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

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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 social influence and the dual model of passion, 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

Underpinned by the dual model of passion, our study provides a theoretical framework explaining how the use of fitness apps can result in opposing wellness outcomes.

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 *et al.,* 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 the dual model of passion (DMP) 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 DMP (Vallerand, 2015) to determine the adaptive and maladaptive outcomes associated with the social influence aspects of fitness apps. The study focuses on core constructs from social influence theory – recognition, reciprocal benefits, and subjective norms (Cialdini and Goldstein, 2004; Cialdini, 2009) – as previous gamification studies demonstrate their importance in shaping user outcomes (Hamari and Koivisto, 2015; Hamari, Hassan and Dias, 2018). Our focus is on understanding how the use of fitness apps interacts with the cognitive processes of social influence in a virtual community to shape perceptions of exercise and wellbeing.

Our study advances fitness app research in a number of ways. Firstly, a crucial contribution we make to the existing literature is to provide a theoretical framework to understanding the process underlying the experience of socialised fitness apps. A focus on the process linking social motivations for using fitness apps to outcomes is critical, because individuals may experience very different outcomes based on the type and intensity of the passion they hold for physical exercise. Secondly, while previous fitness app research has largely paraded the positive health aspects of these technologies, our study demonstrates how social aspects of fitness apps appeal differently to both harmonious and obsessive exercisers, which ultimately manifests as both positive and negative wellness outcomes. Such insights extends our knowledge on the duality of IT use (Turel and Serenko, 2012; Soror et al., 2015; Islam et al., 2019) by showing how the interaction between social motives for using technology and passions lead to directly opposing 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. Gamification and Self Tracking

Many fitness apps rely on gamification and self-tracking to improve wellbeing by providing functions that support a user's motivation to exercise (Hamari *et al.,* 2018). The term 'gamification' first emerged in the early 2000's to describe the application of game-design elements and game principles in non-game contexts (Deterding *et al.*, 2011). Gamification is increasingly being used to direct people's efforts towards intrinsically motivated gameful engagement, such as learning a new language (e.g. Duolingo), driving safely (e.g. NissanConnect), responding promptly to e-mails (e.g. the e-mail game), saving money (e.g. Long Game), taking medications on time (e.g. Mango Health), and of course, promoting exercise (e.g. Strava) which is the focus of this study. Well-established psychological principles underpin gamification. Many gamification services adopt Fogg's Behaviour Model (FBM) (Fogg, 2009) which theorises that three factors influence any behaviour: motivation, ability and a trigger. For example, Strava incorporates badges, leader boards, and peer affirmations to seed and sustain motivation, an automatic data upload option to enhance ability[1], and notifications and newsfeeds to trigger the user into action. Other psychological theories, such as self-determination theory (Deci and Ryan, 1985), which asserts people are driven by innate needs of competence, relatedness and autonomy to continually seek challenges and new experiences to develop and master, are also fundamental to gamification (Sailer *et al.*, 2017).

A review of the pertinent literature concludes that gamification does indeed work, but the context being gamified and qualities of the user are critical (Hamari *et al.,* 2014). For example, individuals who are very outcome focused prefer gamification and self-tracking features, while those who feel the need to prove themselves to others tend to prefer gamification and social networking features (Hamari *et al.,* 2018).

In terms of self-tracking, experimental (Munson and Consolvo, 2012) and qualitative research (Sjöklint, Constantiou and Trier, 2015), concludes it does not necessarily lead to behaviour change, but aids in the refocusing and attainment of goals. Yet, self-tracking has also been written about in the context of self-obsession, narcissism, and extreme navel-gazing

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[1] Fogg uses ability to mean how simple it is for someone to do something at a particular moment in time

(e.g Foss, 2014). Summing up such a view, Morozov writes *"[t]he appeal of self-tracking can only be understood when viewed against the modern narcissistic quest for uniqueness and exceptionalism"* (2014, p. 233). In a similar vein, Lupton (2014, 2016) suggests the quantifiable-self movement is essentially that, focused on the self, and motivated for the benefit of the self.

2.2. Research on Fitness Apps

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 empirical examine how the social influence dimensions of fitness apps relate to both adaptive and maladaptive exercise outcomes. As such, we conceptualise peoples' perception or feelings for 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.

