PH	REF	RES	RV	SR	SE	SM	SV	WM
AF1	**.901**	.127	.312	.281	.236	.362	.224	.670	-.208	.356	.007	.405	-.096	.490	.689	.302	.703	-.001	.369	.342	.052
AF2	**.883**	.221	.320	.302	.323	.272	.304	.662	-.146	.399	.041	.369	-.052	.410	.673	.373	.684	.062	.415	.361	.099
AF3	**.886**	.161	.316	.323	.309	.252	.267	.650	-.142	.400	.049	.394	-.035	.376	.678	.390	.658	.049	.411	.347	.101
AF4	**.866**	.112	.374	.255	.220	.420	.202	.727	-.281	.285	-.054	.438	-.168	.570	.627	.265	.731	-.050	.359	.312	.021
AP1	.346	**.715**	.292	.193	.324	.150	.230	.403	.045	.264	.305	.267	.244	.232	.226	.307	.420	.297	.303	.302	.423
AP2	.039	**.767**	.113	.318	.372	-.186	.370	.103	.401	.367	.468	.021	.556	-.147	.110	.314	.036	.580	.261	.299	.474
AP3	.019	**.819**	.131	.260	.331	-.108	.295	.060	.343	.275	.434	.059	.533	-.134	.076	.301	.054	.513	.234	.254	.533
AP4	.134	**.850**	.190	.245	.349	-.024	.320	.164	.317	.330	.421	.125	.473	-.043	.192	.342	.161	.476	.278	.276	.552
AUF1	.319	.207	**.914**	.110	.150	.438	.055	.386	-.064	.149	.064	.294	.000	.456	.293	.164	.396	.063	.181	.099	.205
AUF3	.331	.167	**.731**	.060	.102	.501	.026	.367	-.133	.074	.025	.238	-.060	.482	.258	.115	.389	.012	.181	.019	.104
AUF4	.324	.206	**.835**	.110	.199	.348	.128	.310	-.069	.168	.080	.232	.001	.367	.262	.164	.353	.066	.185	.072	.148
AUS1	.099	.256	.060	**.694**	.373	-.155	.548	.065	.294	.414	.374	.135	.370	-.084	.241	.385	.024	.371	.284	.295	.310
AUS2	.228	.280	.106	**.716**	.347	-.044	.467	.173	.201	.394	.282	.151	.281	.051	.274	.366	.163	.277	.305	.308	.208
AUS3	.332	.197	.130	**.776**	.369	.007	.484	.291	.180	.407	.232	.239	.223	.141	.414	.354	.263	.234	.319	.383	.252
AUS4	.284	.245	.066	**.783**	.448	-.105	.545	.204	.213	.565	.273	.213	.369	.020	.361	.491	.194	.341	.398	.433	.225
CH1	.065	.352	.083	.423	**.747**	-.169	.479	.061	.428	.484	.443	.066	.526	-.179	.181	.406	.029	.474	.322	.322	.331
CH2	.386	.390	.162	.427	**.819**	-.016	.536	.406	.158	.623	.315	.217	.317	.112	.345	.516	.365	.381	.459	.391	.290
CH3	.273	.333	.204	.424	**.869**	-.060	.522	.284	.228	.601	.375	.176	.361	.006	.293	.503	.271	.376	.415	.403	.308
CP1	.716	.163	.407	.196	.227	.458	.166	**.868**	-.290	.242	-.027	.393	-.161	.612	.502	.223	**.771**	-.005	.299	.262	.072
CP2	.697	.174	.381	.177	.228	.423	.170	**.842**	-.247	.259	-.035	.382	-.181	.544	.498	.214	**.790**	-.003	.287	.233	.049
CP3	.652	.161	.369	.212	.277	.360	.182	**.872**	-.190	.293	-.001	.404	-.100	.519	.497	.243	.694	.031	.288	.317	.055
CP4	.603	.291	.291	.271	.339	.222	.288	**.863**	-.060	.333	.141	.331	.081	.395	.489	.271	.634	.192	.292	.395	.169
CPF1	.414	-.028	.442	-.062	-.075	**.851**	-.205	.418	-.398	-.042	-.198	.247	-.292	.716	.279	-.005	.475	-.212	.119	-.060	-.037
CPF2	.246	-.018	.399	-.115	-.083	**.904**	-.269	.293	-.327	-.110	-.202	.184	-.290	.619	.133	-.070	.350	-.242	.073	-.134	-.010
CPF3	.335	-.068	.438	-.087	-.091	**.899**	-.217	.357	-.376	-.066	-.231	.195	-.346	.697	.227	-.033	.434	-.269	.105	-.115	-.027
CPF4	.372	-.068	.415	-.050	-.076	**.869**	-.224	.424	-.425	-.065	-.252	.248	-.343	.759	.251	-.040	.498	-.268	.114	-.080	-.077
CPS1	.234	.312	.050	.578	.527	-.249	**.827**	.199	.317	.541	.379	.184	.414	-.054	.342	.460	.146	.411	.332	.463	.277
CPS2	.211	.313	.081	.546	.470	-.242	**.807**	.167	.307	.529	.381	.180	.369	-.051	.311	.466	.124	.440	.353	.415	.268
CPS3	.201	.331	.101	.528	.522	-.202	**.795**	.178	.359	.521	.421	.179	.431	-.082	.325	.471	.136	.434	.310	.429	.339
CPS4	.271	.292	.068	.555	.511	-.156	**.797**	.247	.277	.529	.347	.155	.335	-.017	.352	.459	.208	.421	.356	.407	.278
Cont1	-.165	.336	-.033	.281	.307	-.366	.350	-.150	**.902**	.260	.482	.002	.573	-.387	.014	.217	-.212	.477	.110	.292	.376
Cont2	-.184	.318	-.081	.266	.288	-.360	.366	-.178	**.903**	.262	.478	-.058	.522	-.407	.013	.243	-.262	.446	.116	.265	.341
Cont3	-.236	.238	-.127	.206	.231	-.385	.300	-.243	**.807**	.190	.400	-.122	.470	-.451	-.064	.182	-.296	.367	.049	.192	.291
EJ1	.302	.320	.124	.487	.590	-.098	.551	.265	.281	**.838**	.368	.186	.351	-.004	.348	.657	.243	.441	.546	.481	.329
EJ2	.321	.350	.139	.513	.577	-.083	.536	.246	.211	**.841**	.365	.226	.366	.009	.342	.605	.266	.382	.495	.428	.268
EJ3	.371	.297	.123	.509	.628	-.079	.576	.289	.218	**.869**	.377	.248	.369	.016	.372	.625	.273	.397	.530	.522	.280
EJ4	.378	.365	.195	.526	.560	-.031	.537	.320	.215	**.802**	.339	.267	.336	.068	.440	.654	.318	.367	.548	.448	.296
IH1	.139	.365	.143	.287	.358	-.082	.370	.166	.290	.346	**.775**	.072	.455	.001	.168	.388	.117	.435	.332	.388	.390
IH2	-.007	.397	.042	.279	.376	-.199	.361	.012	.434	.321	**.831**	.042	.588	-.183	.075	.402	-.022	.496	.298	.350	.350
IH3	-.022	.436	.056	.286	.365	-.203	.343	.004	.440	.307	**.830**	.034	.625	-.167	.058	.299	-.038	.523	.251	.326	.429

