

University of Galway Research Repository

How the social dimension of fitness apps can enhance and undermine wellbeing: A dual model of passion perspective

Title	How the social dimension of fitness apps can enhance and undermine wellbeing: A dual model of passion perspective
Author(s)	Whelan, Eoin;Clohessy, Trevor
Publication Date	2020-01-02
Publication information	Whelan, Eoin, & Clohessy, Trevor. (2020). How the social dimension of fitness apps can enhance and undermine wellbeing: A dual model of passion perspective. Information Technology and People. doi:10.1108/ITP-04-2019-0156
Publisher	Emerald
Link to publisher's version	https://doi.org/10.1108/ITP-04-2019-0156
Item record	http://hdl.handle.net/10379/16028

How the social dimension of fitness apps can enhance and undermine wellbeing: A dual model of passion perspective

Abstract

Purpose

While the positive health benefits of fitness apps, which motivate and track physical exercise, are widely acknowledged, the adverse connection between these technologies and wellbeing has received little attention. The purpose of this study is to determine how the social dimensions of fitness apps predict the type of passion (harmonious and obsessive) one has for physical exercise, and what the resulting positive and negative implications are for wellbeing.

Design

Drawing from the theoretical frameworks of passion and social influence, this study develops a model depicting how fitness apps relate to the causes and consequences of harmonious and obsessive passion for exercise. Survey data were collected from 272 fitness app using cyclists and analysed with partial least squares structural equation modelling techniques.

Findings

Different social influence aspects of fitness apps appeal to different types of exercisers. A harmonious passion for physical exercise is predicted by the positive reciprocal benefits attained from one's fitness app community, while an obsessive passion is predicted by positive recognition. In turn, a harmonious passion for exercise is negatively associated with life burnout, while an obsessive passion strongly affirms that relationship. In addition, the relationship between social influence and life burnout is fully mediated by the type of passion a fitness app user possesses.

Originality/Value

Our study demonstrates the efficacy of the dual model of passion in explaining the opposing wellbeing outcomes associated with the social influence aspects of fitness apps.

Keywords: Social influence, passion, wellbeing, fitness app, Strava

1. Introduction

To motivate people to exercise, modern physical fitness applications (apps), such as Strava, Nike+, MyFitnessPal, RunKeeper, and Fitocracy, are gamified to provide a variety of rewards to users based on the tracking and analysis of their digital trace data e.g. the number of steps walked per day, calories burned, or average speed of a cycle or run. The market for fitness apps has exploded in recent years as people turn to self-tracking and gamification to motivate and sustain physical activity. For instance, in the United States alone, 92 million people use fitness apps contributing to a market volume of US\$602.0m in 2019 (Statista 2019).

It has been argued that fitness apps have fundamentally altered peoples' physical exercise experiences (Barratt, 2017; Kerner and Goodyear, 2017). A training session today, such as a bike ride or a run, is no longer a memory that just happened. Through a network of satellites, GPS units, computers, power meters, heart monitors, and smartphones, physical exercise has become a quantifiable manifestation of individual digital achievement that endures and can be shared with friends and strangers (Barratt, 2017).

A number of empirical studies have investigated the altered exercise experiences mediated by fitness apps, and largely report positively on the health benefits of using these technologies to monitor physical activity (see Sharon, 2017 for a review). However, the potential negative implications of fitness apps on wellbeing has received limited attention (Barratt, 2017). Moreover, as many fitness apps are designed to exploit peer pressure (e.g. sharing workout data, giving virtual praise) and social comparisons (e.g. leader boards and challenges), scholars have specifically called for future studies which consider; (1) how the social dimension of fitness apps affects the maintenance of difficult exercise habits (Hamari and Koivisto, 2015), and (2) how the motivations of users to engage with the social features of fitness apps enhance or undermine wellness outcomes (James, Wallace and Deane, 2019). In this paper, we attempt to address this neglected and important area of research. To do so, we draw from the theoretical frameworks of social influence and passion to investigate how the social dimensions of fitness apps predict the type of passion (harmonious and obsessive) one has for physical exercise, and what the resulting positive and negative implications are for wellbeing.

Consistent with the views of Rockmann & Gewald (2017), we suspect engagement with the different social dimensions of fitness apps will be associated with both positive and negative outcomes. For example, there is qualitative evidence to suggest fitness apps

motivate users to exercise more frequently, and at a greater intensity (Barratt, 2017). This increase in exercise activity can potentially lead to improved health and wellbeing, but also exercise addiction, which is characterised by increasing exercise amounts, tolerance, withdrawal symptoms and continuing exercise in spite of pain and injury (Adams and Kirkby, 2002). Indeed, with the growing interest in the “quantifiable self”, there is much anecdotal evidence that users are becoming obsessed with the self-tracking data produced by fitness apps to the detriment of self-worth and important social relationships (De Neef, 2014; Foss, 2014; Reynolds, 2018). Hence, we draw from the dual model of passion (DMP; Vallerand 2015) to determine the adaptive and maladaptive outcomes associated with the social influence aspects of fitness apps.

Our study makes theoretical and practical contributions. On the theoretical front, we contribute to the literature on the duality of IT use (Turel and Serenko, 2012; Soror *et al.*, 2015; Islam *et al.*, 2019) by demonstrating how social aspects of fitness apps appeal differently to both harmonious and obsessive exercisers, a result of which is significantly different wellness outcomes. Our findings also have implications for fitness app users. Individuals are adopting fitness apps in an effort to improve their physical wellbeing, which of course is a worthy pursuit. But when motivated by certain aspects of social influence and the affordances of digital trace data, an unintended consequence of fitness app use emerges in that a healthy passion for exercise can traverse into an unhealthy obsession with adverse life outcomes.

2. Theoretical Background

2.1. Research on Fitness Apps

Fitness apps can be considered a persuasive technology (Fogg, 2009) designed to improve wellbeing by providing functions that support a user’s motivation to exercise. Within the expanding body of fitness app literature, scholars have generally focused on two questions – why do people use fitness apps, and what actual outcomes result from fitness app use?

In addressing the first question, studies have applied theories of self-determination (Kerner and Goodyear, 2017; James *et al.*, 2019), goal motivations (Hamari *et al.*, 2018; Wolf *et al.*, 2018), and uses and gratifications (Stragier *et al.*, 2016), to explain users varying degrees of engagement with fitness apps. For example, James *et al.* (2019) find that the

fitness app features adopted depends upon the exerciser's motivations. Both intrinsically and extrinsically motivated exercisers were more likely to engage with the social interaction features of fitness apps (e.g. sharing data, social comparison, offering support), but only the extrinsically motivated users engaged with exercise control features (e.g. rewards, reminders, setting goals). Social motivations have also been found to predict both fitness app use (Stragier *et al.*, 2016) and attitude towards the app (Hamari and Koivisto, 2015). In addition to the adoption of fitness apps, studies have considered the factors related to the discontinuance intentions, with habit and post-adoption regret influential in such decisions (Huang, Chen and Liu, 2019).

In terms of the associated outcomes of fitness app use, most studies have only theorised on positive effects. Through this spectrum, fitness apps have been found to be associated with motivating the commencement of physical exercise (Goh and Razikin, 2015), exercising to a higher intensity (Thorsteinsen *et al.*, 2014; Giddens *et al.*, 2017), and intentions to continue exercising (Hamari and Koivisto, 2015; Stragier *et al.*, 2016). When wellbeing is considered as a dependent variable, use of fitness app features are positively associated (Giddens *et al.*, 2017; James *et al.*, 2019), but only for the more self-determined and amotivated types of exercisers (James *et al.*, 2019).

However, some recent studies point towards an emerging dark side to fitness tracking. In contrast to the aforementioned positive outcomes, after an eight week experiment using the Fitbit watch and app, participants reported significant declines in competence, autonomy, and relatedness, along with reduced levels of autonomous motivation (Kerner and Goodyear, 2017). Fitbit users have reported feeling controlled by the gamification features and under pressure to reach targets (Duus and Cooray, 2015). For example, in Kerner & Goodyear's (2017) interviews with adolescent Fitbit users, one participant stated "*...if I hadn't done 10,000 steps before I went to bed, I used to just walk up and down the corridor because I couldn't let someone else beat me*". There is also some evidence to suggest cyclists will adopt risky behaviour to beat previous personal bests automatically shared on fitness platforms (Vaghela *et al.*, 2017). In possibly the only study to date to consider the duality of fitness apps, Barratt (2017) confirms fitness app use can promote sporting enjoyment and motivation, whilst also fostering overtraining and strain familial relationships.

IS scholars have called for studies which consider the dual effects of IT use (Turel and Serenko, 2012; Mäntymäki and Islam, 2016; Islam *et al.*, 2019). We adhere to the spirit of

the aforementioned calls. To add to the body of knowledge, in this paper we empirically examine how the social influence dimensions of fitness apps relate to both adaptive and maladaptive exercise outcomes. As such, we conceptualise exercise as a dual model of passion (DMP). As the DMP specifically considers how opposing outcomes can materialise from engagement in the same activity, it provides an ideal theoretical mechanism to investigate the dual effects of digital technology.

2.2 The Dual Model of Passion

Vallerand and colleagues (Vallerand *et al.*, 2003; Vallerand, 2008, 2012) have conceptualised the passion a person feels for an activity, such as exercise, as a duality. The DMP posits that an individual can have a strong inclination toward a self-defining activity that is loved, but that activity is comprised of both harmonious and obsessive dimensions (Vallerand *et al.*, 2003; Vallerand, 2008). Both forms of passion describe a “*strong inclination toward an activity that people like, that they find important, and in which they invest time and energy*” (Vallerand *et al.*, 2003, p. 756). However, the opposing dimensions of passion differ in how they become internalised in the identity of an individual.

A harmonious passion is adaptive and reflects a level of control to engage in the activity. The internalisation of the activity into the person’s identity is autonomous (Vallerand, 2015). A person demonstrating harmonious passion is not compelled to do the activity and can stop at any time. Harmonious individuals observe the activity as a supplement to a well-balanced lifestyle and are not consumed by a sense of “I must, I need to” engage with the activity. They are able to bound the activity (e.g., set limits), set personal goals which are consistent with their own strengths and weaknesses, and can align and/or prioritise the activity, thus, reducing conflict with other life domains (e.g., work, family). In other words, the respective activity is in “harmony” with other aspects of person’s life (Paradis *et al.*, 2013).

