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# Unveiling the Impact of Mobile Fitness Applications on Motivational Orientation in Sustaining Exercise Behaviors: A Qualitative Investigation

**Authors' contribution:**

A) conception and design of the study
B) acquisition of data
C) analysis and interpretation of data
D) manuscript preparation
E) obtaining funding

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## Abstract

Notably, a lack of motivation appears as a significant contributing factor to physical inactivity, which raises one's susceptibility to noncommunicable diseases. While research indicates a strong link between smartphone fitness applications (apps) and people's motivational orientation towards physical activity and exercise, the theoretical basis of fitness app features for sustaining exercise routines remains unclear. Therefore, the purpose of this study was to investigate the utility of fitness apps as a behaviour modification tool on people's motivation to maintain physical activity and exercise behaviour. Using individual semi-structured interviews, we collected detailed accounts from nine active male and female fitness app users ($M_{age}$ = 23.4 years, $SD$ = 2.8). The findings of both inductive and deductive reflective thematic analysis revealed core themes emphasising that the use of fitness apps satisfies the participants' psychological needs through fostering emotions of competence, autonomy, and relatedness. Furthermore, fitness apps make it easier to track progress, challenge oneself, and compete against other exercisers, which further motivates participants to sustain their exercise behaviours. Confirming the use of fitness apps as an effective behaviour change tool for sustaining healthy exercise routines, the findings offer valuable feedback on specific app features for fitness software and wearable device developers that could potentially enhance the functionality and impact of their apps. Further discussions include limitations and areas for future research, such as discerning the role of fitness apps in sustaining motivation among diverse age groups with specific health, sport, or lifestyle goals in varying sensory, social, and affective contexts.

**Keywords:** Mobile fitness applications, motivation, physical activity, exercise behaviour

## Introduction

According to the UK Chief Medical Officers' physical activity recommendations (2019), people aged 18 to 64 should engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity every week. Despite these recommendations, 25% of people worldwide remain physically inactive (World Health Organization, 2016). Notwithstanding a notable rebound in physical activity levels to pre-COVID standards, England, like many other Western societies, currently observes a concerning decline, with nearly 500,000 fewer active young individuals (aged 16–34) than six years ago (Sport England, 2023). According to the World Health Organization (WHO), physical inactivity is a global issue and a primary cause of death, accounting for roughly 3.2 million deaths and 32.1 million disability-adjusted life years (DALYs) per year (World Health Organiza-

tion, 2023). Physical inactivity is linked to several health problems, including noncommunicable diseases including coronary heart disease (Gupta et al., 2016), stroke (Kuklina et al., 2012), type 2 diabetes (Admiraal et al., 2011), and malignancies like breast and prostate cancer (Knight, 2012). However, the impact of sedentary behaviour extends beyond physical health, as research has established a connection between inactivity and an elevated risk of mental health disorders such as depression (Zhai et al., 2015) and anxiety (Allen et al., 2019). Therefore, physical inactivity is detrimental both at the individual and societal levels, providing a strong basis for identifying the factors that influence the initiation and maintenance of physical activity and exercise behaviour.

**Motivation as Key Determinant of Exercise Behaviour**

In line with the widely recognized need of increasing physical activity, research seeks to uncover the causes behind noncompliance with exercise standards. According to the findings, low motivation is a substantial obstacle to starting and sticking to an exercise plan (Bauman et al., 2012; Wilson, 2012). In this regard, Maehr and Zusho (2009) define motivation as the process that determines the initiation, direction, quality, and persistence of goal-directed behaviour. There may be numerous motives to begin and continue physically active habits depending on the type of activity selected. For example, fitness initiation and participation are thought to be more motivated by appearance or health reasons, whereas sport initiation and participation are motivated by social reasons and enjoyment (Pedersen et al., 2021). Regardless of the type of activity or exercise setting, early intrinsic incentives derived from enjoying the activity and feeling competent in performing it are believed to be associated with heightened long-term commitment to physical activity or exercise (Emm-Collison et al., 2019; Richard et al., 1997). While it is true that people's motivation tends to fluctuate or change between the initial and adherence periods of participation (Hagger, 2019) there are several theoretical frameworks that explain the relationship between motivation and physical activity for a more nuanced understanding of people's exercise habits.

**Theories of Motivation**

Given the importance of motivation in understanding exercise adherence, distinguishing between extrinsic and intrinsic reasons for physical activity is crucial (Deci & Ryan, 2000). Extrinsic motivation in sports or exercise occurs when a person's engagement is influenced by external considerations such as avoiding censure or seeking recognition and/or rewards apart from the action itself (Deci & Ryan, 2007). In contrast, intrinsic motivation for physical activity derives from the natural sensations of enjoyment and satisfaction that one has when engaging in the activity (Pedersen et al., 2021). Expanding on this idea, a person may join in an athletic activity for the inherent sensation of belonging (Graham, 2021). Affiliation motives are particularly high in social circumstances such as team or co-acting sport (Kesenheimer et al., 2023), but less so in individual sport (Elbe et al., 2013). If an activity is perceived to be optimally difficult, an individual may be intrinsically motivated to participate in sport or fitness (Gavin et al., 2014). Competition is another well-known incentive for engaging in physical activity and exercise practices (Weinberg & Gould, 2019). While healthy competition may serve as motivation to engage in an activity (Ivanova & Korostelev, 2019), the pressure of competition may drive intrinsic motivation down due to the control it withholds over behaviour (Reeve & Deci, 1996; Ryan & Deci, 2017). In this regard, it is not straightforward to say that competition generates motivation in exercise and fitness. Nonetheless, a wealth of research shows that people have different motives for exercising, stressing the relevance of intrinsic motivation in exercise adherence (Huberty et al., 2008; Jekauc, 2015; Marin et al., 2018).

