

# "Keep Going!": Understanding the Implications of Coaching through Fitness Apps to Support Physical Training

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## ABSTRACT

It is widely known that physical activity comes with numerous health benefits. However, many people fail to adhere to an active lifestyle, sedentariness representing one of the world's biggest issues. Technology has many attempts in changing that, offering a variety of types of interventions that aim to support people in their active lifestyle. Conversely, as people start becoming active, performance is desired. From fitness trackers to fitness apps, technology has not necessarily proven itself to sustain performance in training. In spite of fitness app's claims to train the user, there is little evidence of it. This paper presents two main studies focused around how fitness apps sustain physical training for non-athletes and what are the gaps that lead people to eventually abandon them. The paper explores motivation research, sports psychology and relevant human-computer interaction (HCI) perspectives. Using Self-Determination Theory and Technology as Experience framework, Study I confirms overall poor implementation of features in fitness apps that support crucial factors in physical training. We then follow-up with a Study II, where we design a semi-structured interview that aims to gain further insight on people's physical training values, perspectives, and experiences with fitness apps. Study II reveals what people consider helpful and important in their fitness routines and how technology can do better. Finally, we discuss the overall results of the two studies, and conclude with a set of design implications that can offer a superior solution to fitness apps.

## Author Keywords

fitness apps; coaching; performance; physical training; self-determination theory; technology as experience

## ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

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## 1. INTRODUCTION

Physical activity is a "bodily movement produced by skeletal muscles that result in energy expenditure" [8]. Physical activity and exercise training have both been shown to have psychological and physical health benefits over the years [2]. Equally, exercise can offer other benefits such as improved body image or feelings of mastery [43].

With its increase in popularity, exercise, or physical training, has been the subject of many technological products with the purpose to help people develop and maintain a fitness routine, it being home, in the gym or simply outdoors. From fitness trackers to smartphone applications ("apps"), such technology interventions come with functionalities such as fitness plans, activity tracking (i.e., step counter), calorie trackers, coaching apps and online communities to support the user in their fitness journey. In spite of technological advancements in the fitness area, people tend to have many misconceptions about what it means to be physically active, how to maintain a fitness routine and how to facilitate performance. Thus, despite physical activity's habitual nature, there is much evidence of sedentary behaviour. There is evidence showing that fitness apps have been effective, but also abandoned [11, 41, 54] due to insufficient functionality and opportunity for behaviour change.

A report published in 2017 [23], shows that 25% of the UK's population are physically inactive, whilst 14% are fairly active and 61% are physically active. Conversely, even though there seems to be a focus on discouraging sedentary behaviour, there is little focus on individuals that are willing to adopt an active lifestyle, but may need a more performance-supportive intervention. While professional athletes train with a coach or personal trainer (PT), it can be challenging for regular people to adopt such means either because of financial costs, availability to train or other factors. As a result, many people that aspire to attain and maintain a certain fitness level, seek for accessible and affordable ways to educate themselves about exercising and other relative factors, in order to achieve their goal. Regardless, even though technology can represent a solution, it may be challenging to filter out the accurate information. Therefore, people either dedicate their time to become self-aware about their training or become demotivated as a result of stagnation.

Physical training is considered highly personal [17] which is a main reason for needing an expert to offer guidance. Generally,

fitness apps on the current market focus on providing workouts, training plans, running trackers, as part of their coaching interventions. However, in spite of their coaching claim, there seems to be little adoption for this type of fitness apps, or any other type thereof, at a more advanced fitness level. Research in human-computer interaction (HCI) has been undertaken to show the effectiveness of technology and fitness apps to encourage people to adhere to an active lifestyle, in the light of behaviour change and motivation literature. However, there is comparatively little HCI research that focuses on the user experience of fitness apps, and that evaluates them for their performance-supportive solutions.

This paper makes two main contributions and presents implications for design that could be explored to offer a more sustainable solution for physical training through fitness apps. Firstly, we review functionalities of fitness apps on the current market that specifically claim to coach the user. Using Ryan and Deci's Self-Determination Theory [50] and McCarthy and Wright's Technology as Experience Framework [37], we highlight the weaknesses of fitness apps in terms of motivation and affective responses of the user experience. Secondly, we propose a semi-structured interview study to gain insight into how people use fitness apps, and the extent to which fitness apps support them in achieving their fitness goals. We argue that the technological power of fitness apps can be leveraged to process user data into a personal training intervention through user feedback, customisation and information. Furthermore, the repetitive and structured nature of physical training can be used by fitness apps by incorporating timer-based interventions.

## 2. LITERATURE REVIEW

In this section we will discuss relevant background literature based on sports psychology, motivation research, behaviour change, and the HCI approach to physical activity. Topics include self-monitoring and decision-making fostered by personal informatics, how emotion and affective needs may play a role in performance and motivation to be physically active and how technology takes such approaches. We also discuss smartphone interventions that aimed to facilitate behaviour change in terms of physical activity.

### 2.1. Behaviour Change and Persuasive Technology

Behaviour change was discussed by many researchers attempting to understand the design implications of it. Some examples include Theory of Planned Behaviour [3], the Transtheoretical Model [45], MINDSPACE [18], and the COM-B model [38]. Many persuasive technologies are based on behaviour change literature and smartphone interventions are an effective way to reach large-scale populations, thus offering a good opportunity for behaviour change [31].

Much of the technological health interventions focus on persuasive technology and fitness apps are no exception. Smartphone technology represents a good opportunity to address physical activity promotion, as it is ubiquitous, convenient, and a good tool to monitor one's progress and levels of physical activity to gain real-time feedback [31]. The advanced smartphone build-in sensors (i.e., accelerometers) can provide a cost-

effective alternative for physical training participation. Additionally, besides continuous activity monitoring, smartphones can also process data automatically to deliver behaviourally and contextually oriented feedback to the user [27].

The number of smartphone fitness apps is rapidly growing, with thousands available on Apple's AppStore and Google Play. Nevertheless, Mollee et al. [40] argue that despite the increase in smartphone health and fitness apps usage and popularity, it is insufficient for app-based interventions to be just effective, but also that they have to be accepted by users. Thus, evidence has shown that app abandonment is due to several reasons, some being low engagement, lack of user friendliness [40], lack of desired features and abandoning a health goal and thus abandoning the app [41].

This, however, is not unexpected, as Cowan et al. [12], who content analysed 127 iPhone health fitness apps for the presence of health and behaviour change theory constructs, proved that there is little evidence of theoretical content, further suggesting the collaboration between behaviour change experts and app developers toward a superior solution with better health outcomes. Furthermore, a more recent study [53] of systematic reviews, revealed that only 14 out of 21 physical activity based apps showed significant health improvements, suggesting higher app usage associated with health improvements.

Additionally, King et al. [27] demonstrates the importance of how people perceive effectiveness of apps. To do this, three custom applications: "analytical", "social" and "affective", were built to explore their efficacy in behaviour change. In general, results indicated that 69% were motivated by the apps to be more physically active and 71% reported that the apps helped them to exercise regularly [27]. This suggests that fitness apps can persuade people to maintain an active lifestyle if behaviour change constructs are implemented accordingly.

Although many of these studies were based on technologies targeted toward physically inactive individuals with the purpose of reducing sedentary behaviour, persuasive technology and behaviour change remain an important aspect in sustaining physical training long-term. Nevertheless, one key challenge in fitness technology is maintaining high motivation of its users, not only to adhere to an active lifestyle, but to also maintain it [52].

### 2.2. Motivation

It is well known that motivation has been reported as key element in athletes' performance [57]. Ryan et al. [51] argue that health interventions that fail to stimulate intrinsic motivation can inhibit behaviour change and ultimately lead to discontinued use of said technology [51], and, as such, they propose to use self-determination theory (SDT) [50] to address this.

#### *Self-Determination Theory*

SDT is a popular theory of motivation in the area of sports psychology and exercise [24]. Traditionally, SDT is an approach to human motivation that highlights the people's inner resources for personality development and behavioural self-regulation [50]. Ryan and Deci [50] have identified the three

pillars of the SDT, namely autonomy, competence and relatedness. These three psychological needs appear to be crucial to the optimal functioning of the human, in the light of growth, personality and social development, and overall wellbeing. As such, Ryan et al. [51] further propose a self-determination health behaviour model (SDHBM), which takes SDT into a health behaviour change context.

In the context of SDHBM, autonomy represents self-regulation (meaningful information for change and freedom of choice with no external pressure) and integrated regulation (when an individual values not only the behaviour, but also other related aspects). Competence is augmented by meaningful feedback and supportive skills or tools that help individuals change and overcome barriers. Finally, relatedness is reflected through "social support" which promotes internalisations of extrinsic values, but also a sense of respect and understanding [51].