IH4	-.085	.450	-.012	.362	.354	-.324	.431	-.082	.519	.399	**.740**	-.046	.771	-.312	.079	.366	-.124	.623	.204	.331	.438
SP1	.431	.154	.300	.254	.197	.229	.220	.413	-.058	.273	.027	**.970**	-.021	.309	.430	.259	.420	.023	.198	.296	.142
SP2	.448	.144	.295	.241	.181	.231	.202	.428	-.055	.265	.041	**.974**	-.022	.320	.410	.251	.440	.036	.183	.315	.120
PH1	-.082	.451	-.025	.349	.422	-.314	.418	-.067	.499	.362	.639	.006	**.851**	-.305	.067	.359	-.111	.645	.215	.397	.402
PH2	-.072	.527	.019	.325	.424	-.285	.416	-.049	.498	.360	.640	-.017	**.836**	-.293	.081	.349	-.100	.653	.200	.346	.452
PH3	-.068	.420	-.019	.342	.374	-.287	.377	-.067	.484	.324	.616	-.026	**.825**	-.272	.034	.291	-.115	.558	.188	.355	.376
PH4	-.098	.500	.007	.364	.378	-.303	.389	-.085	.520	.364	.630	-.043	**.809**	-.299	.065	.360	-.115	.647	.207	.338	.458
REF1	.493	-.040	.429	.031	.001	.712	-.066	.516	-.438	.035	-.188	.314	-.320	**.886**	.327	.048	.560	-.202	.178	.067	-.086
REF2	.446	-.042	.420	.010	-.014	.711	-.081	.530	-.455	.010	-.213	.270	-.321	**.906**	.280	.017	.569	-.216	.149	.067	-.084
REF3	.490	-.080	.412	.030	-.021	.745	-.068	.539	-.451	.007	-.215	.265	-.398	**.874**	.328	.005	.570	-.265	.147	.046	-.105
REF4	.410	.050	.452	.090	-.012	.587	-.018	.480	-.327	.033	-.112	.282	-.239	**.850**	.302	.075	.515	-.118	.179	.081	.030
RES1	.638	.182	.291	.361	.299	.219	.332	.490	-.020	.381	.122	.399	.087	.311	**.865**	.408	.451	.119	.369	.394	.123
RES2	.684	.180	.288	.414	.312	.177	.381	.528	-.027	.416	.097	.369	.051	.300	**.872**	.372	.501	.117	.370	.370	.136
RES3	.682	.164	.287	.356	.294	.227	.363	.530	-.001	.390	.091	.392	.040	.334	**.887**	.376	.511	.110	.361	.391	.149
RES4	.617	.152	.247	.412	.282	.188	.358	.446	.026	.367	.119	.335	.081	.268	**.848**	.385	.445	.098	.380	.352	.121
RV1	.182	.387	.104	.480	.509	-.172	.524	.073	.336	.595	.435	.196	.468	-.115	.308	**.780**	.099	.480	.501	.394	.348
RV2	.269	.313	.121	.393	.432	.010	.422	.209	.178	.579	.370	.130	.288	.051	.298	**.771**	.207	.339	.529	.355	.323
RV3	.382	.311	.182	.437	.493	-.003	.458	.322	.151	.630	.337	.251	.297	.112	.431	**.845**	.337	.346	.645	.417	.270
RV4	.389	.291	.187	.439	.464	.014	.456	.304	.134	.649	.351	.264	.267	.102	.393	**.841**	.320	.312	.651	.380	.278
SE1	-.006	.504	.051	.357	.424	-.264	.473	.059	.453	.414	.553	.026	.638	-.221	.118	.411	-.001	**.856**	.281	.373	.406
SE2	.012	.445	.076	.302	.390	-.190	.393	.050	.420	.365	.516	.005	.566	-.168	.098	.349	.017	**.740**	.231	.292	.402
SE3	.023	.514	.062	.338	.444	-.230	.456	.073	.416	.423	.570	.047	.682	-.174	.105	.397	.016	**.854**	.242	.384	.407
SE4	.036	.473	.041	.336	.371	-.239	.406	.080	.350	.350	.493	.017	.579	-.147	.100	.338	.034	**.827**	.252	.336	.341
SM1	.461	.208	.228	.367	.345	.205	.280	.392	-.025	.478	.171	.212	.077	.300	.389	.483	.472	.160	**.745**	.308	.131
SM2	.315	.273	.174	.349	.376	.096	.304	.218	.084	.477	.302	.126	.197	.156	.302	.579	.316	.224	**.806**	.297	.237
SM3	.308	.326	.119	.371	.432	.013	.377	.226	.167	.551	.333	.142	.262	.067	.328	.605	.253	.304	**.821**	.358	.259
SM4	.344	.296	.168	.347	.435	.057	.378	.262	.116	.528	.301	.155	.240	.102	.355	.650	.299	.289	**.851**	.323	.265
SR1	.704	.162	.392	.156	.196	.468	.127	.722	-.284	.239	-.051	.370	-.154	.593	.491	.204	**.878**	-.036	.347	.223	.069
SR2	.709	.203	.361	.194	.269	.376	.178	.747	-.248	.303	-.021	.386	-.102	.484	.497	.264	**.867**	.027	.338	.253	.079
SR3	.642	.162	.416	.168	.248	.420	.154	.679	-.205	.263	-.016	.397	-.117	.546	.444	.249	**.849**	.015	.335	.199	.090
SR4	.623	.219	.339	.254	.263	.382	.186	.665	-.238	.307	.036	.366	-.085	.532	.445	.301	**.830**	.055	.384	.241	.106
SV1	.230	.302	.009	.377	.375	-.226	.443	.226	.303	.440	.392	.164	.398	-.054	.295	.390	.112	.391	.292	**.851**	.310
SV3	.486	.272	.240	.352	.349	.130	.349	.494	.055	.439	.226	.351	.151	.292	.470	.389	.448	.186	.383	**.724**	.252
SV4	.309	.332	.056	.442	.435	-.114	.480	.292	.281	.529	.407	.276	.442	.044	.360	.430	.223	.413	.369	**.887**	.319
SV5	.363	.320	.072	.432	.408	-.118	.466	.325	.261	.503	.406	.304	.391	.062	.403	.429	.239	.395	.309	**.856**	.302
SV6	.281	.254	.032	.386	.305	-.123	.429	.243	.254	.396	.350	.227	.354	.030	.312	.314	.154	.325	.282	**.825**	.299
SV7	.282	.329	.072	.441	.424	-.128	.492	.267	.292	.509	.416	.259	.413	.032	.349	.441	.196	.398	.377	**.868**	.323
WM1	.135	.575	.173	.258	.321	-.016	.319	.143	.300	.332	.399	.133	.383	-.026	.159	.341	.132	.419	.249	.322	**.783**
WM2	.048	.440	.212	.174	.191	.073	.170	.089	.220	.149	.343	.152	.273	.047	.086	.204	.119	.269	.154	.197	**.791**
WM3	.042	.514	.159	.295	.344	-.038	.310	.087	.334	.297	.423	.084	.465	-.072	.122	.345	.077	.417	.276	.302	**.841**
WM4	.026	.500	.129	.317	.338	-.101	.334	.040	.385	.317	.462	.085	.487	-.110	.117	.301	.016	.402	.207	.322	**.853**