General cognitive-behavioural theories, such as the Theory of Planned Behaviour (TPB) (Ajzen, 2012) explains that attitude, subjective norms, and perceived behavioural control all contribute to one's intention to exercise. While there is ample evidence supporting the effectiveness of the TPB in explaining exercise behaviour (Azjen, 2015; Boudreau & Godin, 2007; Rivis & Sheeran, 2003), conflicting findings exist (Hardeman et al., 2002). Additionally, the impact of specific model components, such as subjective norms, in influencing exercise behaviour remains uncertain (Armitage & Conner, 2001). Albeit subjective norms are often used in interventions for behaviour modification, notably in sports and exercise (Azjen, 2011). Another explanation for engaging in physical activity and exercise behaviour is Bandura's Self-Efficacy Theory (Bandura, 1977). This theory emphasizes a person's belief in their capability to perform a behaviour as a key driving factor for personal improvement and persistence. In alignment with this, individuals with greater self-efficacy are believed to adhere better to physical activity and exercise (Collado-Mateo et al., 2021; Picha & Howell, 2018). The widely referenced Self-Determination Theory (SDT) (Deci & Ryan, 1985, 2000) provides additional insights into motivation in physical activity and exercise. A key assumption of this theory is that individuals are intrinsically driven toward personal growth, which influences their behaviour (Deci & Ryan, 2008; Ryan & Deci, 2017). Embedded within the SDT is the idea that motivation to engage in physical activity or exercise is brought on by the opportunity it offers to satisfy one's fundamental need for the feeling of competence, autonomy, and relatedness (Ntoumanis et al., 2021). Autonomy is described in this context as a sense of personal

causality in one's activities, competence is the ability to do something efficiently or successfully, and relatedness is the desire to feel connected and involved in the world (Ryan & Deci, 2017). Further explanations for motivation towards physical activity and exercise are understood through the Achievement Goal Theory (Nicholls, 1984). Hereby, an individual is motivated by their interpretation of competence, which might be viewed as low or high in relation to their prior performance or relative to others (Nicholls, 1984). Individuals who develop a sense of competence through their own efforts or improvements in personal task mastery, are thought to be task-involved. In contrast, individuals who acquire a feeling of competence through superior achievement compared to others are believed to be ego-involved (Harwood & Thrower, 2020). Subsequently, in this sense competition with oneself and others may motivate an individual to participate in physical activity and exercise.

What an individual attributes their achievement to can also be used to understand their motivation for exercise and fitness behaviour. In this respect, and in line with Weiner's Attribution Theory (1985), a high achiever's successful performance is often attributed to a stable component such as their aptitude or ability, which increases the predictability of, and motivation for future sporting efforts (Weinberg & Gould, 2019). Also, it is believed that striving for a perfect sporting performance positively impacts motivational orientation, encouraging one to enhance their sporting performance (Pitsiladis & Wang, 2015; Stoeber & Becker, 2006). More recent theorizations on motivation driving intervention approaches for public health include the Affective Reflective Theory (ART) (Brand & Ekkakiss, 2018). This dual process theory posits that an individual's automatic thoughts, experiences, and feelings related to exercise play a significant role in determining their motivation to engage in physical activity. For example, the presentation of an exercise related stimulus that elicits an automatic negative affective valuation (e.g., displeasure, humiliation) is perceived as a deterrent to engaging in exercise behaviour, but a positive affective valuation (e.g., pride, sense of physical reinvigoration) in response to the stimulus results in higher motivation for engagement if self-control resources are available (Brand & Ekkakiss, 2018; Conroy & Berry, 2017). So, in other words, the initial automatic affective valuation (type-1 process) forms the foundation for a regulated, reflective appraisal (type-2 process) that may occur when self-control capabilities are present. The automatic affective valuation is linked to an action urge (inclination to approach or avoid), while the controlled response can lead to the formulation of action strategies for engaging in physical activity and exercise.

The Theory of Energetic Cost Minimization (TECM; Cheval et al., 2018) is another recent explanation that deepens understanding of exercise motivation and physical inactivity. This theory suggests that people have an evolutionary tendency toward effort optimization and therefore are likely to avoid exercising if they think it would be too physically taxing or expensive in terms of energy. Individuals, on the other hand, might be inspired to engage in physical activities that they believe will require less energy expenditure. This can result in a predilection for passive behaviours or low-effort pursuits, which can increase physical inactivity (Brand & Cheval, 2019). In summary, comprehending various theoretical explanations of people's motivational orientation is crucial for facilitating behaviour change aimed at reducing inactivity and improving exercise adherence.