#### *Intrinsic and Extrinsic Motivation*

Intrinsic motivation reflects positive potential in humans and implies a natural tendency to mastery, autonomy, and interest in personal growth [50]. In sports, intrinsic motives reflect on self-determination to exercise for enjoyment, competence, fitness, feeling good after exercising, wellbeing, strength and endurance, just to name a few [24]. Conversely, extrinsic motives represent reasons to engage in exercise for physical appearance, social recognition, weight management, or other forms of health and social pressures and have been demonstrated to not be as sustainable [24].

Vallerand [56] has proposed a hierarchical model of intrinsic and extrinsic motivation (HMIEM), based on the SDT. This model helps to understand the determinants and consequences associated with levels of motivation and generality. In this model, motivation is based on three main constructs: intrinsic motivation, extrinsic motivation and amotivation.

Intrinsic motivation comes from one's need to feel self-determined and competent [14]. As such, engaging in optimal challenges for their capacity, people have a sense of self-efficacy. Moreover, people that are driven by a self-authored motivation typically show more interest and excitement than the ones that are externally controlled. Thus, intrinsic motivation leads to an enhanced performance, persistence, creativity, as well as heightened vitality, self-esteem and wellbeing [50]. Intrinsic motivation fosters the positive potential in humans, by encouraging them to seek out challenges and novelty, to explore and learn. Thus, intrinsically motivated athletes will engage in sport activities with a strong sense of willingness [36].

In sports, athletes may also be motivated by external cues such as rewards, to practice sport, this representing the extrinsic motivation. SDT exposes multiple types of extrinsic motivation that vary in their autonomy and can either be self-determined or non-self-determined. These are external regulation, introjected regulation, identified regulation, and integrated regulation [21].

External regulation is based on behaviours regulated by external sources (i.e., rewards) and is the least self-determined form of extrinsic motivation. Introjected regulation happens when possible future circumstances from external forces are

internalised without one's full endorsement. An example of introjected regulation would be when athletes engage in a sport activity to avoid anxiety, or feelings of guilt. A more self-determined form of extrinsic motivation is identified regulation, which occurs when even though it is not perceived as being attractive by an individual, the behaviours are still performed out of choice. For instance, athletes may engage in a different type of training because it leads to a significant improvement in their sport performance. Finally, integrated regulation, the most self-determined form, refers to one's behaviour determined by choice and fully internalised in their value system and needs [50]. Furthermore, SDT mentions the concept of amotivation which represents the relative absence of motivation and lack of intention to perform an activity [21].

Research shows that intrinsic motivation and self-determined extrinsic motivation are crucial to athletes' optimal performance, in contrast to the non-self-determined extrinsic motivation [36]. Sports and physical training require discipline and a strong sense of determination, which are not always enjoyable or easy to control. For this reason, people who train regularly cannot rely solely on intrinsic motivation, requiring some external factors to pursue training. However, self-determined extrinsic motivation, as opposed to the non-self-determined one, has been proven to be related to positive cognitive, affective, and behavioural responses, similar to the ones fostered by the intrinsic motivation [56].

### **2.3. Determinants**

Dishman et al. [17] argue that failing to acknowledge determinants for physical activity represent a barrier to creating effective methods to promote it. They [17] stress that such interventions would require both abstract (i.e., beliefs) and concrete (i.e., disability) determinants to address psychological and physical barriers to activity, provide knowledge and skills to reinforce the willingness and ability to be active, as well as allowing selection of adequate forms and intensities of activity. It is arguable that fitness apps were successful in addressing such matters [54].

Additionally, in an attempt to understand persuasive strategies in a fitness app, Schneider et al. [52] found that individual differences affect users' behaviour. Past research has addressed individuals perception of behaviour change technology based on personality differences [25]. Thus, personal characteristics are important in how people perceive physical activity. These characteristics are defined by knowledge, personality, beliefs, biometrical traits, just to name a few [17]. As such, people can be attracted by different types of training. For example, a study [20] which examined personal characteristics across the intrinsic and extrinsic motivation spectrum, demonstrated that people with different types of motivation can be attracted by different types of physical activities.

#### *Flow and Self-Efficacy*

Csikszentmihalyi [13] investigated the subjective phenomena of flow that builds on top of the motivation research done by Ryan and Deci [15]. Thus, the flow is supported by a phenomena of activities intrinsically motivated or autotelic which is rewarding of itself [13].

Flow is a concept that was introduced to describe a state of optimal levels of functioning and complete absorption in a task under two conditions: (1) perceived challenges or opportunities that require existing skills on an appropriate level of one's capacity and (2) clear goals and feedback about the progress [42]. In sports, Jackson [26] stresses the importance of the link between flow and peak performance in athletes, further suggesting that the way these factors are perceived by an athlete in terms of control can help them achieve the optimal performance.

Furthermore, Csikszentmihalyi [13] argued that flow can occur either spontaneously or on demand, from the individual's ability to enter such state. However, personal traits could influence one's ability to do so. If the specific activity may exceed one's skill, anxiety can occur, whereas a low-demanding activity may result in boredom. As such, the flow state can be achieved by the athlete only if there is an optimal balanced between skill and challenge [26]. It is important to note that this is not based on an objective interpretation, but rather how one perceives it, and thus, whether flow occurs or not is highly dependent on one's consciousness [13].

Research confirmed that, in sports, flow has a higher chance to occur when there is a positive mental attitude, positive competitive stimulus, focus, physical fitness and also unity when it comes to team sports [26]. Self-confidence and a positive mindset were found to be crucial for sports performance improvement and persistence, and self-confidence was also found to be critical to flow [5].

Self-confidence is highly cited in the research studying the athletic performance and is considered an important affect and construct in the athlete's success and achievements. Terms such as "self-confidence" and "self-efficacy" have been used to describe one's perceived potential to achieve a high level of athletic performance [5]. Conversely, Bandura [5] does not associate self-confidence with self-efficacy explaining that self-confidence is based on the belief that one can successfully execute a behaviour, whereas self-efficacy is based on the perceived competence and the strength of that belief [19].

High self-efficacy was found to be commensurate with the amount of effort individuals were willing to put and persist throughout their journey to success. Thus, such experiences of a successful outcome would reinforce one's sense of self-efficacy and determine them to behave in a less self-defensive manner in future similar situations [5]. Similar in the context of flow, self-efficacy is not concerned with the skills or level of expertise, but rather with one's self-judgement of it.

#### **2.4. Coaching**

Traditionally in physical training, people ask for expert advice when it comes to achieving personal fitness goals. Expert advice often comes from personal trainers or physical therapists. Their responsibility is to develop an effective workout program tailored to their client's need, help them set goals and stay on track, provide feedback and undertake fitness assessments to find out individual's strengths and weaknesses [47]. Our previous sections about motivation and determinants show the importance of an intervention that is personal to one's needs.

Additionally, SDT postulates two types of interpersonal context: autonomy supportive and controlling. Autonomy supportive interventions occur when social agents, such as coaches or peers, encourage choice and decision-making by providing meaningful input and acknowledge one's feelings and perspective [24]. Conversely, the interpersonal context is controlling when social agents do not provide meaningful rationale, pressure people and do not acknowledge challenges or difficulties linked to performance of behaviour [24]. Thus, research has found that frequent use of positive and constructive feedback from social agents enhances self-esteem, increases levels of enjoyment and lowers anxiety [55]. Regardless, although such feedback, instruction and social support can enhance intrinsic motivation, overuse may hinder it and it may result in being perceived as controlling [24].

Furthermore, Mageau and Vallerand [36] discuss the coach-athlete relationship and how the quality of this relationship is an important determinant in the athlete's satisfaction, motivation and performance. They [36] stress that the coach's behaviour must be autonomy-supportive in order to have a positive impact on the athlete's need for the three psychological needs defined in the SDT: autonomy, competence, and relatedness. Thus, the satisfaction of such needs can enhance one's intrinsic motivation and self-determined extrinsic motivation.

#### **2.5. Personal Informatics and Reflection**

Personal informatics are a technological intervention to record one's behaviour. Such records have been used in clinical settings to modify behaviour and explore reactive effects [46] to help individuals exhibit better behaviour. This act of self-monitoring has been proven to be effective in the context of sports to improve athletes' performance, adjust training to their needs, and stimulate self-regulation [46].