Table B.3. Reliability Statistics and Latent Variable Correlations

	C.A.	C.R.	AVE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Affiliation	.907	.935	.782	**.884**																				
2. Appearance	.797	.868	.623	.178	**.790**																			
3. AutoFrust	.803	.868	.689	.372	.234	**.830**																		
4. AutoSatis	.733	.831	.553	.329	.323	.121	**.744**																	
5. Challenge	.744	.854	.662	.310	.439	.189	.520	**.814**																
6. CompFrust	.907	.933	.776	.366	-.050	.474	-.096	-.093	**.881**															
7. CompSatis	.821	.882	.650	.284	.387	.092	.684	.630	-.264	**.807**														
8. Competition	.769	.895	.811	.692	.258	.360	.271	.345	.314	.267	**.900**													
9. Continuance	.844	.905	.760	-.217	.347	-.084	.292	.320	-.420	.391	-.130	**.872**												
10. Enjoyment	.858	.904	.702	.410	.395	.172	.606	.704	-.087	.657	.349	.276	**.838**											
11. HealthAvoid	.787	.875	.701	.050	.475	.099	.339	.437	-.188	.429	.118	.458	.390	**.837**										
12. Marker	.941	.971	.945	.452	.153	.306	.254	.194	.237	.217	.403	-.058	.276	.060	**.972**									
13. PosHealth	.850	.899	.690	-.096	.570	-.007	.415	.482	-.358	.482	.001	.602	.424	.658	-.023	**.830**								
14. RelatFrust	.904	.932	.773	.518	-.022	.490	.050	-.012	.773	-.063	.499	-.467	.026	-.133	.324	-.352	**.879**							
15. RelatSatis	.891	.925	.754	.755	.196	.321	.443	.342	.234	.412	.545	-.007	.447	.124	.432	.074	.350	**.868**						
16. Revital	.825	.884	.656	.379	.403	.184	.541	.587	-.048	.575	.287	.247	.758	.437	.262	.409	.047	.444	**.810**					
17. SocialRec	.879	.917	.733	.783	.220	.438	.228	.286	.478	.190	.732	-.286	.327	.028	.443	-.133	.627	.550	.299	**.856**				
18. StrengEndur	.837	.891	.673	.019	.591	.069	.407	.497	-.283	.528	.133	.499	.474	.576	.030	.753	-.217	.128	.457	.019	**.820**			
19. StressMgmt	.821	.882	.651	.440	.345	.211	.445	.494	.110	.418	.322	.110	.633	.354	.196	.244	.188	.426	.720	.411	.306	**.807**		
20. Vitality	.913	.933	.700	.386	.362	.093	.486	.460	-.119	.532	.399	.292	.564	.426	.315	.434	.077	.435	.478	.270	.425	.400	**.837**	
21. WeightMgmt	.836	.889	.668	.079	.627	.200	.329	.378	-.037	.360	.131	.389	.350	.464	.134	.506	-.060	.153	.375	.101	.473	.278	.360	**.817**

Reliability

To gauge the consistency of our scales over time, reliability statistics can be used (Straub, 1989). In Table B.5, we provide three reliability statistics (Cronbach's alphas, composite reliabilities, and AVEs) for each of our scales. The guidelines state that the composite reliability should be > 0.70 and exceed the AVE value (Hair et al., 2006), which is true for each of our latent variables. A Cronbach's alpha of > 0.70 is recommended, although > 0.50 is considered acceptable (Davis, 1964; Peterson, 1994). The Cronbach's alphas for all of our scales are > 0.70. It is recommended that the AVE values should be > 0.5 (Fornell & Larcker, 1981; Hair et al., 2006), which is true for all our scales. The statistics thus indicate that our scales are reliable.

Multicollinearity

To check for multicollinearity concerns, the variance inflation factors (VIFs) can be used. Table B.4 contains the inner and outer VIFs provided for our items by SmartPLS. VIFs < 5.0 are recommended, but < 10.0 are acceptable (Cenfetelli & Bassellier, 2009; Peng & Lai, 2012). Specifically, the guidelines advise that VIFs > 5.0 indicate moderate multicollinearity and VIFs > 10.0 indicate severe multicollinearity issues (Larose & Larose, 2015). Table B.4 shows that all of the VIFs for the items in our model are below 5.0, which suggests multicollinearity is not an issue in our model.

Table B.4. Collinearity Statistics for All Items

Construct (Inner VIF)	Item	Outer VIF	Construct (Inner VIF)	Item	Outer VIF	Construct (Inner VIF)	Item	Outer VIF
Affiliation (4.656)	AF1	3.132	Continuance (2.025)	Cont1	2.163	Revitalization (3.339)	RV1	1.556
	AF2	2.568		Cont2	2.359		RV2	1.599
	AF3	2.748		Cont3	1.780		RV3	2.026
	AF4	2.567	Enjoyment (3.604)	EJ1	1.968		RV4	2.078
Appearance (2.302)	AP1	1.315		EJ2	2.137	Strength and endurance (2.844)	SE1	2.062
	AP2	1.514		EJ3	2.243		SE2	1.534
	AP3	2.075		EJ4	1.764		SE3	1.993
	AP4	2.228	Ill-health avoidance (2.058)	IH1	1.524		SE4	1.961
Autonomy frustration (1.582)	AUF1	1.784		IH2	1.727	Stress management (2.511)	SM1	1.454
	AUF3	1.811		IH3	1.758		SM2	1.852
	AUF4	1.626	Marker (1.417)	SP1	4.776		SM3	1.723
Autonomy satisfaction (2.233)	AUS1	1.344		SP2	4.776		SM4	2.121
	AUS2	1.387	Positive health (3.715)	PH1	1.989	Social recognition (4.044)	SR1	2.603
	AUS3	1.438		PH2	1.998		SR2	2.213
	AUS4	1.366		PH3	1.879		SR3	2.348
Challenge (2.479)	CH1	1.384		PH4	1.823		SR4	1.885
	CH2	1.515	Relatedness frustration (3.813)	REF1	2.988	Subjective vitality	SV1	2.689
	CH3	1.747		REF2	3.382		SV2	1.639
Competition (2.611)	CP3	1.641		REF3	3.111		SV3	3.192
	CP4	1.641		REF4	1.910		SV4	2.539
Competence frustration (3.129)	CPF1	2.748	Relatedness satisfaction (2.851)	RES1	2.287		SV5	2.302
	CPF2	2.479		RES2	2.550		SV7	2.838
	CPF3	2.753		RES3	2.716	Weight management (1.893)	WM1	1.505
	CPF4	2.756		RES4	2.209		WM2	1.950
Competence satisfaction (2.996)	CPS1	1.781					WM3	2.041
	CPS2	1.743					WM4	2.000
	CPS3	1.642						
	CPS4	1.692						