**The Use of Fitness Applications to Influence and Track Exercise Behaviour**

In recent years, mobile health and fitness applications (apps) that are linked to wearable devices such as GPS enabled smart watches, trackers, and rings have emerged as a potential remedy for inactivity providing individuals access to a wide variety of features ranging from personalized plans, tailored advice from experts or coaches, and the capability to monitor inactivity levels/workouts and nutrition intake (Scheid & Lupien, 2021). This can be extremely beneficial for those who are looking for a structured approach to improving their health and fitness with compelling evidence indicating a positive correlation between these apps and increased levels of physical exercise (Sullivan & Lackman, 2017; Yerrakalva et al., 2019). Consequently, there has been a dramatic rise in the use of smartphone fitness apps using wearable devices, smartphones, and tablets, especially since the COVID-19 pandemic (Eades et al., 2021) with a projected total of 86.3 million users of health or fitness apps in the United States alone (Ceci, 2023). Based on market research, some prominent fitness apps include Run keeper, Google LLC, MyFitnessPal, Sworkit, Runtastic (Adidas), Nike Run Club (Vantage Market Research, 2022). However, despite the persistent increase in fitness app users, a substantial attrition rate among exercisers who use these apps has been reported (Krebbs & Duncan, 2015) as many smartphone programs fail to consider the crucial elements of theory inspired behaviour modification strategies (Conroy et al., 2014; Middelweerd et al., 2014).

As a result, Molina and Myrick (2020) set out to explore how technology works and how users interact with such platforms. The themes that emerged from their research emphasised participants' individual motivations for using fitness apps (such as improved well-being), but they ignored any report on how well these apps support exercise behaviour and whether theoretical frameworks on motivation underpin the intentions of these apps. This study also raises various methodological problems. For

example, participants were mandated to utilize a designated fitness app for two weeks leading up to the interviews of which this approach fails to provide sufficient insight into the app's long-term impact on motivation. Drawing on the reasoning of Barber (2013), the positive outcomes observed in this study may be influenced by expectancy effects resulting from the implementation of these interventions. While other research indicates that personalization features and gamification of fitness programs that allow users to monitor personal behaviours are beneficial for motivation (Damaevius et al., 2022; Kari et al., 2016), there is little explanation as to how this relationship was established and whether theories on motivational behaviour can be applied in this context.

It is no secret that fitness apps often incorporate features like goal setting, self-monitoring, and feedback, which have been linked to autonomous motivation in physical activity and exercise (Hermsen et al., 2016; Knittle et al., 2018). Other factors cited as reasons for continuous usage of fitness apps include its utility, ease of use, satisfaction, goal achievement, and social connection (Zang & Xu, 2020). However, existing research in this field (e.g., Molina & Sundar, 2020; Sun et al., 2021; Tsai et al., 2021), primarily relies on quantitative approaches or preferences on app usage and fail to capture users' in-depth experiences on how the continued use of apps influence their long-term motivation. As a result, qualitative research that delves deeper into users' viewpoints is required to acquire a more comprehensive knowledge of the motivational influence of fitness apps. Using a qualitative method will offer context to this already-established link. Despite the recent spike in studies on how fitness app use changes an individual's intention to exercise (Huang & Ren, 2020; Zhang & Xu, 2020; Valcarce-Torrente et al., 2021), it ignores whether there is following change in the exercise habit portrayed. While traditional theory predicts that intentions and subsequent behaviour will match, this is not always the case, since the intention to do a behaviour may only account for 20–30% of future behaviour (Azjen, 2015). Consequently, the short-term links between fitness apps and intents may be insufficient in cementing the significance of fitness applications in influencing behavioural changes. As a result, the present study will address this issue by focusing on exercise output rather than just on the intention to exercise.

### The Present Study

Although research has identified distinctive fitness app features as variables for ongoing usage and exercise motivation (Hermsen et al., 2016; Knittle et al., 2018; Zhang & Xu, 2020), the theoretical underpinnings of these employed elements remain unknown. Furthermore, because most study focuses on activity intentions rather than actual exercise output, there is a dearth of understanding regarding the long-term maintenance of fitness levels utilizing these apps. Therefore, the present study aims to address gaps in the current understanding of using mobile fitness apps and wearable devices to sustain physical activity and exercise behaviour over time. It will collect qualitative in-depth perspectives and experiences on app usage and assess if modern-day fitness apps are influenced by theoretical frameworks on motivated behaviour. The central research question guiding this study is, "How does the use of mobile fitness applications influence motivational orientation in sustaining physical activity and exercise behaviour?" Our findings may offer valuable insights into the advantages and drawbacks of general fitness apps. These perspectives could have significant implications for utilising fitness technology as a practical tool for establishing and maintaining a healthy exercise routine.

## Method

### Research Design

In this study, we adopted a qualitative approach as the prevalence of quantitative research, which offers limited insights into how fitness apps sustain exercise behaviour, necessitates a compelling case for adopting qualitative designs to gain a deeper understanding of the practical value of fitness applications (Islam & Aldaihani, 2022). Furthermore, this research was influenced by a social constructivist approach, acknowledging how personal, social, and cultural elements affect the experiences of the participants (Lincoln & Guba, 2016). Embracing a relativist perspective (ontology) and a subjectivist transactional understanding (epistemology), we analysed how individuals perceived the use of mobile fitness apps while maintaining their exercise routines within the context of their own life experiences.