As the popularity of the activity tracking systems increases, it is important to address how personal informatics impact the user's training. HCI opens new possibilities of applications that track and monitor one's progress. As the terms suggested by Li et al. [34] "know thyself" imply: personal informatics enable individuals to gain better understanding and deeper knowledge of themselves, in order to make informed decisions based on it.

People strive to know themselves better through their actions, habits and behaviours. This opens up the opportunities for behaviour change, self-insight, and self-control [44]. In sports, self-monitoring and personal informatics can provide coaches and athletes with a deeper understanding of how to tailor trainings in order to reduce risk of overtraining, illnesses or injury and improve performance [46].

However, Li et al. [33] argue that activity tracking systems show physical activity information (i.e., step counts, heart rate, energy expenditure) and although these measurements may be sufficient for self-knowledge needs, contextualised factors that affect physical activity could offer a greater degree of certainty. Contextualised factors such as time, social influence or environment, are often disregarded by tracking devices and systems. Thus, this issue can hinder reflection of physical activity information along with contextual information [33].

The study concluded that personal informatics systems need to integrate data collection and reflection better and while automation may have a detrimental effect on immediate awareness, automated tracking of physical activity and contextual information facilitate the long-term reflection. Moreover, if the cost of manually collecting data was high, participants were less inclined to do this accurately [33].

Rooksby et al. [48] identified different styles of tracking: (1) directive, to achieve a goal; (2) documentary, to document activities; (3) diagnostic, to connect different parameters together; (4) collecting rewards, to collect incentives; and (5) "fetishized," solely out of an interest in data or technology. However, a study comparing amateur to elite athletes [46] found that the elite group understand tracked data by using the knowledge about their bodies and trainings. This suggests that in the context of sports, more experienced individuals may potentially use their personal informatics in a more holistic way, by including related aspects, such as their mood, or how their body feels.

The study [46] also found personal informatics to offer insufficient opportunity to amateur athletes to develop such knowledge. This may be because technologies often fail to provide the necessary information to help people understand their behaviours. For example, a study [11] on physical activity technologies highlighted the lack of sufficient information that supplements the measurements in order to help users understand their behaviour better.

#### *Goals, Habits and Routines*

Although the terms "exercise" and "physical activity" have been used interchangeably and may seem similar, exercise is a subcategory of the physical activity. Exercise (or training) comes in many forms, such as aerobic training, flexibility training or weight training, however, generally, it is planned, structured and repetitive in nature [8] and its purpose is to improve or maintain physical fitness.

The repetitive nature of physical activity implies habit formation, and thus individuals may use their past experiences of exercising to make informed decisions about future opportunities to achieve a fitness goal [2]. Habit is often self-reported and measured by frequency of past behaviour. People often perform actions on a routine basis. Forming habits are highly useful in these circumstances as it enables individuals to perform actions mindlessly and automatically [1].

Goal setting is frequently discussed in research concerning physical activity. Locke and Latham [35] have postulated three strategies for effective goal setting, which can also be applied in sports: (1) setting specific and not generic goals; (2) setting challenging but not extremely difficult goals, and (3) combine short-term and long-term goals. Habits are automated and directed by a goal in the presence of a triggering stimulus and positive experiences can enhance the tendencies of an individual to repeat an action [2]. Furthermore, the satisfactory experiences create a strong link between the behaviour and one's goal. Similarly, the unsatisfactory experience weakens this link, resulting in a decreasing probability for one to want to continue the behaviour. Moreover, high frequency and

consistency in executing behaviours were demonstrated to support habit formation [1]. Thus, enough repetitions of the same task leads to creating routine behaviours [29].

In performing physical activities, Aarts et al. [2] argue that being active for children can be described as habitual due to the mindless, automatic nature, however, as individuals grow older they tend to become less adherent to the active lifestyle. Unless the exercise habits are not (re)established in early life, adults tend to adopt an inactive lifestyle and greater efforts must be made to reestablish habits and routines of exercise. Thus, we argue that implementing constructs to enhance habit and routine formation is crucial to physical training.

#### **2.6 Positive Computing and Affective Interaction**

In their paper, Calvo and Peters [7] aim to promote the power of the positive computing, which describes the potential of technology to enhance and foster health and wellbeing. They extend Ryan and Deci's work on motivation research and SDT [50] to address the hedonic and eudaimonic approach to psychological wellbeing. Technology often takes a hedonic approach to create pleasurable user experiences. However, eudaimonic wellbeing extends beyond the positive emotions and implies that happiness is contingent on human potential and personal development [7]. Calvo and Peters [7] argue that this approach remains fairly new in the technological area. Furthermore, they observe three categories of technological interventions: preventative, active, and dedicated [7].

Compelling evidence suggests that exercise has a high impact on the mental health and affective responses. Studies suggest that athletes participate in sports for various reasons such as fun, enjoyment, skill development, challenge and fitness [20]. However, there are also motives of psychological benefits. Exercise has been shown to improve mental health, proving itself to be effective for a number of mental illnesses such as anxiety, depression or stress. In addition, setting goals for oneself has been proven to contribute toward fitness activity and positive behaviour change [30, 10].

Research [28] suggests that there is an association between affective needs and health behaviours. Furthermore, individuals that have been training for a long time report a positive affect. As a result, this association increases motivation to engage in physical activity. Bandura's [5] social cognitive theory relies on the construct that individuals engage in a process where they weight the cost and benefits of a behavioural choice and select the option with the most favourable benefit-cost ratio. Conversely, research suggest both the affective associations and the interplay of affective associations and cognitive beliefs influence decision-making [28].

#### *Technology as Experience Framework*

McCarty and Wright's theoretical framework, Technology as Experience [37] focuses on the affective states of the human-computer interaction. Through this framework, the authors encourage HCI researchers to go beyond the cognitive aspects of the interaction and use empathy as a tool to access emotions that may be involved in it [58]. Such framework may enable researchers to gain a deeper understanding of the users' subjective experiences and how affective states played a role in

the way they perceived the technology.

Based on the appraisal theory, the framework is made of four threads of experience (sensual, emotional, compositional, and spatio-temporal) and six sense-making processes (anticipating, connecting, interpreting, reflecting, appropriating and recounting). The four threads help people think more clearly about the experience of the technology by providing ways to talk about it and heighten the sensibility of the user toward it [37]. The sense-making processes focus on the way the user may interpret the technology.

## 2.7. Conclusion and Research Aims

In this section we discussed relevant literature regarding important aspects of physical training. As coaching or personal training is crucial for effectiveness in exercise and desirable for people that aim for performance, we argue that fitness apps should aim for a better intervention that accounts for user's personal goals, affective responses whilst enhancing their motivation and form better habits. We explore this issue by investigating how technology currently fosters behaviour change, motivation and coaching. To do this, we first look at fitness apps currently on the market that aim to "coach" users by providing them with "personalised" workouts, guidance and means of activity tracking. Furthermore, we explore the reasons for app abandonment, values, perspectives and expectations users have from fitness apps and technology in general by conducting a series of semi-structured interviews. Finally, we conclude the research with implications of design and suggestions for future improvements of fitness apps with better health and performance outcomes.

## 3. STUDY I: APP REVIEW

Our background study showed the importance of expert intervention and coaching experience in physical training performance, as well as how fitness apps do not focus sufficiently on this. Therefore, we wanted to explore this issue in more detail. In this study, we conducted a review on existing fitness apps on the market that claim to offer coaching interventions to understand how they support behaviour change, performance and motivation, how they record and keep track of progress and goals, the visualisation of personal informatics and the overall user experience. We use self-determination theory to evaluate how apps foster motivation, as well as technology as experience framework to explore the affective perspectives.

### 3.1. Method

A systematic search on the UK Apple AppStore [4] and Google Play Store [22] was conducted as Apple iOS and Android are the most popular operating systems on mobile [32]. Only apps that are found both for iOS and Android were included and system-related design implications were considered in the analysis. Furthermore, apps that were free to download were included only and reviewed based on the free plan, thus they were not upgraded to premium paid subscription. To be eligible, apps had to be in "Health & Fitness" or "Sports" category to ensure poor quality apps were discarded. In addition, to ensure quality and popular usage, apps had to

be highly reviewed and rated (more than 500 ratings). Furthermore, the smartphone apps had to be recently created or updated to ensure ongoing technical support and self-contained, meaning they could not require third-party tools to function. Most importantly, only apps that claimed to offer "coaching" or "personal training" and made it available for free were considered. This was ensured by the search terms: "fitness" + "coach" OR "running" + "coach" OR "workout" + "coach" OR "personal" + "trainer".