In cases of obsessive passion, the internalisation is driven by intrapersonal or interpersonal pressures, such as heightened self-esteem or social acceptance within a specific group (Utz *et al.*, 2012). People demonstrating obsessive passion experience an internal compulsion to engage in the activity even when not appropriate to do so, as it goes beyond the person’s self-control (Paradis *et al.*, 2013). Obsessive passion is maladaptive and is related to negative emotions such as shame (Vallerand *et al.*, 2003). The activity dominates the

person's identity to the extent it conflicts with other aspects of the person's life (Vallerand, 2015). Such obsessive exercise tendencies have been identified in runners (Chapman and De Castro, 1990), triathletes (Blaydon and Lindner, 2002), CrossFit practitioners (Lichtenstein and Jensen, 2016), and football players (Lichtenstein *et al.*, 2014). Regarding cyclists, those of an obsessive passion disposition were more likely to persist in unsafe conditions such as cycling in hazardous weather conditions (Vallerand 2003).

It is important to note that harmonious and obsessive passions are not mutually exclusive. Within a passionate person, it is quite likely both forms coexist. An obsessively passionate athlete will also embody some harmonious passion for their sport, but the split could be 70/30 on the obsessive side. Likewise, an obsessive passion does not represent a deeper engagement or love than a harmonious passion. Both are correlated but represent different forms of passion (Vallerand, 2015). Ultimately, obsessively passionate individuals experience feelings of internal conflict and negative emotional outcomes (e.g., feelings of guilt, shame) and are often overwhelmed by a sense of needing to engage in the activity. In contrast, harmonious passion supports healthy adaptation whereas obsessive passion impedes it by promoting negative affect and rigid persistence (Vallerand *et al.*, 2003).

To aid the development of theoretical arguments of how fitness apps are related to exercise passion, we now turn to the social psychology literature and specifically theories of social influence.

2.3 Social Influence

Theories of social influence advocate that an individual's attitudes, beliefs, and subsequent actions or behaviours are influenced by relevant others (Kelman, 1961). People have a psychological need to be liked and to feel part of a social community. Accepting and conforming to social influence is a primary mechanism for gaining both (Turner, 1991). People are susceptible to social influence when the community provides them with recognition and reciprocation (Hamari and Koivisto, 2015). Positive *recognition* of the person's efforts by the relevant community enhances their affective experience, and further deepens their conformity (Kelman, 1961). On receiving positive endorsements, people usually feel obligated by social norms to reciprocate i.e. return the favour. Social influence has indeed been found to follow a pattern of *reciprocation* (Cialdini, 2009) so that if 'Sue' previously yielded to persuasive arguments of 'Tom', then 'Tom' will reciprocate and will be

open to influence from ‘Sue’. In addition to the psychological needs of recognition and reciprocity, *subjective norms* play an important role in social influence. Subjective norms, which is a central component of the theories of reasoned action (Fishbein and Ajzen, 1975) and planned behaviour (Ajzen, 1991), reflects a person's perception of significant others' opinions whether he or she should or should not perform a behaviour (Wang, Meister and Gray, 2013). Phrased another way, a person is more likely to comply with a certain behaviour if an influential person to them also adopts the same behaviour.

Since social influence can shape an individual's attitudes, beliefs and actions, theories of social influence have been fundamental to IS researchers wishing to understand the acceptance and usage of IT systems. In an adaptation of the theory of reasoned action, Venkatesh & Davis (2000) extend the technology acceptance model (or TAM2) to incorporate subjective norms as a predictor of usage acceptance and adoption. Prior IS studies have also drawn heavily from social influence to explain the adoption and use of knowledge management systems (Wang *et al.* 2013), social networking services (Cheung and Lee, 2010; Huang and Shiau, 2015; Pornsakulvanich, 2017), virtual worlds (Mäntymäki and Riemer, 2014), blogs (Hsu and Lin, 2008), gamified apps (Hamari and Koivisto, 2015), and compliance with IS security policies (Ifinedo, 2014).

Fitness apps like Strava, Nike+, MyFitnessPal, RunKeeper, and Fitocracy, can be considered persuasive technologies designed to change attitudes or behaviours through motivation and social influence (Barratt, 2017). Following the approach of James et al. (2019), we consider reciprocation and recognition as environmental features which exercisers can choose to engage with to support their exercise passion. Reciprocation and recognition are perceptions of what the technology itself affords, while subjective norms are perceptions of other peoples' opinions about the use of the technology. Thus, subjective norms should interact with fitness app features to indirectly support exercise passion.

3. Research Model

Bringing together the theoretical supports of the DMP and social influence (controlling for age, gender, exercise duration, impulsiveness, and perseverance) the research model tested by this study is depicted in Figure 1.

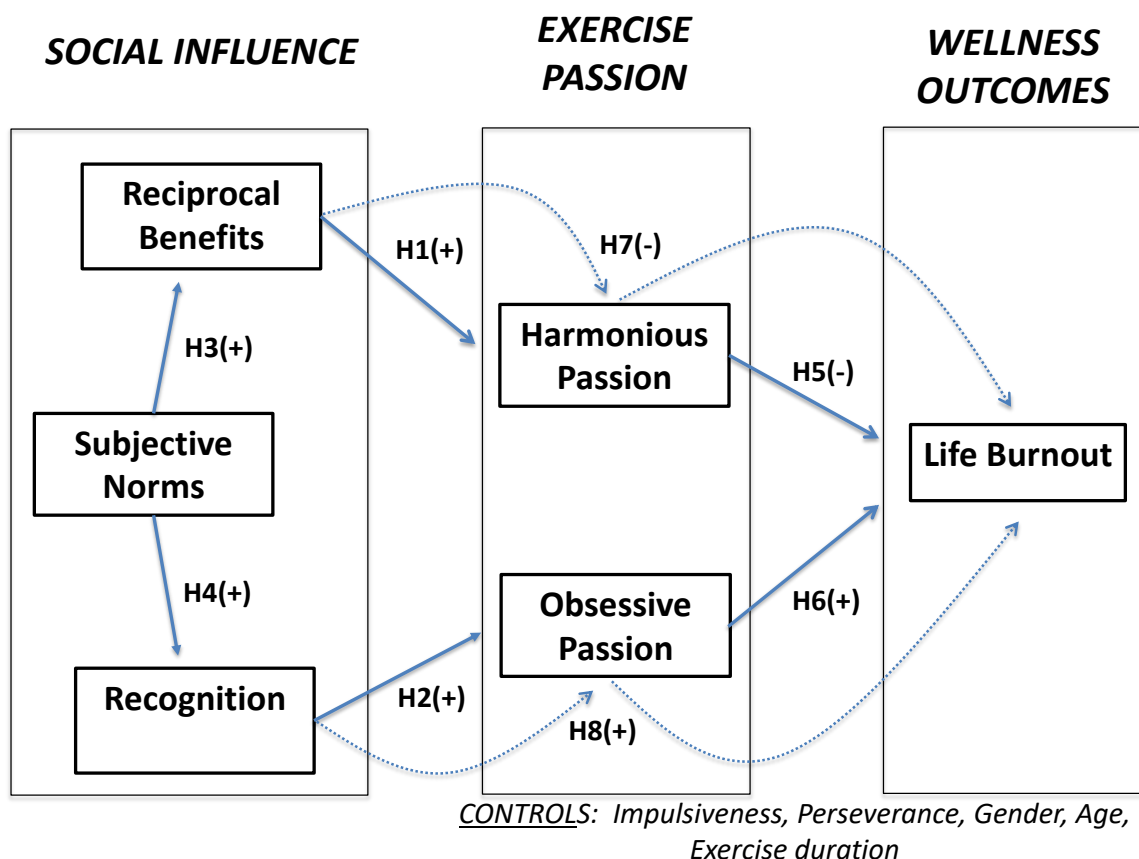


Figure 1. The research model hypothesising on the associations between the social influence aspects of fitness apps, type of exercise passion, and life burnout. Note, dashed lines represent indirect mediated relationships.

3.1 Hypotheses Linking Social Influence to Exercise Passion

Reciprocity is the belief and expectation that providing support will lead to future support in return. Reciprocal benefits arise when these reciprocal interactions lead to a perceived mutual gain for givers and receivers (Hamari, Koivisto and Sarsa, 2014). Research has demonstrated that reciprocal benefits are an important determinant in adhering to physical exercise (Giles-Corti and Donovan, 2002; Cavallo *et al.*, 2012), and a significant predictor of fitness app habitual use (Stragier *et al.*, 2016). On Strava for example, reciprocal behaviour is actively encouraged. As stated on the Strava website; “You get more kudos when you give more kudos. Get out there and be a part of the conversation. Comment on friends’ activities and

*follow people you race with and pretty soon you'll get more kudos than ever.*¹” Other fitness apps have similar mechanisms to support reciprocal behaviour.

When our community provides with us with such support, our psychological needs of autonomy, competence, and relatedness are nurtured, with a harmonious passion for the activity likely to develop (Vallerand, 2015). However, the emergence of a harmonious passion for exercise is dependent on the social support being perceived as positive and non-controlling (Vallerand *et al.*, 2008). Maladaptive social support can result in the person quitting the activity, or in some cases, an obsessive passion developing (Mageau *et al.*, 2009). How a person internalises interactions with their community ultimately determines whether a harmonious or obsessive passion develops for the activity valued. Factors related to autonomous internalisation facilitate the development and maintenance of a harmonious passion (Carbonneau *et al.*, 2010; Vallerand, 2015). For example, Houliort *et al.* (2013) examined how organisational support, which is akin to reciprocal benefits, relates to the development of passion for work. Results from the path analysis revealed organisational support positively predicts harmonious passion, while no relationship was found for obsessive passion. Indeed, additional studies also report that factors similar to reciprocal benefits, such as quality of interpersonal relationships (Philippe *et al.*, 2010) and friendships (Utz *et al.*, 2012) are positively associated with harmonious passion, but not related to obsessive passion. In a similar vein, we expect that reciprocal benefits enhance harmonious passion for exercise, but do not affect obsessive passion. As the latter would be a null hypothesis, we do not formulate a hypothesis on this relationship.