Addressing Common Method Bias

Common method bias (CMB) was dealt with a priori by taking several steps to improve data quality and attention, such as using validated measures and randomizing the appearance of items (Bagozzi, 2011; Lowry et al., 2016; MacKenzie & Podsakoff, 2012; Podsakoff et al., 2003). As a first check of CMB, all correlations were below the threshold of unreasonably high correlations of > .90 (Pavlou et al., 2007). Thus, only low levels of CMB were possible. We also collected a marker variable: symbolic patriotism (Parker, 2010). A marker variable should not be theoretically related to the latent variable of interest but should be subject to social desirability bias (Lindell & Whitney, 2001; Rönkkö & Ylitalo, 2011). The marker variable had low correlations with our constructs (see Table B.3). We included the marker variable in our model and while it was not significantly related to continuance, it was positively related to subjective vitality. Thus, it was a satisfactory but not ideal marker variable.

As a third technique, we used the procedure introduced by Liang et al. (2007) and recently suggested to be best practice by Schwarz et al. (2017). The intention of this check is to "measure the influence of a common latent method factor on each individual indicator in the model versus the influence of each indictor's corresponding construct (Podsakoff et al., 2003)" (Lowry et al., 2014, Appendix p. 3). To conduct this check in PLS, the following steps are taken (Lowry et al., 2014). First, for each indicator of one of the original latent variables, a new construct is created consisting of only the one indicator. Second, the original latent variable is then connected to each of its single indicator constructs making it a second-order reflective construct. Third, a method variable is created using all the indicator for all the latent variables. Finally, the method variable is connected to each of the single indicator constructs. The factor loadings are then examined; for our model, these are given in Table B.5. The average substantive factor loading in our model was 0.839 and the average variance explained for these loadings was 70.610%, whereas for the method variable the average factor loading was 0.470 and the average variance explained was 24.963%. The substantial difference between the two lends further support to the suggestion that common method bias is unlikely to be an issue in our model.

Table B.5. Common Latent Method Factor Analysis

	Substantive factor loading (s)	Variance explained (s^2)	Method factor loading (m)	Variance explained (m^2)
AF1	0.904	0.817	0.494	0.244
AF2	0.877	0.769	0.548	0.300
AF3	0.884	0.781	0.539	0.291
AF4	0.872	0.760	0.453	0.205
AP1	0.673	0.453	0.487	0.237
AP2	0.757	0.573	0.497	0.247
AP3	0.848	0.719	0.454	0.206
AP4	0.871	0.759	0.510	0.260
AUF1	0.854	0.729	0.290	0.084
AUF3	0.858	0.736	0.221	0.049
AUF4	0.828	0.686	0.281	0.079
AUS1	0.725	0.526	0.487	0.237
AUS2	0.745	0.555	0.482	0.232
AUS3	0.769	0.591	0.529	0.280
AUS4	0.742	0.551	0.588	0.346
CH1	0.766	0.587	0.529	0.280
CH2	0.806	0.650	0.653	0.426
CH3	0.866	0.750	0.623	0.388
CP3	0.899	0.808	0.441	0.194
CP4	0.903	0.815	0.526	0.277

CPF1	0.888	0.789	0.054	0.003
CPF2	0.872	0.760	-0.037	0.001
CPF3	0.889	0.790	0.000	0.000
CPF4	0.889	0.790	0.019	0.000
CPS1	0.820	0.672	0.616	0.379
CPS2	0.811	0.658	0.594	0.353
CPS3	0.793	0.629	0.611	0.373
CPS4	0.802	0.643	0.606	0.367
Cont1	0.880	0.774	0.352	0.124
Cont2	0.899	0.808	0.328	0.108
Cont3	0.840	0.706	0.227	0.052
EJ1	0.834	0.696	0.687	0.472
EJ2	0.851	0.724	0.664	0.441
EJ3	0.862	0.743	0.703	0.494
EJ4	0.803	0.645	0.699	0.489
IH1	0.811	0.658	0.512	0.262
IH2	0.848	0.719	0.475	0.226
IH3	0.853	0.728	0.463	0.214
SP1	0.972	0.945	0.393	0.154
SP2	0.972	0.945	0.390	0.152
PH1	0.841	0.707	0.493	0.243
PH2	0.841	0.707	0.494	0.244
PH3	0.824	0.679	0.444	0.197
PH4	0.815	0.664	0.481	0.231
REF1	0.894	0.799	0.144	0.021
REF2	0.913	0.834	0.117	0.014
REF3	0.903	0.815	0.109	0.012
REF4	0.813	0.661	0.178	0.032
RES1	0.860	0.740	0.550	0.303
RES2	0.874	0.764	0.561	0.315
RES3	0.886	0.785	0.557	0.310
RES4	0.853	0.728	0.531	0.282
RV1	0.769	0.591	0.632	0.399
RV2	0.778	0.605	0.584	0.341
RV3	0.842	0.709	0.670	0.449
RV4	0.848	0.719	0.654	0.428
SE1	0.852	0.726	0.542	0.294
SE2	0.751	0.564	0.479	0.229
SE3	0.845	0.714	0.548	0.300
SE4	0.830	0.689	0.493	0.243
SM1	0.738	0.545	0.522	0.272
SM2	0.821	0.674	0.531	0.282
SM3	0.807	0.651	0.584	0.341
SM4	0.859	0.738	0.587	0.345
SR1	0.885	0.783	0.399	0.159
SR2	0.857	0.734	0.445	0.198
SR3	0.865	0.748	0.411	0.169
SR4	0.819	0.671	0.449	0.202
SV1	0.855	0.731	0.582	0.339
SV2	0.720	0.518	0.596	0.355
SV3	0.887	0.787	0.664	0.441
SV4	0.852	0.726	0.652	0.425
SV5	0.829	0.687	0.553	0.306

SV7	0.869	0.755	0.652	0.425
WM1	0.750	0.563	0.488	0.238
WM2	0.835	0.697	0.342	0.117
WM3	0.845	0.714	0.474	0.225
WM4	0.846	0.716	0.467	0.218
Averages:	0.839	70.610%	0.470	24.963%

APPENDIX C. Structural Model Results

Table C.1 provides the detailed results for the full structural model shown in the main manuscript with the covariates (Model 2). We also provide results for the model without the covariates (Model 1). The final R^2 results for Model 1 are as follows: BPNs satisfaction (R^2 = 0.644), BPNs frustration (R^2 = .0.484), subjective vitality (R^2 = 0.480), and fitness technology continuance (R^2 = 0.492). The final R^2 results for Model 2 are as follows: BPNs satisfaction (R^2 = 0.644), BPNs frustration (R^2 = 0.484), subjective vitality (R^2 = 0.499), and fitness technology continuance (R^2 = 0.514). The total effects for the structural model are provided in Table C.2.