Summary of inclusion criteria:

1. Be available for both iOS and Android operating systems
2. Be in "Health & Fitness" (preferably) or "Sports" category
3. Offer/claim to offer a "coaching" functionality
4. "Coaching" functionality present on a free version
5. Have enough reviews and ratings
6. Be self-contained
7. Be created or updated recently
8. Free to download
9. Be in English

A total of 9 apps that met the inclusion criteria were selected. These were separated into two main categories: workout-focused and running-focused. Each app was downloaded and installed on the author's personal Apple smartphone and the second rater's personal Android smartphone. A user account was set where necessary, but apps were not upgraded to premium. If the free plan did not include any type of coaching, the app was discarded.

### 3.2. Analysis

A framework was developed by the author and discussed with a second rater, used to minimise the results' high subjectivity. The framework was based on self-determination theory [50] to assess the cognitive and motivational aspects. In addition, the technology as experience framework [37] was used to assess the affective aspect of the interaction. The two raters downloaded the apps together and tested them out separately over a period of one week, giving scores from 1 (very poor) to 5 (very well) for each aspect, and notes for justification. There was a total of eight categories to score. The categories were the self-determination theory's psychological needs: autonomy, competence, relatedness, accompanied by the technology as experience framework consisting of four threads of experience and the sense-making activity, which covered all the six sense-making processes. Thus, the remaining categories were: sensual, emotional, compositional, spatio-temporal and sense-making activity.

After one week of exploring and assessing the apps, the two raters discussed their notes and scores, agreeing on a final score for each and finally each app receiving an average overall score. The inter-rater reliability score ensured the validity of the app review [6, 39]. In detail, apps were then tested and evaluated for: (1) how they assist with goal-monitoring and

Framework vs App	SELF-DETERMINATION THEORY			TECHNOLOGY AS EXPERIENCE					TOTAL
	Autonomy	Competence	Relatedness	Sensual	Emotional	Compositional	Spatio-temporal	Sense-making activity	
Fitbit Coach	4	5	3	4	3	5	4	4	4.00
Workout Trainer	5	4	4	2	2	3	4	2	3.25
C25K	4	2	2	3	2	4	3	5	3.13
Freeletics Bodyweight	3	3	3	3	3	3	3	3	3.00
MapMyRun	2	3	4	2	2	4	4	3	3.00
Endomondo	2	3	3	2	2	4	4	3	2.88
PEAR	4	2	2	3	2	3	3	3	2.75
5K Runner	4	2	2	1	1	4	3	5	2.75
The RUN Experience	5	1	2	2	2	3	2	2	2.38

Table 1. Overview of scores. Scale 1 to 5 (1 - very poor; 5 - very well)

workout progress, (2) the user flow of completing a workout and the overall user experience, (3) how they offered feedback, tips and advice to support behaviour change and performance, (4) how they provided information about health and physical exercises, (5) issued reminders and prompts for motivation, and (6) allowed sharing on social platforms or with community, (7) how the users feels connected to the app and coach, (8) how the user makes sense of the app. The overview of scores can be seen in Table 1.

### 3.3. Functionalities

Multiple common functionalities were identified and evaluated. Functionalities and scores are described more in depth with examples in the following sections. We then discuss the functionalities through the lens of SDT and technology as experience framework.

#### *Coaching and Personalised Training*

Overall, "coaching" was mostly applied as a form of personalised intervention. All apps offered personalised coaching to a certain extent, however, there were different ways of implementing this. Some apps offered interaction with a personal trainer through chats and training plans (on a premium version), others offered personalised workouts, including recommendations and suggestions. Some apps did not put an emphasis on the personalisation or coaching despite the claim to do so. Moreover, many apps did not make clear what the personalised workouts and recommendations were based on and did not seem to take into account the goal set by the user where applicable. For example, "Freeletics Bodyweight" app asked for user's fitness goal as part of the initiation process but did not make a clear link between how the personalised workouts offered helped the user achieve this goal. "PEAR" makes recommendations based on fitness level, intensity balance (requires a heart monitor) and activity class. "Workout Trainer" allows users to connect with personal trainers and access their workouts (on a premium version).

#### *Goal Monitoring*

Two apps were based on a single goal: "5K Runner" and "C25K". Both focusing on running, they displayed a timeline with the week and day numbers allowing the user to mark them as complete and view their progress (see Figure 1). Moreover, the apps would track the run in real-time through GPS and offer audio guidance, like most running apps do. The rest of

the apps covered a variety of goals, from running to working out. However, only 3 out of 7 asked the user what their goal is, mostly in their initiation process. The initiation process also consisted of setting personal information, such as date of birth, height, weight, age, gender. Within these, 2 apps defined goals as frequency (i.e., number of workouts per week) and 1 app defined goals as category (i.e., losing weight, gaining muscle, etc.). However, none of the apps made clear how they use this information to (1) personalise content and (2) help achieve user's fitness goal. "Workout Trainer" offers programs on a premium version which come with predefined workouts over a period of time and a schedule, focusing on a specific goal chosen by the user.

#### *Personal Informatics*

Personal informatics were found in most apps, displaying the number of workouts/runs, total workout minutes, days the user used the app to workout. Some displayed graphs of weekly stats (i.e., "Workout Trainer"). Conversely, "Freeletics Bodyweight" did not put an emphasis on personal informatics, offering only information about level (based on points of workouts completed) and number of workouts done. Moreover, "The RUN Experience" provided no personal informatics.

#### *Customisation and Motivational Prompts*

Apps used push notifications to remind the user to work out. However, there was no clear pattern identified and the time of reminder was not set by the user. Some apps allowed users to choose the level of audio intervention. For example, "Workout Trainer" had from no audio to coaching including tips, instructions and motivation (see Figure 2). Most apps allowed the user to select the level of difficulty and time of workout. However, this had different implementations across the apps. For example, "Workout Trainer" provided workouts based on these criteria set in the profile, whereas "Freeletics Bodyweight" allowed users to customise difficulty and time for a specific workout selected. Some apps allowed users to join or create challenges to keep them focused. "Endomondo" allowed users to search and join challenges, in addition "MapMyRun" allowed users to create their own challenges and invite friends to join. Most apps also allowed users to add workouts to favourites.

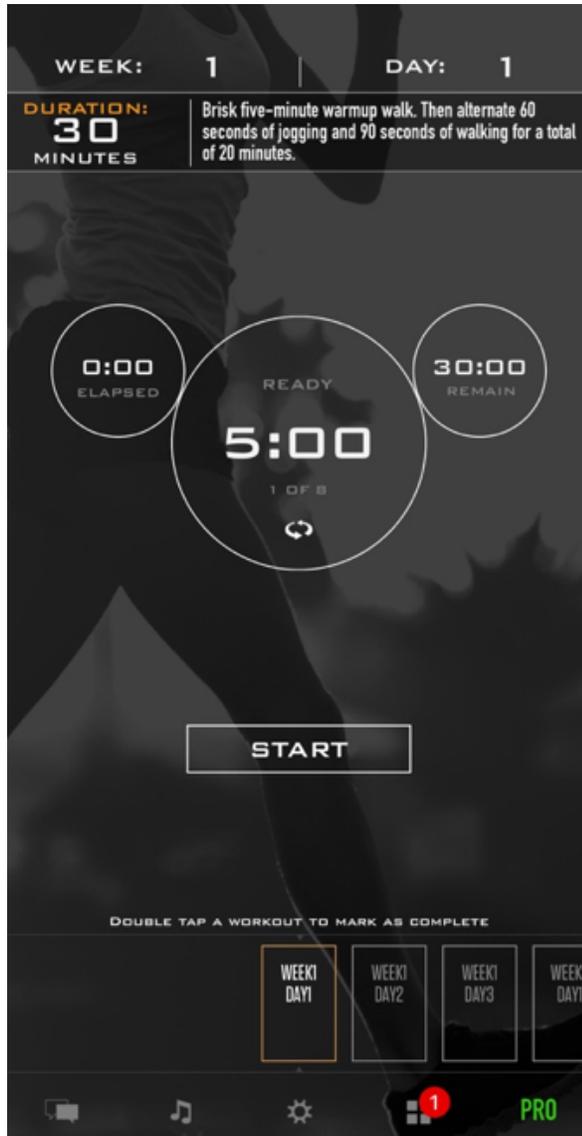


Figure 1. C25K app showing progress by week and day number

#### Feedback

"Fitbit Coach" allowed users to log how many repetitions they did after each exercise and the difficulty. Most apps offered feedback at the end of the session such as total calories burned, time, moves, etc. Apps also offered feedback about remaining time during a workout session and used sound to alert the user when to start or stop the exercise.