H1: Perceived reciprocal benefits in one’s fitness app community are positively associated with a harmonious passion for physical exercise.

Recognition describes the social feedback people receive on their behaviours and actions. Recognition is generally considered a positive experience. Consistent with behaviourist learning theories of operant behaviour (Skinner, 1963) and social learning (Bandura, 1977), such positive reinforcement influences us to continue behaving in the same manner. Social media companies have recognised the power of peer recognition and design

¹ <https://blog.strava.com/how-to-get-more-kudos-12482/>

their services to enable users to provide feedback to each other, such as through ratings, ‘likes’, ‘thumbs up’ and other icons, all of which influences people to keep using the platform. Fitness apps have adopted a comparable approach where users receive recognition for their exercise activities in a number of ways. Similar to liking on Facebook, ‘Kudos’ is the central mechanism the Strava community uses to provide praise. Adopting elements from game design, users are awarded a virtual pat-on-the-back in the form of badges, medals, and trophies for personal bests and noteworthy performances. Peers can also browse the activity feed of fellow users and post public or private comments to them.

Athletes are passionate about their sport and receiving online recognition is important for many. One study found that social media users are more likely to share details of their workout when they received peer recognition (Pinkerton *et al.* 2017). Likewise, for users of a CrossFit gamified service, the intention to continue using the platform is associated with perceived recognition (Hamari and Koivisto, 2015).

Within the DMP tradition, a number of studies link a controlled orientation, where a person is motivated by extrinsic environmental features such as public endorsements, to the developments of an obsessive passion. For example, Vallerand, et al. (2008) gathered data from collegiate basketball players and report that a controlled orientation predicts an obsessive passion for basketball, but not a harmonious passion. Likewise, previous DMP research has considered how extrinsic personal values, which reflect the relative importance of social praise and rewards, relate to obsessive passion. In a study of passionate stone and stamp collectors, extrinsic values positively predicted obsessive passion, but not harmonious passion (Grenier et al., 2014, cited in Vallerand 2015). A study of pathological gamblers concludes with similar results. A strong positive relationship exists between extrinsic motivations and obsessive gambling passion (Back *et al.* 2011). Therefore we hypothesize;

H2: Perceived recognition from one’s fitness app community is positively associated with an obsessive passion for physical exercise.

Subjective norms arise from peer pressure and reside largely in the need for approval (Eagly and Chaiken, 1993). By participating in a community, a person is likely to become exposed to the influence of others. Emerging research in the fitness technology space has

considered the role of concepts related to subjective norms. The need to prove oneself to others has been found to be positively associated with both the social networking and gamification features of fitness apps (Hamari *et al.*, 2018). Likewise, James *et al.* (2019) report that the more extrinsically motivated a person is, the more likely they are to engage with the social interaction features (SIFs) of fitness technology. In explaining this finding they suggest “...users who are amotivated or extrinsically motivated to exercise will be more likely to use the SIFs because the external social pressure may be viewed as an additional control on their exercise” (James *et al.*, 2019).

Drawing from theories of social influence (Kelman, 1961), we argue the more strongly a person believes their peers expect and support certain behaviours, the more positively the reciprocation and recognition will be from conducting that behaviour. Indeed, previous research in an fitness app context validates the positive effect of subjective norms on the impact of recognition received (Hamari and Koivisto, 2015). So if an exerciser perceives their peers approving of their fitness app use, they will seek to demonstrate conformity to such influence through reciprocation (e.g. endorsing other people’s exercise achievements), whilst also being positively impacted by the recognition they receive (e.g. feeling good when their exercise achievements are noticed).

H3: Subjective norms of fitness app use is positively associated with perceived reciprocal benefits.

H4: Subjective norms of fitness app use is positively associated with perceived recognition.

3.2 Hypotheses Linking Exercise Passion to Life Burnout

A number of cognitive, affective and behavioural differences may be anticipated depending on the type of passion that underpins participation in sport (Curran *et al.*, 2013). Such differences reflect the alternative origins of the behaviour that for harmonious passion is volitional, but for obsessive passion reflects ego-invested self-structures (Vallerand, 2008). For example, research in sport has found harmonious passion is positively associated with life satisfaction, positive affect and vitality, while obsessive passion is positively associated with rigid persistence, life conflict, physical ill-health, and avoidant tendencies (see Vallerand, 2012, for review).

Among several indicators of psychological wellbeing (e.g., presence of positive affect, absence of depression, etc.), we focus on life burnout, which is defined as a state of physical, emotional and mental exhaustion that results from long-term involvement in situations that are emotionally demanding (Hakanen and Schaufeli, 2012). In terms of passion, Vallerand and colleagues (Vallerand, 2015) report an inverse relationship between harmonious passion and burnout in samples of teachers and nurses. In terms of sporting activities, research has consistently demonstrated the positive impact of regular physical activity on alleviating life burnout. In addition to improving health, physical exercise can give people the mental space to deal with life's problems. It is believed that regular exercise training recruits psychophysiological processes which confer enduring resilience to stress (Salmon, 2001). Given that individuals who possess a harmonious passion for exercise can bound the physical activity and align it with other commitments, consequently supporting healthy adaptation (Vallerand *et al.*, 2003), we hypothesise that a harmonious passion for physical exercise is negatively associated with life burnout.

H5: A harmonious passion for physical exercise is negatively associated with life burnout.

In the same study of nurses and teachers which observed harmonious passion reducing life burnout, Vallerand and colleagues (Vallerand, 2015) also found obsessive passion enhanced life burnout. The concept of athletic burnout is well traversed in the sporting literature. Amateur and professional athletes can experience burnout because of overtraining, sport attention stress, and over engagement in a physical activity (Perreault *et al.*, 2007). Signs and symptoms of athletic burnout can include reduced cognitive abilities, impaired decision making, emotional distress, withdrawal from the physical activity, physiological impairments, increased occurrences of injury, and diminished performance (Cresswell and Eklund, 2004). Even in non-competitive exercise activities, such as yoga, obsessive passion predicts a significant increase in negative emotions (Carbonneau *et al.*, 2010). Given that an obsessive passion compels individuals to engage in a physical activity when it is not appropriate to do so, we propose that a dependency on physical exercise fuels conditions leading to increased chances of life burnout:

H6: An obsessive passion for physical exercise is positively associated with life burnout.

3.3 *The Mediating role of Passion*

It is unlikely that the importance which a fitness app user attributes to the social influence aspects of the system will directly affect their perceptions of life burnout. Instead, drawing from the findings of the previous studies (discussed in the previous sections), we argue the relationship between social influence and life burnout is indirect, with the type of passion a fitness app user holds for physical exercise acting as a mediating variable. Specifically, we develop the following hypotheses for the current study:

H7: A harmonious passion for physical exercise mediates the negative association between perceived reciprocal benefits from one's fitness app community and life burnout.

H8: An obsessive passion for physical exercise mediates the positive association between perceived recognition from one's fitness app community and life burnout.

3.4 *Individual Differences as Control Variables*

As some research has linked personality differences to both passion (Vallerand *et al.*, 2008; Lafrenière *et al.*, 2011) and life burnout (Topf, 1989), we controlled for the personality differences of impulsiveness and perseverance in our study. We also included age, gender, and time spent exercising as control variables that may influence passion and life burnout.

4. Methods

Strava is the fitness app at the centre of this research study. Strava serves as a social network for amateur and professional athletes, most of who are cyclists, runners or triathletes. Strava enables users to log, monitor and share their fitness accomplishments with other users via status updates, comments, and photos. As a measure of its popularity, it is estimated Strava has 36 million active users worldwide (Kalius, 2018). In May 2017, the one billionth activity was uploaded and shared on Strava (Strava, 2018).

Challenges are an example of a core gamification technique used by Strava to encourage repeated use of the app. Strava users can challenge other members to run or ride a certain distance. The winner of the challenge receives a digital badge which can be displayed on their profile page. There are also monthly challenges designed to encourage users to run or

cycle a specific distance each month. Users are rewarded with 25%, 50% and 75% digital trophies for this challenge. The completion of other challenges enables users to purchase special prizes. Strava users receive a weekly email summarizing their fitness activity output for the week. They also receive an email to inform them when another user has replaced them at the top of a leader board.

Figure 2 highlights two specific examples of the various social influence elements contained within the Strava fitness app. The left-hand side of the image depicts how Strava users can share their workouts on social media platforms where fellow users can give likes, Kudos and comments on their activity. The right-hand side depicts how Strava users can compete in various challenges in order to win vouchers, monetary rewards, and digital badges.