2.3 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.

2.4 Social Influence

Many psychological models exist theorising why people behave in certain ways. In an extension to the behaviourist learning theories of classical conditioning and operant conditioning, social learning theory (SLT; Bandura, 1977) draws attention to the process of observational learning from the social environment. People pay attention to some of those around them and are likely to imitate the behaviour of these 'models'. Behaviours are more likely to be mirrored when the model is perceived as being similar (e.g. same socio-economic background), and when the person (or those in their community) are rewarded or punished for the adoption or non-adoption of certain behaviours, values, beliefs or attitudes (Bandura, 1977). However, people still have cognitive control over the enactment of behaviours, a central feature of social cognitive theory (Bandura, 1986), a successor to SLT. In the social cognitive approach, people still learn by observing others, but have the agency to self-develop with the environment and behaviours they are exposed to.

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 reciprocal benefits (Cialdini and Goldstein, 2004). 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. Considered a 'weapon of influence' in Cialdini's seminal work on persuasion (Cialdini, 2009), *reciprocal benefits* are core to the process of conformity. When one person provides social support for another, there is often a self-imposed onus to try to repay, in kind, what the person has provided (Cialdini, 2009). However, as explained by Bandura (1986), peoples' cognitions will differ towards the level of return expected.

In addition to the psychological needs of recognition and reciprocal benefits, *subjective norms* play an important role in social influence (Hamari and Koivisto, 2015). 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 *et a*l. 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. In essence, subjective norms is similar to the concept of modelling in SLT (Bandura, 1977), in that the values or attitudes adopted depend on an assessment of the model and other cognitive processes.

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 reciprocal benefits and recognition as environmental features which exercisers can choose to engage with to support their exercise passion. Reciprocal benefits 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, the research model tested by this study is depicted in Figure 1. Following existing fitness app studies, we control for the effects of age, gender, and exercise duration (Hamari and Koivisto, 2015; James *et al.* 2019). As research has linked personality differences to both passion (Vallerand *et al.*, 2008; Lafrenière *et al.*, 2011), social networking outcomes (e.g. Meier *et al.* 2016; Turel and Qahri-Saremi, 2016), and life burnout (Topf, 1989), we also controlled for the personality differences of impulsiveness and perseverance in our study.
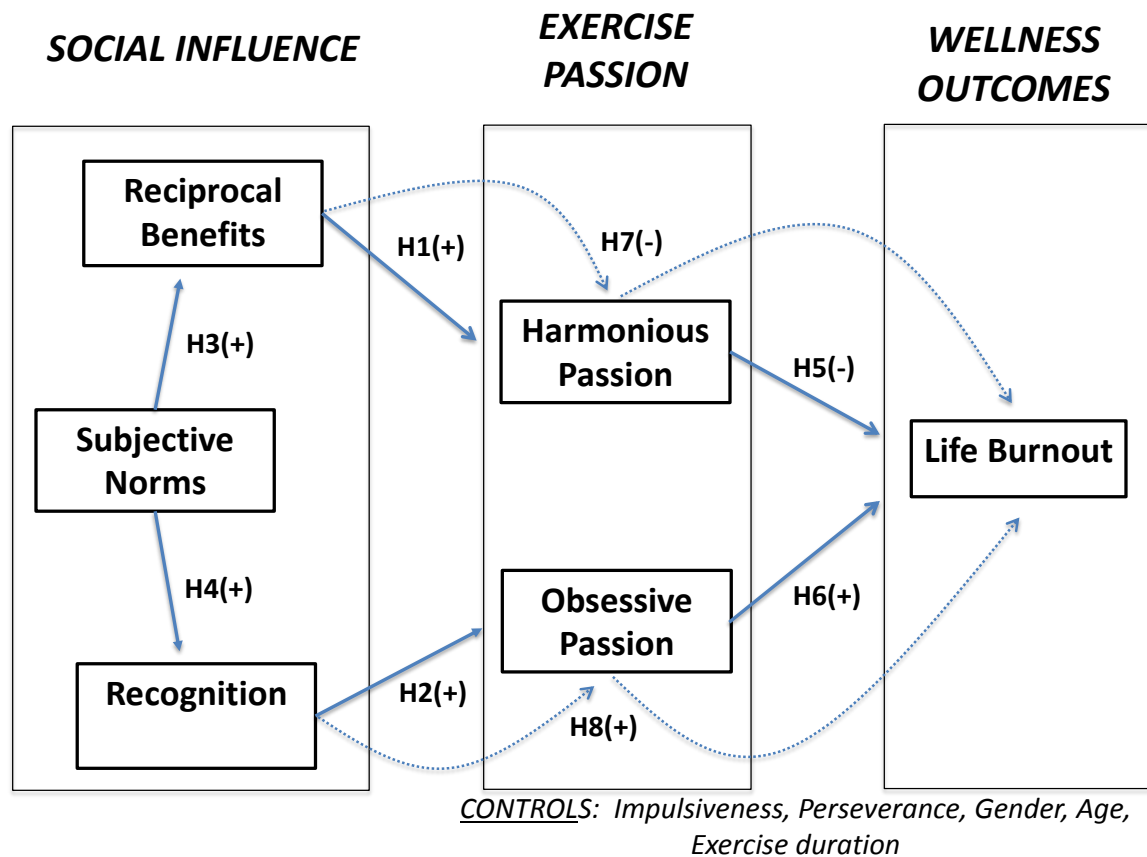
Figure 1. *The research model hypothesising on the associations between the social influence aspects of fitness apps, type of exercise passion, and life burnout. Note, dashed lines represent indirect mediated relationships.*