### Participants

The study sample included nine participants living in the United Kingdom, all of which were active fitness app users who engaged in weekly exercise. The mobile apps predominantly used by the study participants included Strava (N = 2), My Fitness Pal (N = 1), Fitbit (N = 2), and Apple Fitness+ (N = 4). Furthermore, two participants reported using multiple apps, depending on the type of exercise they were engaged in. These apps were integrated with wearable devices like GPS-equipped smartwatches from Apple and Fitbit, and mobile phones, which participants used during physical activity and exercise. Out of the participants, five identified as female (60%) and four identified as male (40%), with ages ranging between 19 to 27 years (Mage = 23.4, SD = 2.8). No participants were excluded from the initial sample. The recruitment strategy used was convenient sampling, as it was deemed the

most suitable for efficiently recruiting readily available participants. An invitation to participate in the study was disseminated through the lead investigator's social media profiles, including sport-related Facebook groups and Instagram. This approach was selected based on the insights from Topolovec-Vranic and Natarajan's (2016) scoping review, which highlighted social media as a more effective recruitment tool for targeting specific categories of potential participants compared to traditional methods. Eligibility criteria for participation in the study required participants to be 18 years or older, an active user of a fitness app that supported their fitness and exercise behaviour for a minimum of six months or longer, with at least 75 minutes of vigorous exercise or 150 minutes of moderate-intensity exercise per week for the past six months or longer. Following Malterud et al.'s (2016) model for evaluating information power in qualitative interview data, we ascertained that the recruited sample size for this study was sufficient. This conclusion considered several factors, including the diverse range of fitness applications utilised by participants, the study's alignment with pertinent theoretical models on motivational behaviour in sport and exercise, the proficiency of the researchers in exercise behaviour and qualitative interviewing skills, and the application of a cross-case analytical approach. Further validation was sought through consultations with an experienced research advisor and a trusted colleague, affirming the appropriateness of the chosen sample size. In this context, the concept of information power provides a more systematic alternative to using saturation as a sample size criterion in qualitative research. This approach addresses concerns raised by Morse (2015) regarding the transparency of saturation reporting, a concern supported by a systematic analysis of interview-based qualitative studies spanning a 15-year period (Vasileiou et al., 2018).

**Procedures**

Ethical approval to conduct the study was obtained through Northumbria University's Faculty of Health and Life ethics review system in the Psychology Department (approval number 52968). Participants who indicated an interest to participate were provided with an information sheet, either in person or via email. This document provided participants with a clear understanding of the study's purpose, requirements, and assurances regarding anonymity, confidentiality, and voluntary participation. After perusing the information sheet, participants completed a written informed consent form to indicate their willingness to participate. Following consent, interviews were arranged. At the commencement of the interview, participants accurate understanding on the study and their willingness to participate were again verbally confirmed, whereafter they were informed that the recording would begin. At the conclusion of the interview, participants were given the opportunity to discuss any aspects they had not previously mentioned, facilitating the generation of detailed and personal accounts. Participants were thanked for their participation and given a debrief sheet upon completion that reiterated the research aims, their right to withdraw up until formal data analyses, and relevant resources and information on the study topic. The debrief sheet also included contact information at the university for any further questions or concerns they may have had.

**Materials**

A semi-structured interview schedule that consisted of open-ended questions was used to explore exercisers' experiences and opinions on their chosen fitness app. Probes and follow-up questions were used to explore the participants' answers in greater detail. This interview method allowed us to cover key questions while giving participants the freedom to elaborate on their experiences in greater detail compared to a structured interview (Evans & Lewis, 2018). The questions focused on the app features that the participants were most interested in, how the apps influenced (or did not influence) their motivation to sustain exercise behaviours, and the impact apps had on their exercise and fitness habits. Example questions included "In the long term, how do you feel your fitness application(s) has sustained your exercise/fitness behaviours?", "What features of the application do you use the most?", "Are there any specific features of the applications that contribute to you continuing to use them? – (if so) how do you feel this influences your own physical activity and exercise behaviours?". Interviews were conducted either virtually through platforms like Zoom and FaceTime, or in person, based on participant convenience. The interviews took place in quiet rooms and typically lasted 30 minutes. All interviews were audio recorded and securely stored on the primary researcher's password-protected cloud storage account for transcription. The recordings were transcribed in verbatim using the Avrio online platform's transcription feature. All transcriptions were assessed to ensure complete accuracy and correspondence with the interview recordings. Instances where anonymity was compromised, such as the mention of names, were removed from the transcribed data. At the point of transcription, notes were made on the documents to support later coding and analysis. The audio files were deleted after they were no longer required.