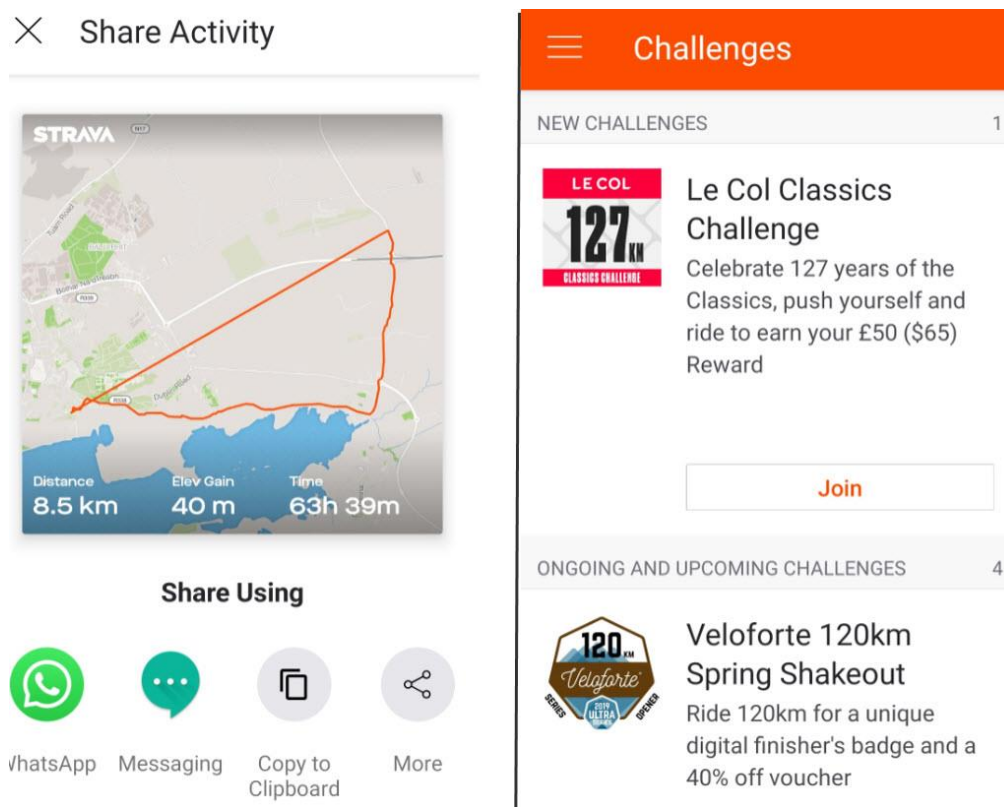


Figure 2. Strava Social Influence Examples

4.1 Sample

To recruit Strava users, an invitation to participate in a survey was posted to an online forum for cyclists in Ireland. We chose cycling for the following reasons. Firstly, to prevent outside

effects for the passion variables and to have comparable responses from participants, we restricted our sample to one cardio-intense physical activity, namely cycling. Second, cycling's popularity as a physical exercise has increased dramatically in Ireland and the UK in recent years, largely due to a Government tax-free incentive scheme to purchase bikes. Thirdly, with the emergence of power meters, heart rate monitors, handlebar mounted GPS units, online training videos, and virtual training platforms, cycling has become a sport synonymous with digital technology.

To ensure all respondents were current and regular users of Strava, a filter question was posed at the beginning of the survey asking respondents to indicate if they met this requirement. All respondents met this condition. In addition, we asked respondents to indicate how often they used certain Strava features over the past month. The entire final sample used at least some features on a regular basis. Those who completed the questionnaire had the option to be entered into a draw for one of four €25 gift vouchers. 286 people completed the survey. Removing incomplete submissions (6), significantly rapid survey completion times (5), and those whose primary sport was not cycling (3), left 272 usable responses.

A number of approaches can be used to estimate minimum sample size for partial least squares-based structural equation modelling (PLS-SEM). For our study, the standard "10 times rule" (Hair, Ringle and Sarstedt, 2011) yields a minimum sample of 70, while the inverse square root method (Kock and Hadaya, 2018) returns a minimum sample of 98. Other scholars recommend 150 observations for models with three or more indicators on constructs (Anderson and Gerbing, 1984). Thus, our sample of 272 more than exceeds the minimum sample size threshold. The sample included 19% females, which is broadly representative of the cycling community in Ireland². The mode age bracket of participants was 40-44 (23%). They cycled an average of 7 hours per week. 47% had premium Strava accounts.

4.2 Survey Instrument

As cyclists can use more than one fitness app, respondents were asked to reflect on their experiences specifically in relation to Strava. All multi-item scales were adapted from well-

² Female membership of Cycling Ireland, the national body for cycling in Ireland, is 21% <http://www.cyclingireland.ie/page/disciplines/women>

established research instruments and were measured on 7-point Likert-type scales. Each variable was measured using reflective indicators. As all responses were self-reported, to mitigate the potential for common method bias (CMB), some items were phrased negatively (Turel and Qahri-Saremi, 2016). We also randomised the order of the measurement items in the questionnaire.

An initial pilot test of the survey with 12 cyclists and 4 academics resulted in the rewording of the participant instructions and a small number of items to improve clarity. The social influence measures of recognition, reciprocation, and subjective norms were adapted from Hamari & Koivisto (2015) and applied to Strava. The 14 item Passion Scale (Vallerand et al. 2003) was used to measure both harmonious and obsessive passion for cycling. Life burnout was measured using Copenhagen Burnout Inventory (Kristensen *et al.*, 2005), which was extended to a 7 point Likert-scale response to stay consistent with the rest of the questionnaire. In terms of the personality control variables, impulsiveness was measured with scales from Soror et al. (2015), with persistence measured with scales taken from Short UPPS-P Impulsive Behavior Scale (Cyders *et al.*, 2014). All items, descriptive statistics, loadings, composite reliabilities (CR) and average variances extracted (AVE) are provided in Appendix 1.

5. Results

5.1 Preliminary Assessment

To analyse the data, we adopted the PLS-SEM approach with SmartPLS software version 3.2.8 (Ringle *et al.*, 2015). In SEM analyses, a two-stage approach, first examining the measurement model and then the structural model is recommended (Hair *et al.*, 2011). Before the structural model can be examined, the measurement model needed to be explored to determine convergent validity, discriminant validity, and reliability. The statistics reported in Appendix 1 show validity and reliability to be acceptable. We followed Gefen and Straub's (2005) procedure to test convergent and discriminant validity. We evaluated the convergent validity by examining item loadings, CR, and AVE values. With regard to item loadings, Fornell & Larcker (1981) have recommended values of at least 0.7 to be acceptable. Based on this criterion, one item from both the harmonious passion and life burnout variables were

removed. The CRs being above 0.8 and AVE values exceeding 0.5 further support satisfactory convergent validity.

Discriminant validity describes the extent to which items differ from one another. We evaluated the discriminant validity by comparing the square roots of AVE values to the inter-construct correlations (see table 1). For each construct, the square root of its AVE has to exceed its correlation with every other construct to satisfy discriminant validity (Fornell and Bookstein, 1982). The square roots of the AVE values for the variables are consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity between the variables. We also examined the heterotrait-monotrait ratio of correlations (HTMT) to assess discriminant validity. If the HTMT value is below 0.90, discriminant validity has been established between two reflective constructs (Henseler *et al.*, 2015). The highest absolute HTMT value for our measures was 0.78 which satisfies the most conservative threshold of 0.85 (Henseler *et al.*, 2015). In sum, the model's convergent and discriminant validity could be established.

The preliminary assessment also focused on the potential influence of CMB. As all CMB detection techniques have limitations, we used a number of methods to assess for CMB. First, the occurrence of a variance inflation factors (VIF) greater than 3.3 is proposed as an indication that a model may be contaminated by CMB (Kock, 2015). Therefore, if all VIFs resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered free of CMB. The VIF matrix confirmed all VIF values were less than 3.3. Second, we conducted Harman's (1976) single factor test. We conducted a principal component analysis and found no single construct accounted for a majority of the total variance. Third, the correlation matrix (Table 1) does not indicate any highly correlated factors (highest correlation = 0.72), whereas evidence of CMB should have resulted in extremely high correlations (> 0.90) (Pavlou *et al.*, 2007). These tests ensure that CMB is not a major concern in our study.

Table 1.

Correlations between latent variables (square root of AVEs in the main diagonal)

	1	2	3	4	5	6	7	8	9	10	11
1.Age	1										
2.Gender	0.01	1									
3. Harmonious passion	-0.26	0.14	0.80								
4. Impulsiveness	-0.04	0.02	0.05	0.87							
4. Life burnout	-0.13	-0.04	0.01	0.10	0.77						
5. Obsessive passion	-0.12	0.03	0.51	0.22	0.21	0.85					
6.Perseverance	-0.02	0.09	0.30	-0.08	0.02	0.13	0.87				
6. Reciprocation	-0.23	0.03	0.43	0.09	0.10	0.33	0.25	0.89			
7. Recognition	-0.26	-0.08	0.35	0.11	0.15	0.39	0.22	0.72	0.92		
8. Subjective norms	-0.22	0.01	0.40	0.12	0.18	0.38	0.20	0.64	0.67	0.90	
9. Training time	-0.05	0.03	0.06	-0.03	0.03	0.01	0.08	0.01	0.08	0	1

Non-response bias (NRB) is also an issue researchers need to consider when applying SEM techniques (Gefen and Straub, 2005). To ensure NRB did not inhibit our findings, we compared the responses of the first and last 20 participants, which showed no significant differences. The idea behind this approach is that late respondents are more likely to resemble non-respondents than early respondents.

5.2 Assessment of the Structural Model

We evaluated the structural model (Figure 3) by using the coefficient of determination and the significance level of each path coefficient (Chin, 2010). The significance of path coefficients was determined via a bootstrapping procedure by setting the number of cases equal to the sample size (as recommended by Tenenhaus *et al.* 2005) and the number of bootstrap samples to 5,000.