Table C.1. Detailed Results of Tested Hypotheses and Covariates for Full Dataset (n=670)

Tested path	**β**	**t-statistic**	***p*-value**	**β**	**t-statistic**	***p*-value**
Hypotheses	**Model 1 (no covariates)**			**Model 2 (with covariates)**		
H1a. Enjoyment goal → subjective vitality	0.241***	3.634	<0.001	0.227***	3.741	<0.001
H1b. Challenge goal → subjective vitality	-0.075 (n/s)	1.491	0.068	-0.082*	1.668	0.048
H1c. Stress management goal → subjective vitality	0.022 (n/s)	0.403	0.344	0.042 (n/s)	0.794	0.214
H1d. Revitalization goal → subjective vitality	-0.047 (n/s)	0.765	0.222	-0.054 (n/s)	0.862	0.194
H2a. Social recognition goal → subjective vitality	-0.130*	2.138	0.016	-0.155**	2.606	0.005
H2b. Affiliation goal → subjective vitality	0.175***	3.058	0.001	0.178***	3.057	0.001
H2c. Competition goal → subjective vitality	0.252***	4.787	<0.001	0.230***	4.143	<0.001
H3a. Ill-health avoidance goal → subjective vitality	0.116**	2.676	0.004	0.118**	2.615	0.005
H3b. Positive health goal → subjective vitality	0.201***	3.204	0.001	0.207***	3.120	0.001
H3c. Strength and endurance goal → subjective vitality	0.017 (n/s)	0.309	0.379	0.026 (n/s)	0.484	0.314
H3d. Appearance goal → subjective vitality	-0.073*	1.641	0.050	-0.082*	1.801	0.036
H3e. Weight management goal → subjective vitality	0.102**	2.296	0.011	0.102**	2.358	0.009
H4a. Enjoyment goal → continuance	0.018 (n/s)	0.293	0.385	0.009 (n/s)	0.148	0.441
H4b. Challenge goal → continuance	0.056 (n/s)	1.112	0.133	0.047 (n/s)	0.931	0.176
H4c. Stress management goal → continuance	-0.009 (n/s)	0.225	0.411	0.000 (n/s)	0.000	0.500
H4d. Revitalization goal → continuance	-0.043 (n/s)	0.857	0.196	-0.054 (n/s)	1.046	0.148
H5a. Social recognition goal → continuance	-0.141**	2.473	0.007	-0.145**	2.656	0.004
H5b. Affiliation goal → continuance	-0.116**	2.317	0.010	-0.095*	1.999	0.023
H5c. Competition goal → continuance	-0.011 (n/s)	0.221	0.413	-0.009 (n/s)	0.187	0.426
H6a. Ill-health avoidance goal → continuance	0.123**	2.857	0.002	0.126***	2.984	0.001
H6b. Positive health goal → continuance	0.194***	3.102	0.001	0.172**	2.762	0.003
H6c. Strength and endurance goal → continuance	0.053 (n/s)	0.984	0.163	0.060 (n/s)	1.119	0.132
H6d. Appearance goal → continuance	0.043 (n/s)	0.969	0.166	0.051 (n/s)	1.131	0.129
H6e. Weight management goal → continuance	0.122***	3.063	0.001	0.101**	2.462	0.007
H7a. Enjoyment goal → BPNs satisfaction	0.254***	5.431	<0.001	0.254***	5.356	<0.001
H7b. Challenge goal → BPNs satisfaction	0.142***	3.516	<0.001	0.142***	3.496	<0.001
H7c. Stress management goal → BPNs satisfaction	-0.021 (n/s)	0.539	0.295	-0.021 (n/s)	0.549	0.292

H7d. Revitalization goal → BPNs satisfaction	0.143**	2.889	0.002	0.143**	2.930	0.002
H8a. Social recognition goal → BPNs satisfaction	-0.142**	2.857	0.002	-0.142**	2.924	0.002
H8b. Affiliation goal → BPNs satisfaction	0.442***	9.869	<0.001	0.442***	10.040	<0.001
H8c. Competition goal → BPNs satisfaction	0.062 (n/s)	1.298	0.097	0.062 (n/s)	1.320	0.093
H9a. Ill-health avoidance goal → BPNs satisfaction	-0.016 (n/s)	0.462	0.322	-0.016 (n/s)	0.484	0.314
H9b. Positive health goal → BPNs satisfaction	0.154**	2.950	0.002	0.154**	2.959	0.002
H9c. Strength and endurance goal → BPNs satisfaction	0.082*	1.700	0.045	0.082*	1.690	0.046
H9d. Appearance goal → BPNs satisfaction	-0.061 (n/s)	1.464	0.072	-0.061 (n/s)	1.416	0.078
H9e. Weight management goal → BPNs satisfaction	0.057 (n/s)	1.462	0.072	0.057 (n/s)	1.441	0.075
H10a. Enjoyment goal → BPNs frustration	-0.139**	2.841	0.002	-0.139**	2.873	0.002
H10b. Challenge goal → BPNs frustration	-0.056 (n/s)	1.448	0.074	-0.056 (n/s)	1.456	0.073
H10c. Stress management goal → BPNs frustration	0.100**	2.568	0.005	0.100**	2.554	0.005
H10d. Revitalization goal → BPNs frustration	-0.017 (n/s)	0.352	0.363	-0.017 (n/s)	0.359	0.360
H11a. Social recognition goal → BPNs frustration	0.383***	6.924	<0.001	0.383***	6.852	<0.001
H11b. Affiliation goal → BPNs frustration	0.029 (n/s)	0.588	0.278	0.029 (n/s)	0.585	0.279
H11c. Competition goal → BPNs frustration	0.239***	4.236	<0.001	0.239***	4.231	<0.001
H12a. Ill-health avoidance goal → BPNs frustration	0.017 (n/s)	0.462	0.322	0.017 (n/s)	0.464	0.321
H12b. Positive health goal → BPNs frustration	-0.178***	3.718	<0.001	-0.178***	3.688	<0.001
H12c. Strength and endurance goal → BPNs frustration	-0.096*	2.122	0.017	-0.096*	2.058	0.020
H12d. Appearance goal → BPNs frustration	0.005 (n/s)	0.131	0.448	0.005 (n/s)	0.128	0.449
H12e. Weight management goal → BPNs frustration	0.092**	2.610	0.005	0.092**	2.592	0.005
H13a. BPNs satisfaction → subjective vitality	0.202***	3.573	<0.001	0.160**	2.864	0.002
H13b. BPNs frustration → subjective vitality	-0.087**	2.327	0.010	-0.107**	2.610	0.005
H14a. BPNs satisfaction → continuance	0.198***	3.630	<0.001	0.198***	3.575	<0.001
H14b. BPNs frustration → continuance	-0.207***	5.369	<0.001	-0.168***	4.164	<0.001
Gender → subjective vitality				-0.040 (n/s)	1.288	0.099
Gender → continuance				-0.005 (n/s)	0.167	0.434
Age → subjective vitality				-0.018 (n/s)	0.560	0.288
Age → continuance				0.003 (n/s)	0.101	0.460
Education → subjective vitality				-0.025 (n/s)	0.725	0.234
Education → continuance				-0.002 (n/s)	0.061	0.476
Employment → subjective vitality				-0.008 (n/s)	0.261	0.397
Employment → continuance				0.010 (n/s)	0.360	0.360
DaysExercise → subjective vitality				0.012 (n/s)	0.334	0.369
DaysExercise → continuance				0.037 (n/s)	1.103	0.135
FTProf → subjective vitality				0.063*	1.811	0.035
FTProf → continuance				0.000 (n/s)	0.011	0.495
FreqFTUse → subjective vitality				0.005 (n/s)	0.181	0.428