#### Exercise Information

Few apps provided information about how to do the exercises. "The RUN Experience" was the only one that consisted of multiple YouTube videos about different exercises gathered together in a unified platform. "Freeletics Bodyweight" provided instructional videos that point out how to do the exercise correctly, but only if the user tapped on an information icon. "Fitbit Coach" offered a video with audio instructions about the exercise before the start of it. Users were allowed to skip

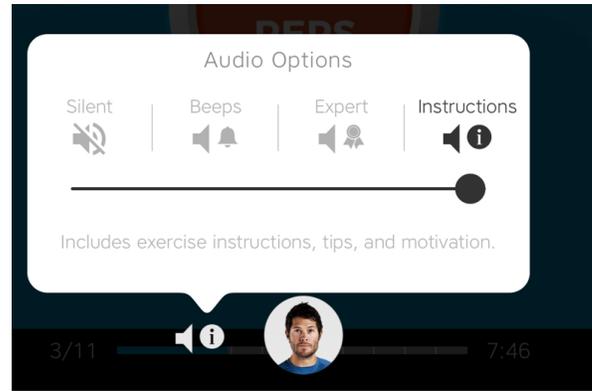


Figure 2. Workout Trainer with customisable instructions

the instructions at the beginning and some instructions were still provided during the exercise. Tips were provided during the exercises in the form of text. "Workout Trainer" offered some audio guidance about the exercise.

#### Social Aspects

Relatedness and social support are crucial for motivation. However, most apps offered a social feature of connecting user's Facebook profile to share progress with their friends. "Workout Trainer" has a community page with forums, leader board. Here, users are allowed to follow other members and share photos, workouts completed, and goals achieved within the app.

#### 3.4. Discussion: App Review Study

In this section we present a classification of apps following the evaluation and we discuss functionalities identified using Self-Determination Theory as framework, focusing on its three pillars: autonomy, competence and relatedness [50]. Furthermore, we discuss the affective interaction through Technology as Experience framework [37].

#### Classification of smartphone interventions

Given the apps assessed, we identified the following types of interventions:

- **Workout-oriented:** apps that provide the user with a set of workouts, mostly categorised into body-part focused exercises, level of difficulty or timing. These offered short-term interventions, with no particular guidance toward which direction to take next, leaving this decision to the user.
- **Running-oriented:** apps similar to the workout-oriented ones, however, they provide more guidance and are more goal-focused. These would either provide a way for the user to track and log their run or focused toward getting the user to progress by increasing time or speed of running and creating a program.
- **Mixed:** almost all apps that covered both running (or walking) and workout only supported tracking rather than offering guidance or focus on progress, performance, motivation or fitness goals.

- Plan-based: some apps offered a long-term intervention in the form of plans.

Regardless of all differences between the apps, they all offer guidance to some extent, however not many apps focus on goals and support behaviour change and motivation. Most apps offer more focused coaching on a premium plan. Despite the fact that fitness objectives require dedication and habit formation, apps lack support in this area even though they provide coaching or personalised training.

#### *Autonomy and Competence*

SDT emphasises the importance of autonomy and competence to support intrinsic motivation, and they are often interrelated [50]. Autonomy concerns the willingness and ability choice through information and opportunities the user is provided with, whereas competence represents the feeling of being capable and confident in regard to a behaviour or goal [16].

In essence, most of the apps evaluated provide a collection of workouts or exercises that do not necessarily reinforce autonomy and competence. As information is crucial to autonomy, apps do not provide information about health implications and what the user needs to do to achieve their goal. Rather than providing a long-term, sustainable assistance, they focus on short-term goals, such as completing one workout, failing to provide further assistance or at least information to support the user in deciding this. Furthermore, they fail to emphasise the importance of posture and form during an exercise, which for a beginner or unexperienced user can be harmful. Apps present a lack of health information which can inhibit performance.

Apps fail to foster competence, not emphasising challenges, opportunities and constructive feedback enough. Intrinsic motivation is based on the need to be competent, which means that agents must engage the user in an optimal challenging environment where people feel personal efficacy [14]. Despite the fact that some apps ask for user feedback on their performance, it is not used to refine future recommendations made by the app or to provide assistance accordingly. Personal informatics are poorly presented, inhibiting reflection, which is crucial for progress [32].

#### *Relatedness*

Deci and Ryan suggest that people want to feel connected and meaningfully related to others [14]. According to SDT, relatedness is one fundamental psychological need - to feel cared for and care for others [14, 32]. Almost all apps provided integration with social platforms, mainly through Facebook. Although this might be limiting as not everyone wants to share progress on Facebook or even has a profile, some apps also offered the possibility to post updates and share with the members of the app.

#### *Technology as Experience*

Overall, apps did not create a meaningful connection with the user. "Fitbit Coach" scored the most in the technology as experience rating, mainly because the interface was clean and more intuitive, compared to other apps. This app also had a better integration of feedback, by asking users how they feel immediately after the exercise and how many repetitions they have managed to do. Generally, apps that were more focused

scored better in this sector, because they were able to focus on the user and provide a simpler interaction. For example, "C25K" was the second best, because it made clear to the user how to achieve their goal, but was also solely focused on getting them to run a specific distance (25k). In contrast, "The RUN Experience" scored the worst, because there was no meaningful user interaction at all, but rather a collection of relevant videos.

### **3.5. Conclusion: App Review Study**

The results of this study highlight disparities between a coach and a fitness app. Regardless of the type of intervention, all apps provided limited coaching as a result of limited information, customisation and motivational prompts to sustain training. Whilst fitness apps cannot replace a coach entirely, we argue that there are still opportunities for them to support training, in spite of this. To explore what solutions can be adopted by fitness apps, we propose a second study based on a semi-structured interview that will help gain insight from participants on their training views, routines and their experiences with fitness apps.

#### *Limitations*

It is important to note that each app was tested on two different operating systems (iOS and Android), and some had some minor differences in functionality and design. Although this issue was addressed in the final discussion between the two raters, it may have impacted the perspectives. Moreover, due to limited time and resources the apps were not updated to premium version and only 9 apps were tested, which may also have impacted the study. We, however, argue that despite the limitations, conclusions seem aligned with the background literature and Study II potentially addresses some of the conclusions.

## **4. STUDY II: SEMI-STRUCTURED INTERVIEWS**

The first study of this paper showed that fitness apps do not offer sustainable coaching interventions, but rather are a collection of workouts or trackers that do not necessarily appeal to everyone, and do not provide constructive feedback, relevant information or long-term monitoring. This issue is further explored in a semi-structured interview study that uses a grounded theory approach. We propose this study to help clarify participants' needs and values of physical training, and their experiences with fitness apps.

### **4.1. Method**

#### **Participants**

Eleven participants (3 females) took part in an approximate 40-minute interview and a short demographic survey. Eight of the participants were students. Nine participants had ages between 18-24, and the other two, 25-34, all residents in London at the time of the study. Examples of used fitness apps included: Nike Run Club, Fitness Point, Map My Run, Runtastic, Pump Up, Endomondo, Strava, Thenx, and Nike Training Club. Although this was not a selection criteria, all participants had been training more than 4 years.

Participants were recruited through posters distributed around local London gyms and the University campus, and through

social media platforms. To be eligible for the study, participants had to be training regularly (at least 3-4 times per week) and use or had used fitness apps. To make it easier to recruit participants, the study did not limit to the use of apps in Study I only, but also other fitness apps in general. Participants were offered a £10 Amazon voucher at the completion of the interview and survey.

### Procedure

The study consisted of two main parts: the completion of online demographic survey, which lasted about 2 minutes followed by an approximate 40-minute semi-structured interview. The purpose of the survey was to gain demographic insight, such as occupation, age group, and fitness apps used by participants. The survey was not linked with the interview and both were completely anonymous. The aim of the interview was to gain a deeper understanding about how participants perceive their training routines and habits, what motivates them, what their goals are and, finally, discussing their experience with technology and smartphone fitness apps.

The approach used was grounded theory, which means the interview data was transcribed to identify themes and to create a new set of questions for the following interview that was designed based on the new found themes. Interviews were semi-structured to ensure the questions aligned with each of the participants' experiences, as they can be unique and personal, and to also make them feel comfortable to talk about their views. The interview was conducted by the author, who would encourage participants to talk about specific topics where the author felt it was relevant to go more in depth. The interviews were recorded to facilitate the verbatim transcription. Examples of questions were: "What does it mean to be physically active to you?", "How do you track your progress?", "How do you know what online sources to trust?". Some generic questions were unchanged throughout the study while others were adapted to the emerging themes due to the grounded theory approach. Interviews occurred in public settings such as cafes or on University campus. An example of an interview script can be found in the appendix.