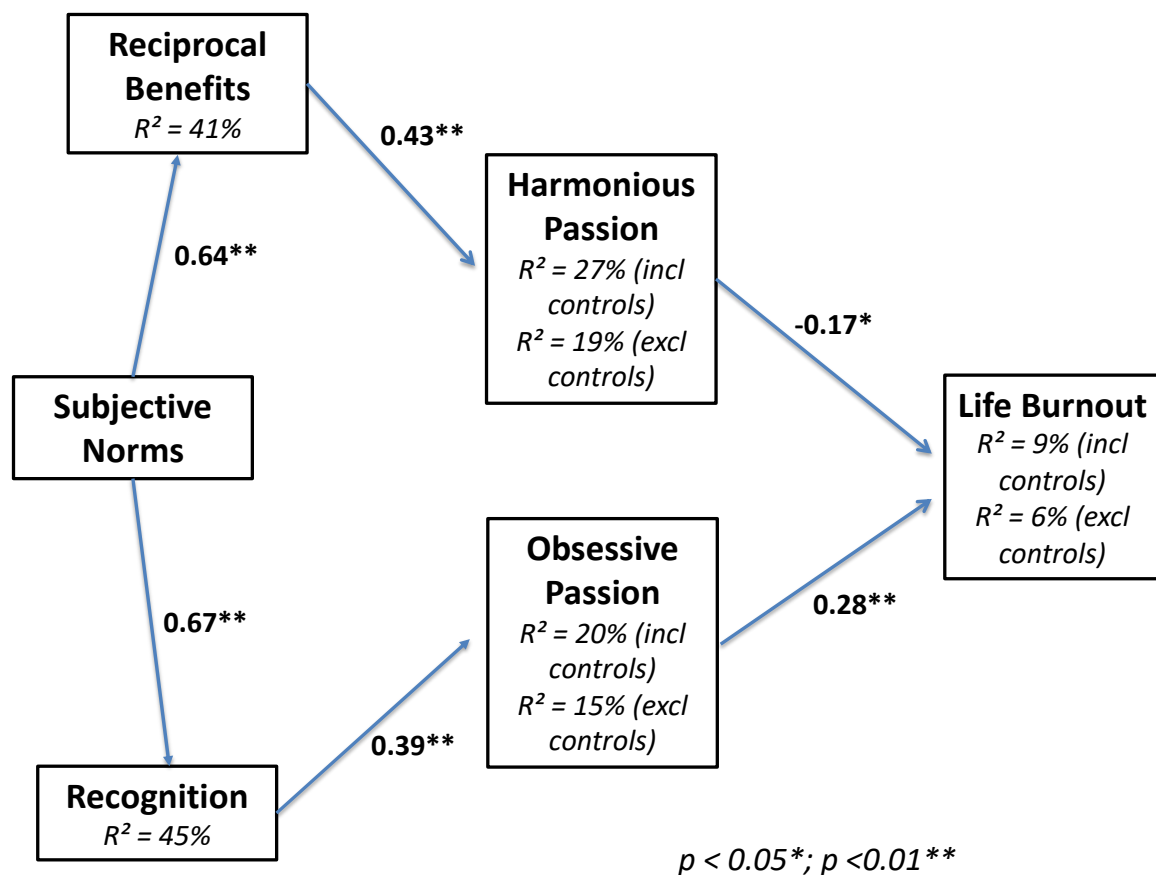


Figure 3. Model results

All hypothesised relationships were supported. Perceived reciprocal benefits from the fitness app community had a significant influence on harmonious passion for exercise, supporting H1 (H1: $\beta = 0.43$, $p < 0.01$). As hypothesised in H2, recognition received through the fitness app users had a positive association with obsessive passion for exercise (H2: $\beta = 0.39$, $p < 0.01$). Subjective norms were strongly associated with reciprocal benefits (H3: $\beta = 0.64$, $p < 0.01$) and recognition (H4: $\beta = 0.67$, $p < 0.01$). As hypothesised in H5, a harmonious passion for physical exercise has a significant negative relationship with life burnout (H5: $\beta = -0.17$, $p < 0.05$). H6 suggested an obsessive passion for physical exercise would positively predict life burnout, which was supported (H6: $\beta = 0.28$, $p < 0.01$). Although not hypothesised as relationships, reciprocal benefits were not related to an obsessive passion for exercise ($\beta = 0.08$, $p = 0.19$), nor was recognition related to a harmonious passion ($\beta = 0.04$, $p = 0.25$).

Concerning alternative theoretical explanations and the significance level of their path coefficients, we can state that impulsiveness was positively associated with obsessive passion ($\beta = 0.19, p < 0.05$), while perseverance was positively associated with harmonious passion ($\beta = 0.11, p < 0.05$). For the control variables, age was negatively associated with harmonious passion ($\beta = -0.16, p < 0.01$) while females were also more likely to report a harmonious passion for exercise ($\beta = 0.13, p < 0.01$). All other control variables were non-significant.

In terms of model fit, the standardised root mean square residual (SRMR) is 0.06. A value less than 0.10, or of 0.08 in a more conservative version (see Hu & Bentler 1998), are considered a good fit. Based on the empirical data, our findings indicate that the subjective norms to use fitness app explain 41% and 45% of the variance in reciprocal benefits and recognition respectively. In turn, fitness app reciprocal benefits explained 27% of the variance of harmonious passion for exercise when controls are included, and 19% when controls are excluded. Fitness app recognition explained 20% of the variance of obsessive passion for exercise when controls are included, and still explain 15% when controls are excluded. Combining harmonious and obsessive passion for exercise explains 6% of the variance of life burnout, increasing to 8% when controls are included. The f^2 effect size for the harmonious passion to life burnout path is 0.02, and 0.04 for the obsessive passion to life burnout path. These f^2 effect size indicate that both passion measures have a substantive impact on life burnout, albeit one that is in the low to moderate effect range (Hair et al., 2017). In terms of the predictors of the two types of passion, the social influence measures have a low to moderate effect. The f^2 value for the reciprocation to harmonious passion relationship is 0.14, and 0.12 for the recognition and obsessive passion relationship. Subjective norms had an extremely strong effect on both reciprocation ($f^2 = 0.68$) and recognition ($f^2 = 0.83$). Concerning the control variables, perseverance had an effect on harmonious passion ($f^2 = 0.04$) and impulsiveness had an effect on obsessive passion ($f^2 = 0.05$).

5.3 The Mediating Effects of Passion

A subsequent analysis was conducted to test for the mediating effects that passion for physical exercise may have between fitness app social influence dimensions and life burnout. Mediation occurs when a third mediator variable intervenes between two other related

constructs. To test for the mediation effects of harmonious and obsessive passion in the model, we followed the approach of Hair et al. (2017). This involves two main steps.

First, we tested whether the indirect relationships between the independent variables and dependent variables, via the mediator, were significant. Next, we determined whether the direct path between the independent and dependent variables were significant. Full mediation occurs when the direct path is insignificant, but the indirect path is significant. Step 1 showed that the indirect paths of ‘reciprocation – harmonious passion – life burnout’ and ‘recognition – obsessive passion – life burnout’ were both significant ($p < 0.01$ for both), with the former relationship being negative and the latter positive. Step 2 showed that the direct path between reciprocation and life burnout was negative but insignificant ($p = 0.45$), as was the direct path between recognition and life burnout ($p = 0.21$). Therefore, these results indicate that; (a) the negative effect of fitness app reciprocal benefits on life burnout is fully mediated by a harmonious passion for physical exercise, and (b) the positive effect of fitness app recognition on life burnout is fully mediated by an obsessive passion for physical exercise.

6. Discussion

Regular exercise is fundamental for the maintenance of physical and mental wellbeing. With obesity and depression rates soaring in many parts of the world, solutions encouraging physical exercise are in great demand. The very embodiment of the quantifiable-self movement, fitness apps enable users to record, analyse, interpret, and share workout data. The social aspects of fitness apps are designed to motivate users to begin and sustain their exercise routines, and of course to continue using the application. When combined with an exerciser’s motivation, empirical studies report positively on the link between fitness apps, exercise, and health (Hamari and Koivisto, 2015; Sharon, 2017; James *et al.*, 2019). However; the dark side of fitness gamification has received far less attention (Barratt, 2017; Rockmann and Gewald, 2017). As the adoption and capabilities of fitness apps continue to grow, it is crucial we understand the conditions under which the social influence aspects of fitness apps lead to adaptive or maladaptive exercise and life outcomes.

6.1 *Theoretical Implications*

Drawing from theories of social influence and the DMP, our objective in this study was to determine if the various social influence dimensions of fitness apps appeal differently to harmonious and obsessively passionate exercisers, and what adaptive and maladaptive wellbeing outcomes emerge as a result. Our findings support the proposed model and make a number of theoretical contributions.

Firstly, a significant portion of the emerging fitness technology literature has focused on understanding the drivers of adoption, engagement, and continued use (Hamari and Koivisto, 2015; Stragier *et al.*, 2016; Hamari *et al.*, 2018; Huang *et al.*, 2019; James *et al.*, 2019). Our study demonstrates that social motivations are instrumental in explaining perceptions towards fitness apps, which echoes previous fitness app studies (Hamari and Koivisto, 2015; Stragier *et al.*, 2016). In terms of social influence, perceived reciprocal benefits amongst fitness app users predicted a harmonious passion for exercise, but not an obsessive passion. Similarly, perceived recognition predicted an obsessive passion for physical exercise, but was unrelated to harmonious passion. While previous studies demonstrate how user motivations (James *et al.*, 2019) and goals (Hamari *et al.*, 2018) determine the fitness app features adopted, our study goes a step further by revealing different aspects of social influence appeal to different types of exercisers, depending on the type of passion held for the physical exercise. Reciprocal benefits are only associated with a harmonious passion and recognition is only associated with an obsessive passion.

Social media scholars can also draw from these insights. Studies focusing on social media have reported inconsistent findings in relation to the influence of subjective norms on engagement (Lin and Lu, 2015). While our results provide support to social media studies confirming the effects subjective norms (Baker and White, 2010; Huang and Shiau, 2015), we also echo calls for consistency in how the construct is operationalised and measured, a lack of which is most likely the reason for the mixed results.

In a second contribution, our empirical findings confirm the dual effect of fitness apps on both the passion a user experiences for their sport and life burnout. A mediation analysis reveals that a harmonious passion for physical exercise explains why perceived reciprocal benefits from the fitness app community is inversely related life burnout. Likewise, an obsessive passion for physical exercise mediates between recognition from the fitness app community and higher life burnout. Thus, our study extends existing insights linking fitness

apps to wellness outcomes (Kerner and Goodyear, 2017; James *et al.*, 2019) by explaining how those different outcomes emerge. These results help research on fitness apps progress from investigating the general association between engagement and its positive and negative consequences, toward more detailed and specific explanations of when, or under what conditions, fitness app use leads to different outcomes. In other words, the results shed light on the boundary conditions, or contextual factors, on which the individual effects of fitness app engagement depend, a critical contribution to theory development and testing.