**Data Analyses**

The data was analysed following Braun and Clarke's steps for reflexive thematic analysis, which is a theoretically flexible method' for "developing, analysing and interpreting patterns across a qualitative dataset" (Braun & Clarke, 2021. p. 4). A deductive approach was employed to assess how fitness app usage aligned with

current motivational frameworks. Additionally, an inductive approach was used to explore other ways in which these apps influence sustained motivation for exercise and physical activity. This combination of approaches ensured a comprehensive understanding grounded in motivational theory. Interviews were read multiple times to familiarise the researcher with the content, noting points of interest related to the research question. Subsequently, responses were coded to identify patterns in the findings. Coding examples were 'application increases autonomy' and 'competition increases motivation'. After carefully considering the coded transcripts, the codes were collaborated into themes. Later, the key themes were reviewed by an independent researcher to ensure they represented the whole data set, and quotations supporting each theme were selected to be reported on.

**Methodological Rigour**

To assure the integrity and credibility of the research, we employed Tracy's (2010) rigour criteria. Direct quotations were used to give voice to participants' experiences and to resonate with other fitness app users, enhancing the richness of the data. The lead author kept a reflexive notebook to ensure an in-depth engagement with the self and the identification of any biases or crucial events that may have influenced the data analysis and gathering methods. For example, the lead author uses a fitness app and has a good attitude towards such technologies. To mitigate the influence of researcher bias, coded transcripts and any areas of uncertainty in responses were relayed back to participants (Birt et al., 2016). In this respect, every participant was contacted and there was a 100% response in confirming the accuracy and completeness of responses. Moreover, the presentation of findings was anchored within the context of pertinent theories and literature to uphold objectivity (Green & Glasgow, 2006). Additionally, negative cases, where participants expressed indifference towards app usage, were thoughtfully included in the analysis (Morse, 2015).

## Results and Discussion

The current research explored individuals' experiences of how using their chosen fitness apps influenced their motivational orientation to sustain physical activity and exercise habits. The results of this study highlight that fitness apps affect motivation to exercise in two main ways: through meeting basic psychological needs and facilitating self-evaluation and competition with others.

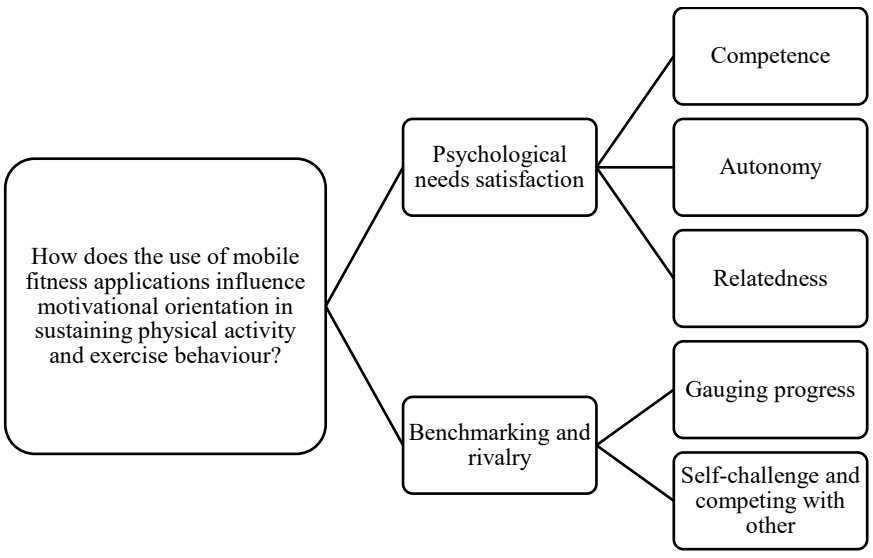


**Figure 1**. Thematic map displaying how the use of fitness applications influences motivational orientation in sustaining physical activity and exercise.

**Psychological Needs Satisfaction**

The findings show that fitness applications contribute to the sustainability of motivation for exercise by allowing the fulfilment of psychological desires. Participants explicitly indicated that using fitness apps made them feel more competent in their own abilities, independent, and in charge of their exercise behaviour, as well as a higher sense of closeness with other exercisers. The feedback from participants on the use of fitness apps is consistent with the principles of Self-Determination Theory (Deci & Ryan, 1985), which like the views presented in exercise contexts (Teixeira et al., 2012; Kang et al., 2019) agree

that the presence of conditions that support an individual's competence, autonomy, and relatedness fosters high-quality motivation for engaging in and maintaining exercise behaviours. Furthermore, this discovery lends support to prior research by Molina and Myrick (2020), which demonstrated the relevance of motivation in the utilisation of fitness apps but fell short in providing a comprehensive theoretical foundation for such usage. In contrast, the present research establishes a connection between the use of fitness apps and significant motivational theories, such as Self-Determination Theory (SDT). This enhances our understanding of fitness applications as an effective strategy for behaviour modification. The connection is exemplified through the subthemes discussed below.

**Competence**

This subtheme represents the idea that the use of fitness apps made users feel more competent regarding their abilities. Competence is hereby understood as an individual feeling confident in their capabilities to successfully accomplish an outcome or perform a task (Vansteenkiste & Ryan, 2013). To elaborate on this, most participants highlighted that being able to see a visual trail of evidence of their performance data on their fitness app increased their feelings of competence and confidence in their ability.

> *"The app makes me feel more competent because I can see how I have improved over time and how well I am performing. Um, which proves to myself that I can do more than I sometimes think I can."* – P4.