### Ethical Considerations

A risk assessment was undertaken, and an ethical approval was obtained from University College London Research Ethics Board. All participants were briefed and received an online information sheet and a consent form that was signed. The information sheet offered information about the study and the session, informing and assuring participants that their data was anonymised, and the interview was recorded. Before the beginning of the session, provided that they signed the consent form, participants were briefed about what topics the researcher was interested in discussing, and questions were answered to ensure the participant was fully informed and comfortable in taking part to the study.

### Data Analysis

The iterative data gathering and data analysis consisted of the completion of an interview, followed by immediate transcription and coding. The emerging themes and new information were used to accordingly reformulate and adapt the questions

which would be used for the following interview. Data saturation was reached quickly, resulting in a total of 11 interviews.

To avoid bias toward any theory, the interview script was designed to allow themes to emerge inductively [9]. Grounded theory methodology allowed themes to form categories with no constraints from theories, and thematic analysis was the chosen technique to help identify themes [6]. Theoretical sampling and the constant comparative analyses helped generate new insights [6].

## 4.2. Results

### Non-Technology Related Findings

A series of questions were based on habits, routines, and views on physical training, both from a mental and physical perspective, to understand the beliefs and values participants have and what they require to assist their training and promote performance.

#### *Determinants and Values*

##### *Mental, Physical Health and Wellbeing*

All participants addressed the mental health benefits of exercising, and considered it as one of the main factors to sustain motivation:

*"[I train] to look good in the mirror, most of the time, that is kind of a motivation and the second kind of motivation is my mental health because I found that if I exercise regularly I tend to be in a better mood and I tend to be just generally more positive. For me I guess looking good in the mirror is almost a second to the mental health. Cause if I keep going to the gym I tend to be more positive about the aspects of my life. [...] I feel good after the workout that's really motivating to go back."* (P4)

Other similar determinants were feeling good about themselves and their body, as well as having a positive thinking:

*"I try to go to gym during the work week and before going into the office because I feel it energises me and helps me focus better"* (P2)

##### *Perseverance, Intrinsic Motivation and Mindset*

Some participants showed understanding toward how their performance might not improve constantly sometimes and kept a positive mindset:

*"Sometimes, you see a downward trend as well, but I just learned that it's part of training, and sometimes you'll have a good day and sometimes not, and you'll have to keep going and you'll see progress eventually and be good at it."* (P5)

*"I was trying to work on a movement called a muscle up and I've been working on it for months and I couldn't do it [...] and I would be working on training the muscles or training in a progressed way to eventually get that movement for months and it's really discouraging but I just kept working at it and eventually, one day I could just do it and then that was incredibly satisfying."* (P10)

Moreover, there were participants that believed that technology or apps are not meant to be motivating, and that it is more sustainable to have an intrinsic motivation:

*"I think that it's not the app itself that motivates you. Thinking about it it's kind of hard to pin point what motivation actually is, but I would say it should not be an app that does it, it should be intrinsic, like why you're going to the gym, what you want to achieve, and not an app. [...] Obviously, you can say the app is what influences your inner thoughts and the app can be what actually kick starts your motivation. But I think it should be longer term goals, so not tangible for an app to inspire. As an almost trivial example, getting to go to the beach and feeling good on the beach, this is a motivation that I think many people actually have. And this is not captured by an app, it cannot inspire or motivate you to have that desire." (P2)*

#### **Self-Efficacy**

Participants valued their independence and acknowledged their potential, which made them feel determined:

*"It's good to keep a habit and just keeping generally fit. I'm just doing sports in general you know I guess I'm a lot more pragmatic in that sense. I know that it's a good thing and I should do it, therefore, I do it. I don't need any external motivation just to say 'hey oh I'm feeling lazy today I'm not gonna do it'. Just go up and do it because as St. Augustine said, 'Take care of your body as if you're going to live forever and take care of your soul that's if you're going to die today'. That's why that's my inspiration just remain stoic about it." (P7)*

Most participants addressed the importance of feeling competent and accomplished about what they are doing:

*"I think being physically active and training and challenging yourself tells yourself also that you're treasuring your body in many ways, so that's how I feel at least. I feel like I'm putting that time [at the gym] 30 minutes or one hour a day to just take care of my body, and then taking care of my body is also like it equates actually achieving a goal so that also makes me feel like I've tried my best to make myself feel motivated and feel accomplished." (P9)*

#### **Factors that Sustain Training**

##### **Diversifying and Experimenting**

Repetitiveness was regarded as being demotivating, and some participants stated that diversifying can increase their motivation while experimentation offered the opportunity for improvement and performance.

*"[Diversifying is motivating], just keeping things interesting and not getting into too much of a routine because you want to have a routine so you have some discipline and you know what you're doing and then there's like, you're actually working toward a certain goal but you don't want to have such a routine that it's just kind of becomes repetitive and boring and then it demotivates*

*you to go to the gym because you're going the same thing over and over and not actually have fun." (P4)*

##### **Nutrition and Sleep Quality**

Almost all participants regarded nutrition as being the most important in sustaining their training and performance:

*"I guess also maintaining a healthy diet [is important]. Getting the right foods before training because this can just massively increase your willingness to train. I usually, for example take coffee before, always, because I've found that it definitely boosts my activity during training." (P8)*

Some participants also addressed the influence of sleep quality on their performance and overall feeling:

*"Nutrition is one very big factor and another thing is sleep, so feeling rested and not stressed to a point that you know like, if I'm really stressed I realised that if I go to the gym I just feel really really terrible and I will feel terrible about myself." (P9)*

##### **Sharing Experiences and Knowledge**

Some participants suggested that they feel motivated when they are part of a community.

*"Peer support... so feeling like there's a sense of community with my training that's not something I had before joining a CrossFit gym, but it helped so much and at least how my internal motivational system works I need to have other people there to not necessarily hold me accountable but just to push me. Likewise, I hope I'm providing that for other people as well." (P10)*

#### **Technology Related Findings**

Interviews focused on technology that participants use, how and why they use it and gained insights about how it assists them. Questions regarding fitness apps were based on an application of participants' choice, and were encouraged to interact with it on their smartphone to facilitate self-report [6].

##### **Progress Tracking**

Participants seemed to address the fact that there is a larger picture when it comes to training, and solely tracking things such as steps or number of workouts is not telling them much:

*"It's fun to see like how many steps you've taken in a day or whatever but I don't really use [my phone] as a fitness tracker I'm just like 'wow I walked a lot today'. Pulse rate that's quite useful." (P7)*

Participants were more interested about how their body feels, rather than numbers:

*"I always just kept a general perspective of the weight that I'm doing, I never really went "ok... today I lift 43.75.." so on, because there are so many different factors, how tired are you before going to the gym, have you eaten properly, have you done something during the day, are you stressed, all of these thing are so many factors that affect, like the details of everyday, but the important thing is the general picture. Is your body getting closer [...] to your goal?" (P1)*

*"It is more like taking a step back and taking like a more holistic look I think, because sometimes in the past maybe I get too focused on logging a certain amount of time because I think like that was a good way to track it. But honestly, it's more like kind of balancing it all out like eating well and spending some time in the gym. It doesn't necessarily have to be a certain amount, just as long as you feel good. Yeah, just feeling like I've been proved I guess or at least maintaining." (P6)*

#### Gathering Reliable Information

##### Accessibility and Affordability

Participants also considered technology as an accessible and cost-effective source of information:

*"I use [technology] to see what supplements I should take, how they are going to assist the training, the food. [...] And just reading online about people talking about all these different things that revolve around nutrition, workouts. You know, it puts you in the mindset, like knowing kinda what you're doing, whether or not you are going on the right track, because the other way is a very expensive way which is paying constantly dieticians, nutritionists, personal trainers to be around you. And if you cannot afford that, you use technology, and I think it's more sustainable. [...] every single source of information that I properly had besides the little stuff that I learned from the people [at the gym], was online and that's pure technology" (P1)*

##### Online Misconceptions and Misinformation

However, some participants addressed the potential harmful effects access to information might have:

*"[Fitness influencers on YouTube] do many things that you see is fake. But, I guess, it's motivating to see them on video and even though I know it's not completely real. [...] It's their life to go to the gym and train and look good, or get ready for like a competition, and just stay fit. So, it's not fair I guess to compare myself to them, because it's impossible with other purpose in life to follow their lifestyle. And especially if you're like on Instagram. Probably all the pictures are photoshopped." (P3)*