Our quantitative evidence supports the qualitative work of Barratt (2017), who reports Strava use is associated with a greater enthusiasm to exercise, but at a cost to familial relationships and conjugal contributions. While both positive and negative aspects of IT use have been discussed in the literature, very few studies have examined them in parallel. Recent investigations of social media have considered duality in terms of engagement versus addiction (Turel and Serenko, 2012), sharing information versus constant connectivity (Fox and Moreland, 2015), building a community versus exhibitionism (Mäntymäki and Islam, 2016), and vitality versus addiction (Islam *et al.*, 2019). Our findings contribute to this body of work on the dual effects of IT, particularly in relation to fitness apps. While existing studies report on the adaptive outcomes of gamification on health and fitness (Thorsteinsen *et al.*, 2014; Goh and Razikin, 2015; Hamari and Koivisto, 2015; Stragier *et al.*, 2016), our study demonstrates the adaptive/maladaptive duality. When motivated by peer recognition, an obsessive passion is likely to emerge with higher life burnout also a consequence. When reciprocation and building a community of likeminded exercisers is the motivation, a harmonious passion emerges which decreases life burnout. The psychological levers which fitness apps like Strava tug to encourage exercise, may also cause an unhealthy obsession to develop. This aspect of our study also contributes to the passion literature which has tended to focus hereto now on the outcomes of the DMP, and paid limited attention to the drivers of passion. To fully appreciate the consequences of both aspects of passion, scholars need to consider the etiology of this motivational force.

As a third theoretical contribution, our use of the DMP (Vallerand, 2015) increases the diversity of theoretical perspectives that are being brought to bear in the study of the human interaction with persuasive technology. As such, we showed that the DMP (Vallerand *et al.*, 2003) is a useful framework for exploring why positive and negative effects of digital technology can emerge for different users. Scholars have drawn from the DMP to shed light

on the effects of online gaming (Wang and Chu, 2007; Przybylski *et al.*, 2009; Utz *et al.*, 2012), social media use (Orosz *et al.*, 2016), and internet activities (Tosun and Lajunen, 2009). Building on these insights, and our own study, IS scholars can draw from the DMP to identify and explain the duality of digital technology. For example, rather than focusing on issues such as technology addiction (Turel and Serenko, 2012; Soror *et al.*, 2015; Turel *et al.*, 2016; Islam *et al.*, 2019), we suggest the DMP provides a more appropriate theoretical framework to investigate the simultaneous harmonious and obsessive behaviours emerging from our use of personal technology.

6.2 Practical Implications

Our study has practical implications for the individual users, managers, and designers of fitness tracking services. For the individual, fitness apps can certainly help seed and sustain exercise routines, but there is a danger that some users may develop obsessive tendencies, which need to be avoided. The effect of fitness app social influence is only slightly stronger on harmonious passion for exercise than it is for obsessive passion. For individuals struggling to begin or sustain regular exercise, we would advise them to try using gamification services like Strava, Fitocracy, and Nike+. A passion for exercise and positive life outcomes may result. In that case, the user needs to be conscious of the fact that the digital affordances of fitness technology may transform exercise passion into a dependency. For fitness app users developing an obsessive passion, simply stopping the use of services may not be the best solution. This could eliminate the benefits such services provide. And as the nomophobia literature shows (e.g. Hartanto & Yang, 2016), a complete ban on technology often results in the user experiencing even more stress. A more advantageous approach could be to limit certain fitness app features, such as detailed performance comparisons with peers, but further research is needed in this regard.

Many organisations have incorporated fitness apps as part of employee wellness programs in the belief that gamification and self-tracking of physical activity can only lead to positive health and work performance outcomes. Our results shed light on the darkside of fitness app engagement in that they may indirectly lead to greater burnout. If the organisation supports fitness app use among employees, they should also be responsible for ensuring the employee maintains control over their exercise patterns. One possible solution could be for the organisation to monitor the exercise log files of employees and assess these for signals of

exercise obsession. However, such an approach comes with privacy challenges which would need to be traversed (see Whelan *et al.* 2018 for a deeper discussion).

For designers of gamification services, our findings confirm that facets of social influence explain perceptions of such applications. When a harmonious passion for the activity emerges, that is a win for both the designers and the user. But as fitness apps are designed to be persuasive, maladaptive practices such as obsessiveness can emerge. From an ethical point of view, fitness app designers need to draw from our study and exploit social influence to promote healthy outcomes. This could be in the form of badges promoting harmony, for example when a user does not exercise when they are injured, or an automatic feature alerting the user to the onset of obsessiveness.

6.3 *Limitations and Future Research*

There are certain limitations to our study that should be considered when interpreting our results. In addition to the future studies suggested above, addressing these limitations would prove fruitful in advancing our knowledge of the consequences of interactions with fitness apps. Firstly, our study relied on a cross-sectional sample of one particular type of user (cyclists who use the Strava app). To increase the generalisability of the findings, the study should be replicated in other populations of users (e.g., walkers, runners, triathletes, swimmers, who use different Fitness apps). Secondly, we drew from theory to determine the flow of causation in our model. Further research is needed for directional validation. Tracking fitness app usage and behaviours longitudinally would be a fruitful approach to validating the model tested in this study. Such a longitudinal study could capture data from individuals who quit using fitness apps, which would advance the field as the present study only gathered data from active Strava users. Thirdly, as the personality variables we used as controls were significantly related to the DMP, futures studies could consider how differences in personality interact with fitness app features to influence wellness outcomes. Finally, our study considered only one wellness outcome (i.e. life burnout). A simple extension of our work could measure a variety of additional wellness outcomes (e.g. satisfaction, happiness, anxiety, quality of life) and how these may directly or indirectly spill over into work outcomes (e.g. productivity, job commitment, engagement, organisational morale).

References

- Adams, J. and Kirkby, R. J. (2002) 'Excessive exercise as an addiction: A review', *Addiction Research and Theory*, 10(5), pp. 415–437.
- Ajzen, I. (1991) 'The theory of planned behavior', *Organizational Behavior and Human Decision Processes*, 50(2), pp. 179–211.
- Anderson, J. C. and Gerbing, D. W. (1984) 'The effect of sampling error on convergence, improper solutions, and goodness-of-fit indices for maximum likelihood confirmatory factor analysis', *Psychometrika*, 49(2), pp. 155–173.
- Back, K. J., Lee, C. K. and Stinchfield, R. (2011) 'Gambling Motivation and Passion: A Comparison Study of Recreational and Pathological Gamblers', *Journal of Gambling Studies*, 7(3), pp. 355–370.
- Baker, R. K. and White, K. M. (2010) 'Predicting adolescents' use of social networking sites from an extended theory of planned behaviour perspective', *Computers in Human Behavior*, 26(6), pp. 1591–1597.
- Bandura, A. (1977) *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.
- Barratt, P. (2017) 'Healthy competition: A qualitative study investigating persuasive technologies and the gamification of cycling', *Health and Place*, 46, pp. 328–336.
- Blaydon, M. J. and Lindner, K. J. (2002) 'Eating disorders and exercise dependence in triathletes', *Eating Disorders*, 10(1), pp. 49–60.
- Carbonneau, N., Vallerand, R. J. and Massicotte, S. (2010) 'Is the practice of yoga associated with positive outcomes? the role of passion', *Journal of Positive Psychology*, 5(6), pp. 452–465.
- Cavallo, D. N., Tate, D. F., Ries, A. V., Brown, J. D., Devellis, R. F. and Ammerman, A. S. (2012) 'A social media-based physical activity intervention: A randomized controlled trial', *American Journal of Preventive Medicine*, 43(5), pp. 527–532.
- Chapman, C. L. and De Castro, J. M. (1990) 'Running addiction: Measurement and associated psychological characteristics', *The Journal of Sports Medicine and Physical Fitness*, 30(3), pp. 283–290.
- Cheung, C. M. K. and Lee, M. K. O. (2010) 'A theoretical model of intentional social action in online social networks', *Decision Support Systems*, 49(1), pp. 24–30.
- Chin, W. W. (2010) 'How to Write Up and Report PLS Analyses', in Esposito Vinzi, V., Chin, W.W., Henseler, J., Wang, H. (ed.) *Handbook of Partial Least Squares*. Springer.

- Cialdini, R. B. (2009) *Influence: Science and Practice, Book*. Boston, MA: Pearson Education.
- Cresswell, S. and Eklund, R. (2004) 'The athlete burnout syndrome: possible early signs', *Journal of Science and Medicine in Sport*, 7(4), pp. 481–487.
- Curran, T., Appleton, P. R., Hill, A. P. and Hall, H. K. (2013) 'The mediating role of psychological need satisfaction in relationships between types of passion for sport and athlete burnout', *Journal of Sports Sciences*, 31(6), pp. 597–606.
- Cyders, M. A., Littlefield, A. K., Coffey, S. and Karyadi, K. A. (2014) 'Examination of a short English version of the UPPS-P Impulsive Behavior Scale', *Addictive Behaviors*, 39(9), pp. 1372–1376.
- Duus, R. and Cooray, M. (2015) *How we discovered the dark side of wearable fitness trackers*, *The Conversation*. Available at: <https://theconversation.com/how-we-discovered-the-dark-side-of-wearable-fitness-trackers-43363> (Accessed: 2 May 2018).
- Eagly, A. H. and Chaiken, S. (1993) 'Psychology of Attitudes', *Psychology of Attitudes*, p. 794.
- Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*, Addison-Wesley Publishing Company.
- Fogg, B. (2009) 'A behavior model for persuasive design', in *Proceedings of the 4th International Conference on Persuasive Technology - Persuasive '09*, p. 1.
- Fornell, C. and Bookstein, F. L. (1982) 'Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory', *Journal of Marketing Research*, 19(4), pp. 440–452.
- Fornell, C. and Larcker, D. F. (1981) 'Evaluating structural equation models with unobservable variables and measurements error', *Journal of Marketing Research*, 18(4), pp. 39–50.
- Foss, J. (2014) 'The Tale of a Fitness-Tracking Addict's Struggles With Strava', *Wired*, p. 3. Available at: <https://www.wired.com/2014/10/my-strava-problem/>.
- Fox, J. and Moreland, J. J. (2015) 'The dark side of social networking sites: An exploration of the relational and psychological stressors associated with Facebook use and affordances', *Computers in Human Behavior*, 45, pp. 168–176.
- Gefen, D. and 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), p. 20.