> *"Even though you kind of know it in your own self, the extra data, it just gives you that little confidence boost."* – P9

The ability to view past performances is a feature of fitness apps that helps users feel more competent and confident in their abilities, which enhances the likelihood that they will continue exercising. These results are in line with those yielded by Kari et al. (2016), who suggested that tracking one's own fitness activities can help with motivation. Furthermore, this idea complements Hermsen et al.'s (2016) findings, which were based on a rigorous evaluation of the literature and confirmed the utility of feedback via digital technology as an effective strategy to respond to undesired habitual behaviour. However, the current research can add to previous works by describing how these fitness apps are useful for motivation in specific ways, such as by providing visual reinforcement of skill and showing evidence that users are getting better over time, which have been suggested to elicit exercise behaviours even on days where participants would not typically exercise. Moreover, fitness apps were also suggested to enhance exercise competency by providing personalised workout routines and instructing individuals on the correct execution of specific exercises. This added guidance instils exercisers with a sense of confidence, knowing they are following the right techniques. In this way, the app's exercise demonstration feature fosters a better execution of the exercise and increase motivation to keep working out.

> *"You can get like a demo of how you actually perform the exercises. I guess this makes me sort of feel more confident that I am doing things correctly.... In the past I have held back from exercising by thinking I did not know what I am doing in the gym, but because the app makes me feel more competent, I am more likely to do the exercise and do it well." – P 3*

Because of the app's tailored sessions and exercise demonstration features, this increase in exercise motivation may provide cognitive resources to exercises, which, according to the Theory of Energetic Cost Minimization, can weaken the automatic tendency towards effort optimisation (Brand & Cheval, 2019). Therefore, the recent literature on the use of fitness apps to initiate exercise behaviour (Huang & Ren, 2020; Zhang & Xu, 2020; Valcarce-Torrente et al., 2021) benefits considerably from this influence on the quality and persistence of exercise output.

**Autonomy**

The use of fitness apps enhanced participants' feelings of autonomy, which refers to one's freedom of choice over their actions, such as choosing to exercise on their own volition rather than under pressure from others (Ryan & Deci, 2017). All the participants acknowledged that using their fitness apps gave them a sense of control over their exercise behaviour and placed additional focus on the personalisation of such apps to increase their sense of autonomy.

> *"I think because I have the app, like I feel like I enjoy being in charge of my own exercise and what I log. As I say, it is like my own workout journal. So, I feel accountable to myself for what I log and track on there."* – P3

> "*It gives me autonomy as I can use it as and when I need it to monitor my own exercise. So, I am sort of in control of what I'm doing ... I can use it to set challenges and personalise workouts to suit me."* – P6

> [When asked how fitness application usage influenced their autonomy] – "*I can set my own schedule with it. I've got goals that I can set ... it allows me to design my workouts."* – P8

Fitness applications clearly influence exercise motivation by increasing a person's sense of behavioural control. This is made feasible by software features that allow users to personalise their workouts, create personal objectives, and keep a private activity journal. These findings back up Deci and Ryan's (2000) SDT, which states that for behavioural changes to occur, people must be able to manage their own behaviour. Furthermore, the findings are similar with Kang et al.'s (2020) findings that autonomy has a substantial predictive potential for exercise adherence over a six-month period. This shows that when aiming to induce sustained behaviour change in an exercise setting, encouraging control over exercise behaviour is critical. Hereby, more information about the mechanisms of fitness applications that cause these changes in autonomy is provided by these findings, which also help us better grasp the viability of these applications for their function in long-lasting behaviour change.

**Relatedness**

Another subtheme under psychological needs satisfaction represents feelings of relatedness that stems from fitness app usage. Relatedness is here understood as a feeling of being part of a community of individuals who share interests. This is notably accomplished through fitness app features enabling users to add friends and contacts.

> *"You really get a sense of community because you can add your Facebook friends and your phone contacts, and just all being in it together really is quite nice."* – P1

> *"I think I enjoy feeling like part of something. The feature of having friends on the exercise app, it like creates a sort of community and makes me feel involved."*– P3

Participants expounded on this concept suggesting that by continuing their workout regimen, they might further blend into the established community.

> *"It's like a sense of feeling of wanting to carry on and, you know, fit in."* – P2

> *"The app like makes a community of people, and I want to keep using the app and keep exercising to sort of feel like I still fit into that."* – P3

Considering the research question guiding the present study, it may be noteworthy that users of fitness apps also continue to exercise because they do not want to feel excluded from the community these applications create, in addition to the ways in which they foster a sense of connection among others. This sub-theme concurs with the findings of a mixed methods investigation conducted by Zang and Xu (2020), which underscored the opportunity for 'social connection' as a primary factor for college students' continuance intention to use fitness apps. This aligns with the SDT (Deci & Ryan, 2000) and other research showing that feeling a part of a group or community of people who have similar interests should improve a person's desire to sustain related behaviour (Beal et al., 2003) and preserve the connections established through fitness apps. According to Maslow's hierarchy of needs (Maslow, 1943), the idea that feeling related is a key determinant of one's behavioural orientation further establishing the participants reasoning for sustaining their exercise behaviour and app usage.