*"I've been made aware of how many fitness blogs are just trying to sell products and somewhat in [...] ways, so, even though they wouldn't directly promote their protein or whatever, they would say that it is important to eat a lot of protein per day from various sources such as meat or whatever, which is indirectly influencing you to 'oh, so I need to have a bigger intake for this particular stuff so I must be looking into this', so I'm very sceptical of reading these articles" (P2)*

##### Trust

Two participants mentioned brand as being a trustworthy source, however both recognised that although the brand was a reason to download an app, what made them keep using it was the usability of the interface and functionality:

*"So far, I mentioned two Nike apps, so you can see a pattern here. The pattern being popularity. [...] Brand and also, obviously I would've uninstalled it if it were hard to use, so, it started by having it because of its name, of the app, having "Nike" in the name, but I kept it for a while because the interface was alright and intuitive, and it seemed interesting, and that motivated me to engage in a trial period. But as I found what it was lacking, I stopped using it." (P2)*

*"I guess it's the brand pretty much. It looks nicer and it says Nike, nothing in particular. [Also, the interface] just looks nicer. When you're running, you don't really need it. So, what I do is I start it and just end it. It just feels more intuitive and nicer." (P3)*

#### Reasons for App Abandonment

##### Customisation and Feedback

Limited or inappropriate customisation and feedback were some of the most common reasons for app abandonment:

*"Pump Up (a fitness app) couldn't tell me [how to adjust my exercises]. There was no option for me to say, 'I have a messed-up shoulder, can you give me an alternative exercise?'. It's simple considerations... or I get back spasms a lot and I have to adjust exercises, so it doesn't engage my back, or my wrists sometimes get sore and I have to change up the grips so they don't affect me that much. A lot of that just comes from feeling it, and sort of improvising at the gym, which initially I would be scared of doing but because I've used Pump Up and been training for a while I'm a lot more confident with it." (P4)*

##### Limitations of Functionality

Limitation of functionality, especially in terms of feedback was also mentioned as being a main factor for app abandonment:

*"I tried the Nike Training Club app, although that didn't last too long, the usage of that, because I found it quite inflexible in my training in the sense that the type of feedback wouldn't be that that I would be hoping for in the sense of what the one from a personal trainer would be, like 'move faster' or 'you're not doing it correctly'. It was just a naive instruction-giver." (P2)*

##### Costs

Some participants did not like the idea of manually inputting progress into apps:

*I don't always log [runs] anymore [into the app]. [...] In order to log them, I would feel the need of some sort of motivation, because the act itself of logging them is not free. So, in order to log my runs, I would need to have the phone in the pocket of my gym equipment and that adds a weight. (P2)*

*"If I have to input anything into the [fitness apps'] tracker, then I don't [use it]." (P7)*

Financial costs were also a main factor:

*"I stopped using Pump Up (fitness app) mainly because after their update it became slow, laggy and the videos on it wouldn't load. And it basically was, I think, that they wanted you to pay for the paid version, so they made the free version really bad, so I stopped using it because it was not workable. And after that I haven't really used fitness apps because a lot of them, you have to pay for, and they're usually very expensive and I don't want to use that money." (P4)*

#### Commitment

Long-term commitment was one aspect that participants felt it hindered their performance and motivation:

*"Some other apps do different things, like they give you an all training plan. I didn't use that because I find it hard to stick. They ask you how many times you want to go to the gym or do you want to lose weight or build muscle. They ask you a series of questions while signing up and then they give you the final thing. Maybe some people may like that... not for me" (P1)*

#### Expectations

##### Informing and Educating the User

Participants pointed that technology should aim to educate the user about the importance of training, injuries and other factors that sustain it. For example, one participant mentioned that the native health app on iOS helped them to understand how to account for specific statistics, such as sleep patterns:

*"I think many people are not aware of the importance of [sleep quality] and I think the [iOS Health app], just by having a short paragraph, it just gives a little story, but if you read it, you really are better at understanding why those numbers are important to you and you basically become better at using them. I think we can call it 'educating the user'. I think doing that is an important part of these [fitness] apps and so far, I'm not sure I noticed that there's a particular focus of doing this in any of these." (P2)*

Some participants suggested that videos available on social platforms, such as YouTube, make it very easy for them to understand the movements or the form required for exercises:

*"[Trainers] really have concise descriptions and videos demonstrations of all the exercises they recommend, and that's really, really useful, because they teach you good posture and the range of motion and how to do the exercise perfectly, and they really stress the fact that you shouldn't try an exercise that you cannot do with perfect form and that was really nice. [...] [form] is important, if you try to do something you should do it by the book." (P5)*

##### App vs Coach

Some participants that have had prior experience with coaches or personal trainers recognised the fact that apps are more limited than the coach in terms of feedback, but can be more powerful when it comes to analysing data, such as personal informatics.

*"The trainer can literally see you doing the exercise wrong and correct you, right? The app, as much as you can try mimicking, what they see, the person acts like an analyst. He sees you doing something wrong and he can correct all the flaws. That's the power of having a human with you. The power of the machine and technology is that they can use a lot of data to match your goal. If it's a really good app, getting it to meet your goal, whatever goal that is, in the long run, it can be much better than a personal trainer." (P1)*

#### 4.3. Discussion: Semi-Structured Interviews

The second study of this paper explored the values and needs of participants and experiences with fitness apps to help improve them. In general, results show that whilst fitness apps can help track progress, they are far from providing the same interventions as a coach. However, participants discussed a series of needs and important factors of their training, as well as their experience with a fitness app.

To discuss the themes, similarly to Study I, we will use the self-determination theory [50] and, more specifically, self-determination health behaviour model [51]. However, technology as experience framework [37] will not be used in this instance as it is a framework to evaluate technology rather than interview data.

##### Intrinsic and Extrinsic Motivation

As mentioned, all participants had been training more than 4 years. As such, their motivations changed through time, from motivation to start training to motivation to keep a fitness routine. Reasons to start training were dependant on their background and past experience and less intrinsic. For instance, some participants started training to improve their performance in a sport they were practising at the time. Although this is extrinsic motivation, its form is identified regulation, which still represents a self-determined form of motivation and is adopted by many athletes [56]. None of the participants were still practicing a sport for performance at the moment of study, but rather in a casual way alongside with the training.

As their fitness journey progressed, participants' motivations became more intrinsic and recognised the importance of intrinsic motivation to sustain their training. All participants considered mental health and wellbeing as some of the most important factors that stimulates their motivation. In SDT, this is labelled as intrinsic motivation [49].

Furthermore, some participants described training toward a goal, either for physical or mental health, but some also mentioned physical appearance, weight loss or to help with injuries. However, this may be an integrated regulation form of extrinsic motivation, which is the most self-determined form. Intrinsic motivation and self-determined extrinsic motivation is crucial to athletes to maintain a positive mindset and perseverance [36]. Participants showed a similar approach, as there was almost no mention of non-self-determined extrinsic motivation. Most importantly, none of them wanted to rely fully on technology or fitness apps to motivate them to train.

### *Autonomy and Competence*

Autonomy and competence are inter-related. As SDT states, competence is facilitated by autonomy [51]. Hence, we will discuss the two together.

Participants valued the importance of being independent and have control on their fitness routine and considered it part of their schedule. All participants showed a strong sense of self-efficacy reinforced by their dedication to learn to improve their training [19].

Both autonomy and competence require relevant information [51]. Similar to a previous study on fitness apps [11], participants showed dissatisfaction with the fact that fitness apps provided little to no information about fitness outcomes, their progress or related factors to training. To gain information, all participants would use online resources, and some would also ask other people. However, they acknowledged that often information online cannot be trusted and can do harm.

Besides autonomy, competence is fostered by feedback and relevant effective interventions. Fitness apps did not seem to foster competence overall for participants. Feedback was seen as limited and interventions were not taking into account personal factors. For example, P4 was unsatisfied with the lack of exercise alternatives offered by apps to help with their injury.

Feedback and further interventions can be based on personal informatics. Although coaches do this for athletes [46], fitness apps also show limitations. Participants stated that they are less focused on the conventional progress tracking, such as step counts, and have learned to interpret how their body responds to different types of exercises to improve their performance. Thus, fitness tracking apps, were ineffective for them, long-term. For example, P3 and P6 gave up using a fitness tracker app because the app provided them with a map of the running route, which they did not see useful because they would always use that route. In this instance, they were more interested in metrics such as heart rate, which was not done by an app. Other apps were asking the difficulty level of a workout, which did not seem to change any further recommendations and participants stated to never look at that data themselves.