3.1 Hypotheses Linking Social Influence to Exercise Passion

Reciprocal benefits arise when reciprocal interactions lead to a perceived mutual gain for givers and receivers (Hamari *et al.* 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*

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pretty soon you'll get more kudos than ever.[2]*"* Other fitness apps have similar mechanisms to support reciprocal behaviour.

When a community provides such support, the 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, Houlfort 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

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[2] https://blog.strava.com/how-to-get-more-kudos-12482/

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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 hypothesis;

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 social influence theory (Cialdini and Goldstein, 2004; Cialdini, 2009), we argue the more strongly a person believes their peers expect and support certain behaviours, the more positively the reciprocal benefits 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 reciprocal benefits (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.

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 whom 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). We choose to focus on Strava as social interaction among its users are currently more prevalent than other in fitness apps (Stragier *et al.*, 2018). Indeed, to differentiate itself from other fitness apps, Strava targets 'social fitness' through features such as a calendar for inviting friends to work out, a feed to follow others' activities, and a blog for workout reports (Lindsey, 2019). Thus, the features of Strava are more likely to facilitate social influence among fitness users than in other fitness apps.

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.
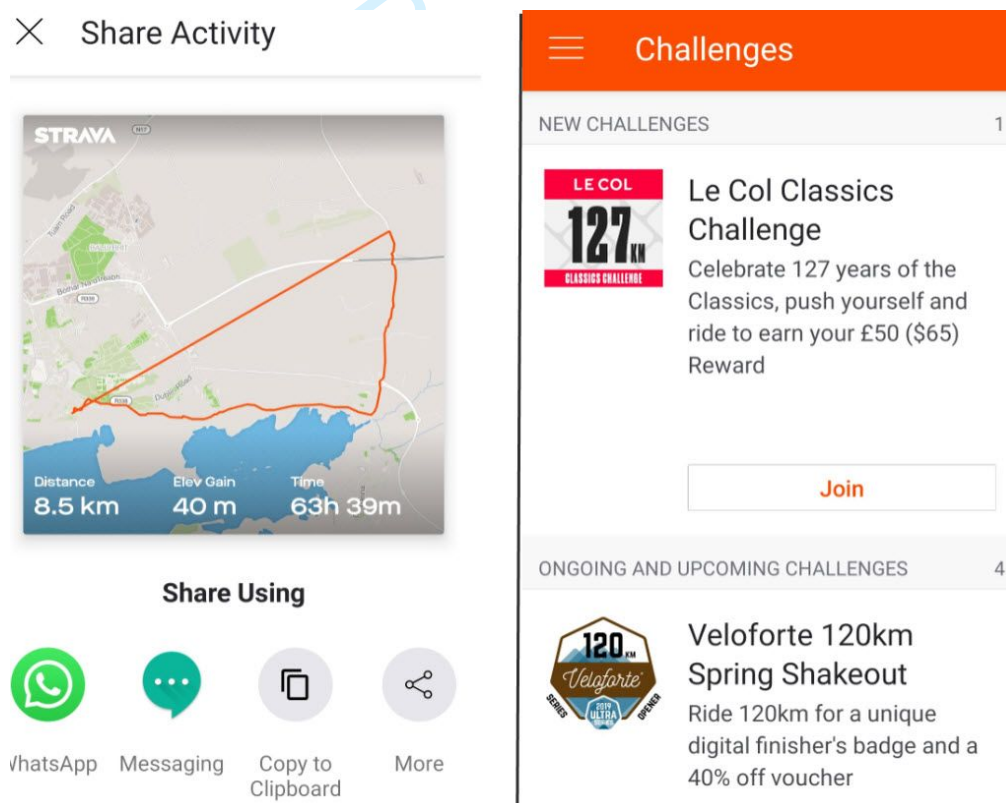