FreqFTUse → continuance				-0.092**	2.625	0.004
LengthFTUse → subjective vitality				0.029 (n/s)	0.932	0.176
LengthFTUse → continuance				0.060*	2.031	0.021
NoFriends → subjective vitality				-0.004 (n/s)	0.145	0.442
NoFriends → continuance				-0.090**	2.412	0.008
Marker → subjective vitality				0.124***	3.134	0.001
Marker → continuance				0.025 (n/s)	0.796	0.213

*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$, n/s = not significant

Table C.2. Total Effects (n=670)

Construct	BPNs satisfactions	BPNs frustration	Subjective vitality	Continuance
Enjoyment goal	0.254	-0.139	0.283	0.082
Challenge goal	0.142	-0.056	-0.053	0.085
Stress Management goal	-0.021	0.100	0.028	-0.021
Revitalization goal	0.143	-0.017	-0.029	-0.023
Social Recognition goal	-0.142	0.383	-0.219	-0.237
Affiliation goal	0.442	0.029	0.246	-0.012
Competition goal	0.062	0.239	0.215	-0.037
Ill-health avoidance goal	-0.016	0.017	0.113	0.120
Positive health goal	0.154	-0.178	0.251	0.232
Strength and endurance goal	0.082	-0.096	0.050	0.093
Appearance goal	-0.061	0.005	-0.092	0.038
Weight management goal	0.057	0.092	0.101	0.096
BPNs satisfaction			0.160	0.198
BPNs frustration			-0.107	-0.168
Covariates				
Gender			-0.040	-0.005
Age			-0.018	0.003
Education			-0.025	-0.002
Employment			-0.008	0.010
DaysExercise			0.012	0.037
FTProf			0.063	0.000
FreqFTUse			0.005	-0.092
LengthFTUse			0.029	0.060
NoFriends			-0.004	-0.090
Marker			0.124	0.025

Mediation Testing

To test for mediation, the Baron & Kenny (1986) and Sobel (1982) tests have traditionally been used. However, with more computing power available to researchers, other methods have become more prevalent. The bootstrapping method is the leading approach. It was developed in behavioral research (Hayes, 2009; MacKinnon, 2008) and has been recently introduced into IS research (e.g., Vance et al., 2015). This method has several advantages (Vance et al., 2015): it provides greater statistical power, allows for the direct measurement of "indirect effects," and does not assume a normal distribution, which is the case in the Sobel (1982) method.

In the bootstrapping method, we resampled (from the obtained sample) with replacement 5,000 times (Hayes, 2009). In each resample, we obtained the product (*ab*) by multiplying the coefficients in paths *a* (i.e., independent variable → mediating variable) and *b* (i.e., mediating variable → dependent variable), which estimated the indirect effect in the resample (MacKinnon, 2008). The coefficient corresponding to *c′* was also obtained, which is the path coefficient from the independent variable to the dependent variable. Sorting the values of *ab* and *c′* in ascending order yields a percentile-based confidence interval *ci*%. To do this, the ordinal positions of *ab* and *c′* corresponding to the bounds of our interval were calculated using the formula $k(.5 - ci/200)$ for the lower bound and the formula $1 + k(.5 + ci/200)$ for the upper bound (Hayes, 2009). In this case, *k* was the number of resamples mentioned earlier. We assumed a standard 95% confidence interval, so our ordinal ranges were 125 (lower bound) and 4,876 (upper bound).

Observing the confidence interval *ab*, if we did not find zero between the upper and lower bounds, we could conclude with a confidence of *ci*% that the indirect effect existed; that is, that it was not zero (MacKinnon, 2008). Examining the confidence interval for *c′* allowed us to infer whether the mediation was full or partial. If *ab* were nonzero and *c′* were zero, full mediation could be inferred; otherwise, if

both *ab* and *c′* were nonzero, partial mediation could be inferred.

Additional Analysis

In Table C.3, we provide results for the disaggregated model, in which BPNs satisfaction and frustration are not modeled as second-order factors.

Table C.3. Detailed Results of Disaggregated Model (n=670)