### *Relatedness*

In self-determination health behaviour model [51], relatedness is presented differently than in the traditional self-determination theory view. In this context, relatedness is viewed as respect and understanding toward an individual, and "social support". As physical training requires expertise, people lacking these have to look for inputs from professionals.

However, the interviews showed that despite some exceptions, participants do not have a personal trainer or train in a group due to the fact that is either unaccessible for them (i.e., time, lack of resources) or cannot afford it. This is an opportunity for fitness apps to address these problems. Conversely, none of the participants saw fitness apps as a personal trainer or effective coaching intervention, but rather a way to track progress or to follow pre-defined workouts without much expert input.

A way that participants addressed this issue was to follow workouts on YouTube or to learn how to do a specific exercise, what to eat, and mainly how specific people got to a similar fitness level that they aspire to. Social media was not necessarily viewed as useful to training, whereas social integration in fitness apps was not seen as significant by participants.

An effective coaching intervention needs to be autonomy-supportive [24]. This means that the coach, either a human or a technological intervention, has to take into account how the client feels, how they perform and how they respond to different types of training. This may be a potential explanation about why, with YouTube, participants seemed to look for someone with similar characteristics and goals to watch their videos.

### **4.4. Conclusion: Semi-Structured Interviews**

Overall, all participants had different experiences. Regardless, interviews suggested the similar views on fitness apps and training. This seems promising, as technology has a "one size fits all" approach which seemed counter-intuitive at first, considering research that proves physical activity is highly dependant on personal characteristics [17]. Conversely, participants seemed to acknowledge the realistic limitations of apps to try to fit everyone's needs, which was a main reason for discontinued app usage.

### *Limitations*

The specialist nature of the study and the specific criteria constrained the ability to recruit a wide variety of participants, being limited to mostly University students. This may have impacted the ecological validity of the study.

## **5. GENERAL DISCUSSION**

In this paper we discussed relevant background literature regarding behaviour change, motivation research and sports psychology. Based on this we made two contributions. Firstly, we reviewed 9 fitness apps on the current market that aim to "coach" users in order to see whether they are successful in stimulating motivation and affective needs.

To assess to what extent they address motivation, we used self-determination theory whilst affective interaction was evaluated by applying technology as experience framework. This study revealed that current fitness app do not offer coaching support, but rather are limited in their functionalities and are, in essence, a collection of workouts or a way to track activity. We then followed up with a second study, semi-structured interviews with 11 participants to take a step further in understanding what users with experience and dedication to training value, need and believe about training, technology and, more specifically, fitness apps.

If Study I used a scoring system made by the author based on a combination between self-determination theory and technology as experience framework, Study II was purposefully designed without a theory in mind, to allow themes to emerge with no constraints. However, data was discussed using self-determination theory and its approach to health behaviour. Study II revealed themes that help contribute to a set of design implications that could potentially be used to design a superior

smartphone application with better health and performance outcomes.

### 5.1. Implications for Design

Based on the two contributions made by this paper, we will describe five design implications with the aim of improving current smartphone fitness technology.

#### *Information*

Dishman et al. [17] stressed the importance of information in stimulating autonomy and decision-making. Study I revealed that fitness apps do not focus on educating the user about training and other relevant aspects of it. This was further confirmed by Study II, where participants expressed their disagreement toward the lack of information. As research showed that coaches or personal trainers need to be autonomy-supportive, rather than controlling, to effectively help individuals to perform better [36], we argue that fitness apps should provide meaningful information to the users, about exercises, how to correctly do them, what alternatives there are, what the fitness outcomes are, as well as information about related aspects, such as nutrition and sleep quality which were mentioned in Study II.

#### *Customisation*

Study I revealed that some apps provide personalised interventions to replace the coach. However, it was not clear how exactly they use data provided by user to generate personalised workouts or training plans. In Study II, participants agreed that fitness apps are limited in this sector and that they would prefer to be able to customise workouts based on their preference and personal experience. One of the most important suggestions was exercise alternatives for injury. As users that have injuries are unable to perform any type of exercise, providing alternatives can be really useful for them as it allows them to use the app and feel accounted for. As the SDT approach suggests in the health behaviour context [51], relatedness refers to making an individual feel understood and respect their needs, to increase intrinsic motivation. This does not limit to injuries, as participants in Study II expressed their desire to control the way they train, customisation can allow them to explore and create their own workouts.

#### *Feedback and Analysis*

Although it is impossible for a fitness app to tell whether someone is doing an exercise correctly or not, it can ensure this by carefully explaining users how to perform it, by using videos and instructions. Study II revealed that most participants used YouTube to learn this, and someone demonstrating it, whilst providing instructions seemed to be effective for them. Feedback can be asked from users to help generate effective personalised interventions. For example, fitness apps can adapt exercises' difficulty based on real-time feedback. We also propose that feedback could be used to diversify fitness plans to make sure the user feels challenged and motivated to an appropriate degree.

#### *Goals and Routines*

Attaining goals require dedication and motivation, as well as consistency. Study I revealed that fitness apps lack mostly motivational features or a clear visualisation of goals. Similarly,

Study II confirmed this, but some few examples were considered useful. We argue that better social aspects of fitness apps can provide a meaningful stimulus for motivation. As some participants showed that they feel motivated when they offer and are being offered tips and general information, a social intervention as this may be more effective. Moreover, creating a clear visualisation of goals and balancing challenges and long-term vs. short-term goals, can motivate the user [35]. Taking advantage of timer-based features, reminding users their intentions and what their goals are also two potentially effective ways to stimulate motivation and perseverance. As smartphones are ubiquitous [31], push notifications can be leveraged in this instance, however, the frequency must be controlled, as previous studies showed that too frequent feedback or cues can lead to frustration [24].

#### *Health and Personal Informatics*

Study II revealed that participants prefer listening to their body and how they feel mentally and physically. As a result, health tracking was seen as more meaningful than progress tracking. Although it is good to have personal informatics based on progress in order to make informed decisions, health should also be regarded. Although it is challenging to measure health levels (i.e., heart rate) without a tracking device, such as a smartwatch, fitness apps should aim to integrate health outcomes, whether in the form of information or with an integration of a tracking device. Progress tracking remains important, however better representations that support reflection [44] should be accounted for and data entering should be done automatically where possible as research and Study II has shown that manual entering affects accuracy [33].

## 6. CONCLUSIONS AND FUTURE WORK

This paper made two main contributions: a fitness apps review and a semi-structured interview study. Both were conducted to investigate whether current fitness apps are a good intervention for behaviour change and performance. Traditionally, physical training requires personal trainers (PT) to customise workouts, undertake fitness assessments, and keep the client on track toward their goal. As many people do not have a PT due to various reasons (i.e., financial costs), technology and fitness apps offer means for effective coaching interventions. We argue that due to limited similar contributions in the HCI area, further work should explore this issue more in depth. Thus, we explore the issue using self-determination theory and self-determination health behaviour model, as well as the technology as experience framework. Both studies revealed that fitness apps are far from fostering motivation and performance as a PT would, due to the lack of information, customisation and overall autonomy-supportive interventions. Therefore, we proposed five design implications to potentially develop fitness apps with better health and training outcomes.

We argue that this study can be taken further by conducting an interview study with personal trainers or coaches to explore how they train their clients, and what technology should do for better fitness outcomes from an expert insight. A design intervention that tests prototypes implementing the design implications of this study may allow for further investigations and refinements. Although fitness trackers such as smartwatches

are not the scope of this project, we suggest that better integration may potentially improve health tracking and a more automatic logging of activity, which may be used for further refinements in fitness apps interventions.

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## APPENDIX

Example of interview script.

1. What does it mean to be physically active to you?
2. Tell me about how you started going to the gym/training (personal trainer/tech/both/other).
  - (a) What were your motivations then?
3. How long have you been training roughly? How often do you train?
4. Tell me about your current fitness goals...
  - (a) What are your motivations to train now?
  - (b) How do you stay motivated?
5. What are the most important things to you when it comes to training?
6. Tell me about the role technology played or plays in your training (apps, YouTube, fitness trackers, social platforms etc.) - how did you use them?
7. Have you ever given up on a certain technology you tried? Why?
8. I want you to focus on a certain fitness app that you have used.
  - (a) Why that app?
  - (b) What did you like about it? What did you not like about it?
  - (c) Do you think it motivates you to stay fit? How/Why?
  - (d) What particular features did you enjoy/not enjoy?
9. Is there anything we haven't covered that you'd like to add?