Figure 2. Strava Social Influence Examples

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 Ireland[3]. 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-established research instruments and were measured on 7-point Likert-type scales. Each

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

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 Strava users 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, reciprocal benefits, 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. This inventory was deemed appropriate for this study given its prevalent use in extant sports and exercise studies (For a review see Pacewicz et al., 2019). Additionally, while burnout is a key construct in sports and exercise literature (Jensen et al., 2018), the manner with which digital technology may influence burnout has not really been investigated. 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). PLS-SEM is an appropriate method to use when the goal of the study is both to evaluate the validity of a research model, and to test the hypothesised relationships within that model (Hair *et al.* 2017), as is the case for this present study. While the covariance based (CB-SEM) approach could also have been used for thus study, Hair et al. (2011, p.144) recommend selecting PLS over CB when *"...the goal is predicting key target*

constructs or identifying key 'driver' constructs" and *"...the research is exploratory or an extension of an existing structural theory."* CB-SEM approaches are preferred to PLS when the goal is the comparison of alternative theories, or the research model contains circular relationships. For these reasons, PLS-SEM was deemed a better fit for this study's objectives over CB-SEM.

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. We also conducted the Mahalanobis D^2 test, applying a value threshold of 5%, to detect possible outliers in the dataset. Using this threshold, no outliers were detected in the final sample.

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 and observable 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.
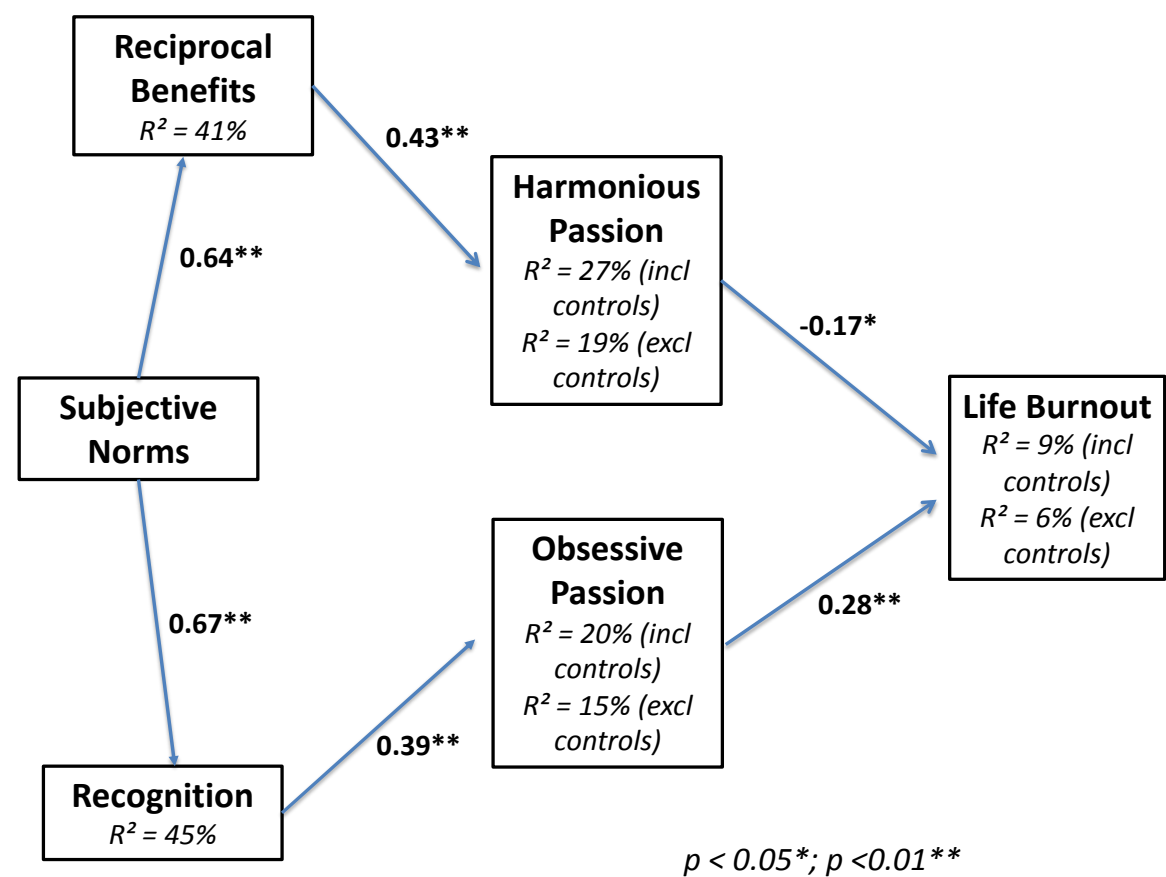