Tested path	β	t-statistic	*p*-value
Enjoyment goal → autonomy satisfaction	0.293***	5.134	<0.001
Enjoyment goal → competence satisfaction	0.295***	4.785	<0.001
Enjoyment goal → relatedness satisfaction	0.044 (n/s)	0.892	0.373
Enjoyment goal → autonomy frustration	-0.106 (n/s)	1.383	0.167
Enjoyment goal → competence frustration	-0.162**	2.874	0.004
Enjoyment goal → relatedness frustration	-0.093*	2.118	0.034
Enjoyment goal → subjective vitality	0.229***	3.721	<0.001
Enjoyment goal → continuance	0.009 (n/s)	0.144	0.886
Challenge goal → autonomy satisfaction	0.099 (n/s)	1.914	0.056
Challenge goal → competence satisfaction	0.239***	4.562	<0.001
Challenge goal → relatedness satisfaction	-0.006 (n/s)	0.133	0.894
Challenge goal → autonomy frustration	0.048 (n/s)	0.831	0.406
Challenge goal → competence frustration	-0.059 (n/s)	1.255	0.210
Challenge goal → relatedness frustration	-0.067 (n/s)	1.700	0.089
Challenge goal → subjective vitality	-0.065 (n/s)	1.412	0.158
Challenge goal → continuance	0.025 (n/s)	0.488	0.625
Stress management goal → autonomy satisfaction	0.038 (n/s)	0.726	0.468
Stress management goal → competence satisfaction	-0.085 (n/s)	1.790	0.074
Stress management goal → relatedness satisfaction	0.004 (n/s)	0.095	0.924
Stress management goal → autonomy frustration	-0.001 (n/s)	0.018	0.985
Stress management goal → competence frustration	0.117**	2.608	0.009
Stress management goal → relatedness frustration	0.078*	1.978	0.048
Stress management goal → subjective vitality	0.044 (n/s)	0.826	0.409
Stress management goal → continuance	0.009 (n/s)	0.213	0.831
Revitalization goal → autonomy satisfaction	0.094 (n/s)	1.429	0.153
Revitalization goal → competence satisfaction	0.122*	2.035	0.042
Revitalization goal → relatedness satisfaction	0.133**	2.669	0.008
Revitalization goal → autonomy frustration	0.031 (n/s)	0.480	0.632
Revitalization goal → competence frustration	-0.038 (n/s)	0.714	0.475
Revitalization goal → relatedness frustration	-0.020 (n/s)	0.441	0.659
Revitalization goal → subjective vitality	-0.055 (n/s)	0.984	0.325
Revitalization goal → continuance	-0.055 (n/s)	1.051	0.293
Social recognition goal → autonomy satisfaction	-0.089 (n/s)	1.626	0.104
Social recognition goal → competence satisfaction	-0.098 (n/s)	1.696	0.090
Social recognition goal → relatedness satisfaction	-0.132**	2.683	0.007
Social recognition goal → autonomy frustration	0.314***	4.267	<0.001
Social recognition goal → competence frustration	0.433***	7.907	<0.001
Social recognition goal → relatedness frustration	0.441***	8.832	<0.001
Social recognition goal → subjective vitality	-0.152**	2.649	0.008
Social recognition goal → continuance	-0.142**	2.810	0.005
Affiliation goal → autonomy satisfaction	0.200***	3.648	<0.001
Affiliation goal → competence satisfaction	0.153**	2.936	0.003
Affiliation goal → relatedness satisfaction	0.752***	16.670	<0.001
Affiliation goal → autonomy frustration	0.083 (n/s)	1.206	0.228

Affiliation goal → competence frustration	0.051 (n/s)	0.956	0.339
Affiliation goal → relatedness frustration	0.070 (n/s)	1.511	0.131
Affiliation goal → subjective vitality	0.183**	2.931	0.003
Affiliation goal → continuance	-0.125*	2.191	0.029
Competition goal → autonomy satisfaction	0.020 (n/s)	0.353	0.724
Competition goal → competence satisfaction	0.016 (n/s)	0.364	0.716
Competition goal → relatedness satisfaction	0.081 (n/s)	1.722	0.085
Competition goal → autonomy frustration	0.050 (n/s)	0.805	0.421
Competition goal → competence frustration	0.042 (n/s)	0.916	0.360
Competition goal → relatedness frustration	0.172***	3.763	<0.001
Competition goal → subjective vitality	0.183***	3.713	<0.001
Competition goal → continuance	0.049 (n/s)	1.250	0.212
Ill-health avoidance goal → autonomy satisfaction	-0.035 (n/s)	0.734	0.463
Ill-health avoidance goal → competence satisfaction	0.042 (n/s)	1.128	0.259
Ill-health avoidance goal → relatedness satisfaction	-0.056 (n/s)	1.536	0.125
Ill-health avoidance goal → autonomy frustration	0.053 (n/s)	1.201	0.230
Ill-health avoidance goal → competence frustration	-0.021 (n/s)	0.508	0.612
Ill-health avoidance goal → relatedness frustration	0.053 (n/s)	1.405	0.160
Ill-health avoidance goal → subjective vitality	0.109*	2.427	0.015
Ill-health avoidance goal → continuance	0.129**	3.133	0.002
Positive health goal → autonomy satisfaction	0.210***	3.654	<0.001
Positive health goal → competence satisfaction	0.056 (n/s)	0.901	0.368
Positive health goal → relatedness satisfaction	0.124*	2.451	0.014
Positive health goal → autonomy frustration	-0.114 (n/s)	1.921	0.055
Positive health goal → competence frustration	-0.160**	2.992	0.003
Positive health goal → relatedness frustration	-0.233***	4.418	<0.001
Positive health goal → subjective vitality	0.217***	3.608	<0.001
Positive health goal → continuance	0.160**	2.687	0.007
Strength and endurance goal → autonomy satisfaction	0.035 (n/s)	0.552	0.581
Strength and endurance goal → competence satisfaction	0.178**	3.038	0.002
Strength and endurance goal → relatedness satisfaction	-0.021 (n/s)	0.430	0.667
Strength and endurance goal → autonomy frustration	-0.015 (n/s)	0.233	0.816
Strength and endurance goal → competence frustration	-0.128**	2.588	0.010
Strength and endurance goal → relatedness frustration	-0.053 (n/s)	1.184	0.237
Strength and endurance goal → subjective vitality	0.030 (n/s)	0.591	0.555
Strength and endurance goal → continuance	0.050 (n/s)	0.945	0.345
Appearance goal → autonomy satisfaction	-0.073 (n/s)	1.336	0.182
Appearance goal → competence satisfaction	-0.040 (n/s)	0.811	0.417
Appearance goal → relatedness satisfaction	-0.044 (n/s)	0.994	0.321
Appearance goal → autonomy frustration	0.123*	2.160	0.031
Appearance goal → competence frustration	0.003 (n/s)	0.068	0.946
Appearance goal → relatedness frustration	-0.027 (n/s)	0.611	0.542
Appearance goal → subjective vitality	-0.059 (n/s)	1.328	0.185
Appearance goal → continuance	0.032 (n/s)	0.746	0.456
Weight management goal → autonomy satisfaction	0.077 (n/s)	1.571	0.116
Weight management goal → competence satisfaction	0.034 (n/s)	0.665	0.506
Weight management goal → relatedness satisfaction	0.036 (n/s)	1.032	0.302
Weight management goal → autonomy frustration	0.108*	2.424	0.016
Weight management goal → competence frustration	0.114**	2.844	0.005
Weight management goal → relatedness frustration	0.036 (n/s)	1.045	0.296
Weight management goal → subjective vitality	0.119**	2.756	0.006
Weight management goal → continuance	0.091*	2.147	0.032
Autonomy satisfaction → continuance	0.033 (n/s)	0.780	0.435