Giddens, L., Leidner, D. and Gonzalez, E. (2017) 'The Role of Fitbits in Corporate Wellness Programs: Does Step Count Matter?', *Hawaii International Conference on System Sciences (HICSS) 2017*, pp. 3627–3635.

Giles-Corti, B. and Donovan, R. J. (2002) 'The relative influence of individual, social and physical environment determinants of physical activity', *Social Science and Medicine*, 54(12), pp. 1793–1812.

Goh, D. H.-L. and Razikin, K. (2015) 'Is Gamification Effective in Motivating Exercise?', in Kurosu, M. (ed.) *HCI 2015: Human-Computer Interaction: Interaction Technologies*. Springer, pp. 608–617.

Hair, J. F., Hult, G. T. M., Ringle, C. M. and Sarstedt, M. (2017) *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd edn. Sage: Thousand Oaks.

Hair, J. F., Ringle, C. M. and Sarstedt, M. (2011) 'PLS-SEM: Indeed a Silver Bullet', *The Journal of Marketing Theory and Practice*, 19(2), pp. 139–152.

Hakanen, J. J. and Schaufeli, W. B. (2012) 'Do burnout and work engagement predict depressive symptoms and life satisfaction? A three-wave seven-year prospective study', *Journal of Affective Disorders*, 141(2–3), pp. 415–424.

Hamari, J., Hassan, L. and Dias, A. (2018) 'Gamification, quantified-self or social networking? Matching users' goals with motivational technology', *User Modeling and User-Adapted Interaction*, 28(1), pp. 35–74.

Hamari, J. and Koivisto, J. (2015) "'Working out for likes": An empirical study on social influence in exercise gamification', *Computers in Human Behavior*, 50, pp. 333–347.

Hamari, J., Koivisto, J. and Sarsa, H. (2014) 'Does gamification work? - A literature review of empirical studies on gamification', in *Proceedings of the Annual Hawaii International Conference on System Sciences*, pp. 3025–3034.

Harman, H. . (1976) *Modern Factor Analysis*. Chicago: Chicago University Press.

Hartanto, A. and Yang, H. (2016) 'Is the smartphone a smart choice? The effect of smartphone separation on executive functions', *Computers in Human Behavior*, 64, pp. 329–336.

Henseler, J., Ringle, C. M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modeling', *Journal of the Academy of Marketing Science*, 41(3), pp. 115–135.

- Houliort, N., Philippe, F. L., Vallerand, R. J. and Ménard, J. (2013) 'On passion and heavy work investment: Personal and organizational outcomes', *Journal of Managerial Psychology*, 29(25–45).
- Hsu, C. L. and Lin, J. C. C. (2008) 'Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation', *Information and Management*, 45(1), pp. 65–74.
- Hu, L. T. and Bentler, P. M. (1998) 'Fit Indices in Covariance Structure Modeling: Sensitivity to Underparameterized Model Misspecification', *Psychological Methods*, 3(4), pp. 424–453.
- Huang, C.-K., Chen, C.-D. and Liu, Y.-T. (2019) 'To stay or not to stay? Discontinuance intention of gamification apps', *Information Technology & People*, Forthcomin.
- Huang, L. C. and Shiau, W. L. (2015) 'Why do people use microblogs? An empirical study of Plurk', *Information Technology and People*, 28(2), pp. 281–303.
- Ifinedo, P. (2014) 'Information systems security policy compliance: An empirical study of the effects of socialisation, influence, and cognition', *Information and Management*, 51(1), pp. 69–79.
- Islam, A. K. . N., Mäntymäki, M. and Benbasat, I. (2019) 'Duality of self-promotion on social networking sites', *Information Technology & People*, 32(2), pp. 269–296.
- James, T. L., Wallace, J. and Deane, J. . (2019) 'Using Organistic Integration Theory to Explore the Association Between Users' Exercise Motivations and Fitness Technology Feature Set Use', *MIS Quarterly*, (Forthcoming).
- Kelman, H. C. (1961) 'Processes of Opinion Change', *Public Opinion Quarterly*, 25(1), p. 57.
- Kerner, C. and Goodyear, V. A. (2017) 'The Motivational Impact of Wearable Healthy Lifestyle Technologies: A Self-determination Perspective on Fitbits With Adolescents', *American Journal of Health Education*, 48(5), pp. 287–297.
- Kock, N. (2015) 'Common method bias in PLS-SEM: A full collinearity assessment approach', *International Journal of e-Collaboration*, 11(4), pp. 1–10.
- Kock, N. and Hadaya, P. (2018) 'Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods', *Information Systems Journal*, 28(1), pp. 227–261.
- Kristensen, T. S., Borritz, M., Villadsen, E. and Christensen, K. B. (2005) 'The Copenhagen Burnout Inventory: A new tool for the assessment of burnout', *Work and Stress*, 19(3), pp. 192–207.

- Lafrenière, M. A. K., Bélanger, J. J., Sedikides, C. and Vallerand, R. J. (2011) ‘Self-esteem and passion for activities’, *Personality and Individual Differences*, 51(541–544).
- Lichtenstein, M. B. and Jensen, T. T. (2016) ‘Exercise addiction in CrossFit: Prevalence and psychometric properties of the Exercise Addiction Inventory’, *Addictive Behaviors Reports*, 3, pp. 33–37.
- Lichtenstein, M. B., Larsen, K. S., Christiansen, E., Stoving, R. K. and Bredahl, T. V. G. (2014) ‘Exercise addiction in team sport and individual sport: Prevalences and validation of the exercise addiction inventory’, *Addiction Research and Theory*, 22(5), pp. 431–437.
- Lin, K. Y. and Lu, H. P. (2015) ‘Predicting mobile social network acceptance based on mobile value and social influence’, *Internet Research*, 25(1), pp. 107–130.
- Mageau, G. A., Vallerand, R. J., Charest, J., Salvy, S. J., Lacaille, N., Bouffard, T. and Koestner, R. (2009) ‘On the development of harmonious and obsessive passion: The role of autonomy support, activity specialization, and identification with the activity’, *Journal of Personality*, 77, pp. 601–645.
- Mäntymäki, M. and Islam, A. K. M. N. (2016) ‘The Janus face of Facebook: Positive and negative sides of social networking site use’, *Computers in Human Behavior*, 61, pp. 14–26.
- Mäntymäki, M. and Riemer, K. (2014) ‘Digital natives in social virtual worlds: A multi-method study of gratifications and social influences in Habbo Hotel’, *International Journal of Information Management*, 34(2), pp. 210–220.
- De Neef, M. (2014) ‘All about the bike: what happens when cycling becomes an “obsessive passion”’, *CyclingTips*, p. 2. Available at: <https://cyclingtips.com/2014/11/all-about-the-bike-what-happens-when-cycling-becomes-an-obsessive-passion/>.
- Orosz, G., Vallerand, R. J., Bothe, B., Tóth-Király, I. and Paskuj, B. (2016) ‘On the correlates of passion for screen-based behaviors: The case of impulsivity and the problematic and non-problematic Facebook use and TV series watching’, *Personality and Individual Differences*, 101, pp. 167–176.
- Paradis, K. F., Cooke, L. M., Martin, L. J. and Hall, C. R. (2013) ‘Too much of a good thing? Examining the relationship between passion for exercise and exercise dependence’, *Psychology of Sport and Exercise*, 14(4), pp. 493–500.
- Pavlou, P. A., Liang, H., Xue, Y. and Anderson, A. G. (2007) ‘Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal- Agent Perspective Online Exchange Relationships: A Principal Agent Perspective’, *MIS Quarterly*, 31(1), pp. 105–136.

- Perreault, S., Gaudreau, P., Lapointe, M. C. and Lacroix, C. (2007) ‘Does it take three to tango? Psychological need satisfaction and athlete burnout’, *International Journal of Sport Psychology*, 38(4), pp. 437–450.
- Philippe, F. L., Vallerand, R. J., Houliort, N., Lavigne, G. L. and Donahue, E. G. (2010) ‘Passion for an Activity and Quality of Interpersonal Relationships: The Mediating Role of Emotions’, *Journal of Personality and Social Psychology*, 98(6), pp. 917–929.
- Pinkerton, S., Tobin, J. L., Querfurth, S. C., Pena, I. M. and Wilson, K. S. (2017) “‘Those sweet, sweet likes’”: Sharing physical activity over social network sites’, *Computers in Human Behavior*, 69, pp. 128–135.
- Pornsakulvanich, V. (2017) ‘Personality, attitudes, social influences, and social networking site usage predicting online social support’, *Computers in Human Behavior*, 76, pp. 255–262.
- Przybylski, A. K., Weinstein, N., Ryan, R. M. and Rigby, C. S. (2009) ‘Having to versus Wanting to Play: Background and Consequences of Harmonious versus Obsessive Engagement in Video Games’, *CyberPsychology & Behavior*, 12(5), pp. 485–492.
- Reynolds, H. (2018) ‘Are you a Strava addict?’, *Cycling Weekly*, p. 2. Available at: <http://www.cyclingweekly.com/news/latest-news/are-you-a-strava-addict-347746>.
- Ringle, C. M., Wende, S. and Will, A. (2015) ‘Smart PLS’, <Http://www.smartpls.de> Hamburg, Germany.
- Rockmann, R. and Gewald, H. (2017) ‘Is IT What You Make out of IT? On Affordances, Goals, and Positive and Negative Consequences in Activity Tracking’, in *Proceedings of the 2017 International Conference on Information Systems*. Seoul, p. 35. Available at: <http://aisel.aisnet.org/icis2017/HumanBehavior/Presentations/35/>.
- Salmon, P. (2001) ‘Effects of physical exercise on anxiety, depression, and sensitivity to stress: A unifying theory’, *Clinical Psychology Review*, pp. 33–61.
- Sharon, T. (2017) ‘Self-Tracking for Health and the Quantified Self: Re-Articulating Autonomy, Solidarity, and Authenticity in an Age of Personalized Healthcare’, *Philosophy and Technology*, 30(1), pp. 93–121.
- Skinner, B. F. (1963) ‘Operant behavior.’, *American Psychologist*, 18(8), pp. 503–515.
- Soror, A. A., Hammer, B. I., Steelman, Z. R., Davis, F. D. and Limayem, M. M. (2015) ‘Good habits gone bad: Explaining negative consequences associated with the use of mobile phones from a dual-systems perspective’, *Information Systems Journal*, 25(4), pp. 403–427.
- Stragier, J., Vanden Abeele, M., Mechant, P. and De Marez, L. (2016) ‘Understanding

persistence in the use of Online Fitness Communities: Comparing novice and experienced users', *Computers in Human Behavior*, 64, pp. 34–42.