Figure 3. *Model results*

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

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harmonious passion for physical exercise has a significant negative relationship with life burnout (H5: β = -0.17, p < 0.05). H6 suggested an obsessive passion for physical exercise would positively predict life burnout, which was supported (H6: β = 0.28, p < 0.01). Although not hypothesised as relationships, reciprocal benefits were not related to an obsessive passion for exercise (β = 0.08, p = 0.19), nor was recognition related to a harmonious passion (β = 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 (β = 0.19, p < 0.05), while perseverance was positively associated with harmonious passion (β = 0.11, p < 0.05). For the control variables, age was negatively associated with harmonious passion (β = -0.16, p < 0.01) while females were also more likely to report a harmonious passion for exercise (β = 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 reciprocal benefits 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 reciprocal benefits (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 'reciprocal benefits – 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 reciprocal benefits 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). While 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), we extend the existing knowledge base by establishing how the types of social motives are associated with opposing wellbeing outcomes. 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. This study yields a deeper theoretical understanding of the relationship between social motivations for using fitness apps and wellness outcomes, revealing the type of passion held for physical exercise as a pertinent mediating mechanism. We provide a theoretical framework explaining how outcomes are influenced by engagement with fitness apps which can be modified in future research to revealed more nuanced insights.

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. Strava users may be drawn to the app for its social interaction and comparison features, but they need to be aware these social features can be a double-edged sword. Strava social features which promote recognition, such as posting only positive workout data or photos, can be linked to maladaptive perceptions of exercise and burnout in the long run. In contrast, Strava social features which promote reciprocal benefits, such as giving kudos and commenting on colleagues' activities, are likely to lead to adaptive outcomes. 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. Another alternative approach would be to implement a voluntary pilot project in order to assess the benefits and drawbacks such a wellness program may entail. For example, IBM gave out 50,0000 Fitbits over a two-year pilot period. IBM set the Fitbit users individual and team challenges during the trial period in order to increase employee physical activity. They found that 96% of the voluntary Fitbit users regularly logged their health data and took 8,800 steps more than non-Fitbit users. Most surprisingly, 63% of IBM employees continued to use their Fitbits following the pilot project. One important lesson to be harnessed from IBM's pilot use of Fitbits was the manner with which they collected the personal data from employees. FitBit allows 15 categories of data to be measured. IBM removed all traces of personal identifiable information from the data. Next, they aggregated the data for all employees and made it readily available for viewing on their fitness dashboards on their intranet (Gray, 2017). However, such an approach still comes with other 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).

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Appendix 1

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

Construct	Item	Mean	S.D	Loading
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.			
	HPass5: This sport is in harmony with the other activities in my life.	*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	*BurnOut1: How often do you feel tired?*	*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*