Autonomy satisfaction → subjective vitality	0.016 (n/s)	0.337	0.737
Competence satisfaction → continuance	0.140**	2.622	0.009
Competence satisfaction → subjective vitality	0.064 (n/s)	1.233	0.218
Relatedness satisfaction → continuance	0.109*	2.383	0.017
Relatedness satisfaction → subjective vitality	0.075 (n/s)	1.452	0.147
Autonomy frustration → continuance	0.045 (n/s)	1.562	0.119
Autonomy frustration → subjective vitality	-0.119**	3.154	0.002
Competence frustration → continuance	0.046 (n/s)	0.977	0.329
Competence frustration → subjective vitality	-0.223***	4.095	<0.001
Relatedness frustration → continuance	-0.292***	5.123	<0.001
Relatedness frustration → subjective vitality	0.253***	4.555	<0.001
Gender → continuance	-0.024 (n/s)	0.825	0.410
Gender → subjective vitality	-0.014 (n/s)	0.462	0.644
Age → continuance	0.010 (n/s)	0.388	0.698
Age → subjective vitality	-0.011 (n/s)	0.357	0.721
Education → continuance	-0.003 (n/s)	0.089	0.929
Education → subjective vitality	-0.017 (n/s)	0.535	0.593
Employment → continuance	0.006 (n/s)	0.229	0.819
Employment → subjective vitality	0.002 (n/s)	0.067	0.947
DaysExercise → continuance	0.054 (n/s)	1.577	0.115
DaysExercise → subjective vitality	-0.005 (n/s)	0.141	0.888
FTProf → continuance	0.002 (n/s)	0.073	0.942
FTProf → subjective vitality	0.064 (n/s)	1.832	0.067
FreqFTUse → continuance	-0.077*	2.224	0.026
FreqFTUse → subjective vitality	-0.020 (n/s)	0.717	0.473
LengthFTUse → continuance	0.060*	1.995	0.046
LengthFTUse → subjective vitality	0.020 (n/s)	0.656	0.512
NoFriends → continuance	-0.092**	2.625	0.009
NoFriends → subjective vitality	-0.007 (n/s)	0.257	0.798
Marker → continuance	0.013 (n/s)	0.426	0.670
Marker → subjective vitality	0.128***	3.516	<0.001

*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$, n/s = not significant

References for Appendices

Bagozzi, R. P. (2011). Measurement and meaning in information systems and organizational research: Methodological and philosophical foundations. *MIS Quarterly,* 35(2), 261-292.

Baron, R. & Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology,* 51(6), 1173-1182.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly,* 25(3), 351-370.

Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the subjective vitality scale using structural equation modeling. *Social Indicators Research,* 52(3), 313-324.

Cenfetelli, R. T. & Bassellier, G. (2009). Interpretation of formative measurement in information systems research. *MIS Quarterly,* 33(4), 689-707.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Duriez, B., et al. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion,* 39(2), 216-236.

Davis, F. B. (1964). *Educational Measurements and their Interpretation*. Belmont, CA: Wadsworth Publishing Company.

Deci, E. L. & Ryan, R. M. (2012). Self-determination theory, In P. A. M. Van Lange, A. W. Kruglanski &

E. T. Higgins (Eds.), *Handbook of Theories of Social Psychology* (Vol. 1). London: Sage.
Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research,* 18(1), 39-50.
Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems,* 4(1), 2-77.
Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis*. Upper Saddle River, NJ: Pearson Prentice Hall.
Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs,* 76(4), 408-420.
Larose, D. T. & Larose, C. D. (2015). *Data Mining and Predictive Analytics, 2nd Edition*. Hoboken, NJ: Wiley.
Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly,* 31(1), 59-87.
Lindell, M. K. & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology,* 86(1), 114.
Lowry, P. B., D'Arcy, J., Hammer, B., & Moody, G. D. (2016). "Cargo Cult" science in traditional organization and information systems survey research: A case for using nontraditional methods of data collection, including Mechanical Turk and online panels. *Journal of Strategic Information Systems,* 25(3), 232-240.
Lowry, P. B. & Gaskin, J. (2014). Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE Transactions on Professional Communication,* 57(2), 123-146.
Lowry, P. B., Wilson, D. W., & Haig, W. L. (2014). A picture is worth a thousand words: Source credibility theory applied to logo and website design for heightened credibility and consumer trust. *International Journal of Human-Computer Interaction,* 30(1), 63-93.
MacKenzie, S. B. & Podsakoff, P. M. (2012). Common method bias in marketing: Causes, mechanisms, and procedural remedies. *Journal of Retailing,* 88(4), 542-555.
MacKinnon, D. P. (2008). *Introduction to Statistical Mediation Analysis*. New York, NY: Erlbaum.
Markland, D. & Hardy, L. (1993). The exercise motivations inventory: Preliminary development and validity of a measure of individuals' reasons for participation in regular physical exercise. *Personality and Individual Differences,* 15(3), 289-296.
Markland, D. & Ingledew, D. K. (1997). The measurement of exercise motives: Factorial validity and invariance across gender of a revised exercise motivations inventory. *British Journal of Health Psychology,* 2(4), 361-376.
Ng, J. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J. L., et al. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science,* 7(4), 325-340.
Parker, C. S. (2010). Symbolic versus blind patriotism: Distinction without difference? *Political Research Quarterly,* 63(1), 97-114.
Pavlou, P. A., Liang, H., & Xue, Y. (2007). Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective. *MIS Quarterly,* 31(1), 105-136.
Peng, D. X. & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management,* 30(6), 467-480.
Peterson, R. A. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research,* 21(2), 381-391.
Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology,* 88(5), 879-903.
Rönkkö, M. & Ylitalo, J. (2011). *PLS marker variable approach to diagnosing and controlling for method variance.* Paper presented at the Thirty-Second International Conference on Information Systems, Shanghai, PRC, 1-16.

Rose, E. A., Markland, D., & Parfitt, G. (2001). The development and initial validation of the exercise causality orientations scale. *Journal of Sports Sciences,* 19(6), 445-462.

Rose, E. A., Parfitt, G., & Williams, S. (2005). Exercise causality orientations, behavioural regulation for exercise and stage of change for exercise: exploring their relationships. *Psychology of Sport and Exercise,* 6(4), 399-414.

Ryan, R. M. & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality,* 65(3), 529-565.

Schwarz, A., Rizzuto, T., Carraher-Wolverton, C., Roldán, J. L., & Barrera-Barrera, R. (2017). Examining the Impact and Detection of the Urban Legend of Common Method Bias. *The DATABASE for Advances in Information Systems,* 48(1), 93-119.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology,* 13(290-312.

Staples, D. S., Hulland, J. S., & Higgins, C. A. (1999). A self-efficacy theory explanation for the management of remote workers in virtual organizations. *Organization Science,* 10(6), 758-776.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems,* 13(1), 380-426.

Straub, D. W. (1989). Validating instruments in MIS research. *MIS Quarterly,* 13(2), 147-169.

Vance, A., Lowry, P. B., & Eggett, D. (2015). Increasing accountability through user-interface design artifacts: A new approach to addressing the problem of access-policy violations. *MIS Quarterly,* 39(2), 345-366.

Zhou, Z., Fang, Y., Vogel, D. R., Jin, X.-L., & Zhang, X. (2012). Attracted to or locked in? Predicting continuance intention in social virtual world services. *Journal of Management Information Systems,* 29(1), 273-306.