It is interesting to note that one person's ideas about meeting the need for relatedness differed from those of every other participant. While most participants said that using a fitness app would boost their emotions of competence, autonomy, and relatedness, participant 5 said that while using this feature of their fitness app was "nice", they did not necessarily find it to be particularly motivating. When questioned further if application features help their exercise habits, participant 5 said, "Not really" stating that their sustained engagement in exercise is more a result of previously established habitual conduct. This underlines personal habits and routine as a motivating element related with exercise adherence because not all people' motivation to continue exercising is reliant on fitness app use. Important to note is that this participant was the only one from the sample that reported engaging in team activity, such as football, as opposed to individual exercise behaviour. Therefore, it may be that using fitness apps is not as relevant at sustaining exercise and physical activity in group exercise, as it is in solo fitness behaviours. Findings from this participant may be supported by the fact that enjoyment is the primary motivator for group sports participation (Frederick & Ryan, 1993), and that group exercise has been shown to produce greater satisfaction of the need for relatedness and belonging than individual contexts (Lovell et al., 2015). In these circumstances, additional motivational support from apps may not be necessary for a person to maintain their exercise habits. Therefore, these findings offer an intriguing way to compare the efficiency of fitness applications as a behaviour modification strategy in individual and group environments in future studies.

**Benchmarking and Rivalry**

The use of fitness apps, which make it possible to track progress and participate in challenges and competitions with others, influences motivation to maintain physical activity and exercise, which is another key finding of the study. According to the Achievement Goal Theory (Nicholls, 1984), a person might be motivated by rais-

ing their standards of self-reference (task mastery) or by competing with and outperforming others (ego goal orientation). According to the participants, self-monitoring of progress and rivalry with oneself and other app users are two ways that fitness applications affect motivation to keep exercising. The subthemes below present these findings in further detail.

*Gauging of progress*

This subtheme outlines how most participants felt their fitness apps allowed them to observe previous workouts and activities, which gave a foundation for improvement and a motivation to continue with their exercise regime. Furthermore, fitness apps and the display of previous performance allowed users to set objectives for future exercise.

> *"With the statistics ... they allow me to sort of like compare to my previous workouts ...it also allows me to sort of exercise more and try lower and improve my times."* – P2

> *"It [the fitness application] really helps to show how I've improved over time, which is a big motivator."* – P4

> *"Seeing previous results on my watch makes me want to progress each week."* – P7

In this regard, it is recognised that the use of fitness apps provides exercisers with the opportunity to record and evaluate prior performances, which facilitates motivational orientation in sustaining exercise and physical activity for self-improvement. This is consistent with the Achievement Goal Theory (Nicholls, 1984), which confirms the motivational effect of accomplishing task-oriented goals (Elliot & McGregor, 2001). The suggestion that self-monitoring of behaviour via apps is advantageous for enhanced exercise motivation is consistent with the work of Rockman and Maier (2019) and Rockmann and Gewald (2018), who prioritise self-monitoring features as catering to those with task mastery aspirations. This conclusion is also consistent with earlier research that shows how self-monitoring enhances autonomous motivation (Knittle et al., 2018).

*Self-challenge and competing with others*

This subtheme demonstrates that most participants said that seeing their peers exercising via the apps increased their drive to maintain physical activity or exercise. Participants reported increased motivation as well as an increase in exercise output because of competing with others.

> *"For example, it is 7:00am and someone has done a workout. It kind of gives you a little bit of motivation to be like, if they can do it work, can I not do it."* – P9

> *"It [having friends on their application] drives me to be better... I want to be thinking I could beat that ... So, it drives me to get to the next workout."*– P8

> *"It [comparing with friends on the application] makes me feel like a little bit competitive… it gives me a goal to push me to run a bit more."* – P6

It may thus be accepted that fitness apps alter one's drive to sustain physical activity and exercise by creating a basis to compete with peers. Again, this perception is warranted by the Achievement Goal Theory, which proposes that ego goal-oriented persons are motivated by outperforming others as it is regarded as a form of success (Nicholls, 1984). Building upon the notion that social comparison through fitness app leaderboards can boost physical activity (Wu et al., 2015), the present study assessed if this holds true for apps beyond Nike running, such as Apple Fitness+, Fitbit, and Strava. By doing so, our findings can contribute to a broader understanding of how various fitness applications influence motivation and long-term exercise behaviour, leading to a more comprehensive view of fitness apps in general.

While fitness apps linked to wearable devices are associated with increased motivation in ways such as providing competition, it is recommended that applications suit an individual's goal orientation for motivational transformation to occur (Rockmann & Maier, 2019). In this aspect, it may be more reasonable to suggest that apps can assist people stay motivated to exercise if the app and their goal orientation are compatible. As a result, in situations where goal orientation is not supported, it is probable that motivational and behavioural gains will not occur. Based on this line of reasoning, one participant's suggestion that they do not use fitness apps as "motivation to get up and do something" does not undermine the motivational capacity of such applications; rather, it may indicate a mismatch between the user's goal orientation and their respective app's motivational features. As a result, it is critical to analyse elements of fitness app usage on a subjective basis, which allows future studies to assess how personal motivational differences correlate with the varying use of fitness apps.

While not prominent enough to record as a separate theme, it is worth noting how participants described the fitness app function of push notifications as eliciting feelings of guilt, especially when they had not previously exercised.