Strava (2018) *Strava Upload Rate Surges 5X, Total Uploads Surpass 2 Billion*.

Tenenhaus, M., Vinzi, V. E., Chatelin, Y. M. and Lauro, C. (2005) 'PLS path modeling', *Computational Statistics and Data Analysis*, 48(1), pp. 159–205.

Thorsteinsen, K., Vittersø, J. and Svendsen, G. B. (2014) 'Increasing physical activity efficiently: An experimental pilot study of a website and mobile phone intervention', *International Journal of Telemedicine and Applications*, page 74623, p. 9.

Topf, M. (1989) 'Personality hardiness, occupational stress, and burnout in critical care nurses', *Research in Nursing & Health*, 12(3), pp. 179–186.

Tosun, L. P. and Lajunen, T. (2009) 'Why Do Young Adults Develop a Passion for Internet Activities? The Associations among Personality, Revealing "True Self" on the Internet, and Passion for the Internet', *CyberPsychology & Behavior*, 12(4), pp. 401–406.

Turel, O. and Qahri-Saremi, H. (2016) 'Problematic Use of Social Networking Sites: Antecedents and Consequence from a Dual-System Theory Perspective', *Journal of Management Information Systems*, 33(4), pp. 1087–1116.

Turel, O., Romashkin, A. and Morrison, K. M. (2016) 'Health Outcomes of Information System Use Lifestyles among Adolescents: Videogame Addiction, Sleep Curtailment and Cardio-Metabolic Deficiencies.', *PloS One*, 11(5), p. e0154764.

Turel, O. and Serenko, A. (2012) 'The benefits and dangers of enjoyment with social networking websites', *European Journal of Information Systems*, 21(5), pp. 512–528.

Turner, J. C. (1991) *Social Influence, Social Influence*. Belmont, CA, US: Thomson Brooks/Cole Publishing Co.

Utz, S., Jonas, K. J. and Tonkens, E. (2012) 'Effects of passion for massively multiplayer online role-playing games on interpersonal relationships', *Journal of Media Psychology*, 24(2), pp. 77–86.

Vaghela, A., Patel, S. and Perry, M. (2017) 'Can Health Tracking Apps Spur Risk-Taking Behaviour? A 2-Year Retrospective Review of Strava Related Cycling Injuries Within North-West London', *British Journal of Oral and Maxillofacial Surgery*, 55(10), pp. e144–e145.

Vallerand, R. J. (2008) 'On the psychology of passion: In search of what makes people's lives most worth living', *Canadian Psychology*, 49(1), pp. 1–13.

Vallerand, R. J. (2012) 'The dualistic model of passion in sport and exercise.', in Roberts, G.

- and Treasure, D. (eds) *Advances in Motivation in Sport and Exercise*. Champaign, IL: Human Kinetics., pp. 169–206.
- Vallerand, R. J. (2015) *The psychology of passion: A dualistic model, Series in positive psychology*. Oxford: Oxford University Press.
- Vallerand, R. J., Mageau, G. A., Elliot, A. J., Dumais, A., Demers, M. A. and Rousseau, F. (2008) ‘Passion and performance attainment in sport’, *Psychology of Sport and Exercise*, 9, pp. 373–392.
- Vallerand, R. J., Mageau, G. A., Ratelle, C., Léonard, M., Blanchard, C., Koestner, R., Gagné, M. and Marsolais, J. (2003) ‘Les Passions de L’Âme: On Obsessive and Harmonious Passion’, *Journal of Personality and Social Psychology*, 85(4), pp. 756–767.
- Vallerand, R. J., Ntoumanis, N., Philippe, F. L., Lavigne, G. L., Carbonneau, N., Bonneville, A., Lagacé-Labonté, C. and Maliha, G. (2008) ‘On passion and sports fans: A look at football’, *Journal of Sports Sciences*, 26, pp. 1279–1293.
- Venkatesh, V. and Davis, F. D. (2000) ‘A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies’, *Management Science*, 46(2), pp. 186–204.
- Wang, C. C. and Chu, Y. S. (2007) ‘Harmonious passion and obsessive passion in playing online games’, *Social Behavior and Personality*, 35, pp. 997–1006. Available at: http://www.euro.who.int/__data/assets/pdf_file/0004/288112/IRELAND-Physical-Activity-Factsheet.pdf?ua=1.
- Wang, Y. L., Meister, D. B. and Gray, P. H. (2013) ‘Social Influence and Knowledge Management Systems Use: Evidence From Panel Data’, *MIS Quarterly*, pp. 299–313.
- Whelan, E., McDuff, D., Gleasure, R. and Vom Brocke, J. (2018) ‘How Emotion-Sensing Technology Can Reshape the Workplace’, *MIT Sloan Management Review*, pp. 10–12.
- Wolf, T., Weiger, W. H. and Hammerschmidt, M. (2018) ‘Gamified Digital Services : How Gameful Experiences Drive Continued Service Usage’, *Proceedings of the 51st Hawaii International Conference on System Sciences (HICSS)*, 9, pp. 1187–1196.

Appendix 1

Construct reliabilities (CR), average variance extracted (AVE), item means, standard deviations (S.D.), loadings.

<i>Construct</i>	<i>Item</i>	<i>Mean</i>	<i>S.D</i>	<i>Loading</i>
Recognition Adapted from Hamari & Koivisto (2015) CR: 0.96 AVE: 0.84	Recog1: I feel good when my achievements in Strava are noticed	4.77	1.62	0.92
	Recog2: I like it when other Strava users comment and like my exercise	4.64	1.68	0.95
	Recog3: I like it when my Strava peers notice my exercise reports	4.22	1.76	0.91
	Recog4: It feels good to notice that other user has browsed my Strava feed	4.06	1.77	0.89
Reciprocal Benefits Adapted from Hamari & Koivisto (2015) CR: 0.94 AVE: 0.79	Recip1: I find that participating in the Strava community can be mutually helpful	4.20	1.72	0.86
	Recip2: I find my participation in the Strava community can be advantageous to me and other people	4.11	1.70	0.87
	Recip3: I think that participating in the Strava community improves my motivation to exercise	4.61	1.72	0.93
	Recip4: The Strava community encourages me to exercise	4.43	1.77	0.90
Subjective Norms Adapted from Hamari & Koivisto (2015) CR: 0.95 AVE: 0.82	SubNorm1: People who influence my attitudes would recommend Strava	3.83	1.70	0.87
	SubNorm2: People who are important to me would think positively of me using Strava	3.84	1.74	0.92
	SubNorm3: People who I appreciate would encourage me to use Strava	3.72	1.70	0.94
	SubNorm4: My friends would think using Strava is a good idea	4.33	1.56	0.89
Harmonious Passion Taken from Vallerand et	HPass1: This sport allows me to live a variety of experiences	5.62	1.24	0.87
	HPass2: The new things that I discover with this sport allow me to appreciate it even more	5.64	1.27	0.87
	HPass3: This sport allows me to live memorable experiences.	6.01	1.12	0.83
	HPass4: This sport reflects the qualities I like	5.49	1.31	0.77

al. (2003) CR: 0.90 AVE: 0.61	about myself.			
	<i>*HPass5: This sport is in harmony with the other activities in my life.</i>	4.85	1.35	0.50
	HPass6: For me it is a passion that I still manage to control.	5.33	1.33	0.75
	HPass7: I am completely taken with this activity.	5.44	1.53	0.71
Obsessive Passion Taken from Vallerand et al. (2003) CR: 0.95 AVE: 0.73	OPass1: I cannot live without it.	4.17	1.90	0.84
	OPass2: The urge is so strong. I can't help myself from doing this sport.	3.94	1.83	0.87
	OPass3: I have difficulty imagining my life without this activity.	4.41	1.83	0.83
	OPass4: I am emotionally dependent on this sport.	3.74	1.90	0.85
	OPass5: I have a tough time controlling my need to do this sport.	3.16	1.77	0.86
	OPass6: I have almost an obsessive feeling for this sport.	3.46	1.92	0.90
	OPass7: My mood depends on me being able to do this activity	4.34	1.81	0.74
Life Burnout Taken from the Copenhagen Burnout Inventory (Kristensen et al., 2005). CR: 0.95 AVE: 0.73	<i>*BurnOut1: How often do you feel tired?</i>	4.61	1.17	0.66
	BurnOut2: How often are you physically exhausted?	4.02	1.33	0.71
	BurnOut3: How often do you think: "I can't take it anymore"?	3.45	1.45	0.80
	BurnOut4: How often do you feel worn out?	2.31	1.38	0.82
	BurnOut5: How often do you feel weak and susceptible to illness?	3.43	1.43	0.83
Impulsiveness Taken from Soror et al. (2015) CR: 0.93 AVE: 0.76	Impls1: I often buy things on impulse.	3.33	1.62	0.82
	Impls2: I generally do things without stopping to think.	2.73	1.34	0.87
	Impls3: I'm an impulsive person.	2.94	1.46	0.91
	Impls4: I often do things on the spur of the moment.	3.18	1.53	0.87

Perseverance Taken from Short UPPS- P Impulsive Behavior Scale (Cyders et al. 2014)	Pers1: I generally like to see things through to the end.	5.54	1.23	0.86
	Pers2: Unfinished tasks really bother me.	5.14	1.52	0.80
	Pers3: Once I get going on something I hate to stop.	5.28	1.35	0.89
	Pers4: I finish what I start.	5.40	1.24	0.91

*Note: * Items were removed due to loadings less than 0.70*