> *"The apps have notifications which kind of perpetuates the guilt."* – P1

> *"I sort of feel guilty if I haven't done or logged any exercise that day and I get the notification."* – P3

Similarly, another participant highlighted notifications to elicit exercise behaviour, which otherwise would not have occurred.

> *"It alerts me that I've not done enough exercise in an hour, that encourages me to exercise and to make time to exercise when otherwise I might not."* – P4

While this discovery was not conclusive, it offers valuable insights into the influence of push notifications on exercise behaviour, paving the way for future investigations. The Affective Reflective Theory (Brand & Ekkakiss, 2018) underlines the function of an exercise-related stimulus in eliciting automatic positive or negative evaluations that can either increase or decrease regulated actions leading to exercise participation. As a result, this discovery lays the groundwork for future research into the nature and frequency of push notifications used in apps and wearable devices in relation to exercise behaviour, including the mediating role of guilt in this process. Another interesting finding is that when asked if fitness apps had any psychological drawbacks, a considerable percentage (half) of the participants described their use as obsessive. While this does not directly address the research question, it does shed light on how fitness app users may exercise out of a desire for acknowledgment. Previous studies have already shown that ego-involved contexts, such as competitive apps, have a positive association with exercise commitment (González-Cutre & Sicilla, 2012). Nevertheless, the impact of this fixation on obsessive health monitoring and recognition on exercise behaviour remains uncertain. This is an area that warrants further investigation for fitness app and wearable manufacturers, considering the emerging belief that obsessive health monitoring in certain individuals could potentially have adverse effects on their health and sleep. Finally, it is necessary to highlight the views of one participant who suggested they would continue to exercise irrespective of using their fitness app. When questioned if their app influenced their motivation to exercise, the participant responded, "*because of what I am doing [running a marathon], I'm just going to have to do it [exercise] anyway"* (P9). In contrast to other participants who were not primarily motivated by the nature of the sport, one individual placed significant emphasis on the requirements of the sport, considering them sufficient to drive exercise behaviour even without the support of a fitness app. This narrative aligns to Toner and colleagues' (2023) recent findings that distance runners may have developed a situational awareness ('habit-body') that eschews mobile technology use in favour of their embodied needs to train. Toner et al (2023) also note in their study that mobile fitness technology frequently lacks context-specificity (e.g., weather conditions), which in the case of distance running makes exercisers' somatic experiences more meaningful than real-time statistics. While it has been proposed that people with personified identities, such as marathon runners, have elevated levels of self-determination to sustain exercise behaviours (Qui et al., 2019), more research into the effectiveness of mobile fitness apps as a behaviour modification tool in relation to various spatiotemporal, sensory, social, and affective contexts would be beneficial.

# Conclusion

The current study builds on earlier quantitative findings (Molina & Sundar, 2020; Sun et al., 2021; Tsai et al., 2021) by investigating how fitness apps work as a behaviour modification tool for maintaining exercise behaviours. The findings show that mobile fitness apps encourage physical activity and exercise habits by meeting exercisers' psychological demands for competence, autonomy, and relatedness through features like tailored sessions and exercise demonstration, goal personalisation and social connectivity. These apps also provide progress tracking and peer challenges, which not only stimulates exercise output but also corresponds with popular motivational theories that explain behaviour change for prolonged physical activity and exercise. The strength of this study is that it draws on the rich and significant insights provided by individuals who have engaged in prolonged exercise practises as defined by the World Health Organisation (2016) while having varying fitness goals and app preferences. Our findings, however, were based on a relatively youthful cohort (19–27 years old), which is a limitation of our study given that 41% of fitness app users globally are aged 30–39 (Statista, 2023). As a result, careful data analysis is essential, because older users may interact differently with these apps, impacting motivational orientation for continuous activity. However, the findings are essential for fitness app developers since they provide theoretical reasoning and insight into the core fitness app features that are primarily responsible for maintaining exercise behaviours. Future research should investigate into the motivational role of fitness applications in connection to specific health, sport, or lifestyle goals of diverse groups of exercisers from varying sensory, social, and affective contexts to gain a better understanding of their efficacy in sustaining behaviour change.

**Competing interests**

The author(s) of a paper submitted to *Physical Culture and Sport. Studies and Research* are required to declare competing interest for any commercial associations or financial interests held by the author.

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**Data accessibility statement**

The dataset supporting the results of the study is available upon request.

# References

Admiraal, W. M., van Valkengoed, I. G., L de Munter, J. S., Stronks, K., Hoekstra, J. B., & Holleman, F. (2011). The association of physical inactivity with Type 2 diabetes among different ethnic groups. *Diabetic Medicine*, *28*(6), 668–672. https://doi.org/10.1111/j.1464-5491.2011.03248.x

Ajzen, I. (2012). The Theory of Planned Behaviour. Handbook of Theories of Social Psychology: Volume 1, 438–459. https://doi.org/10.4135/9781446249215.n22

Ajzen, I. (2015). The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review*, *9*(2), 131–137. https://doi.org/10.1080/17437199.2014.883474

Allen, M. S., Walter, E. E., & Swann, C. (2019). Sedentary behaviour and risk of anxiety: a systematic review and meta-analysis. *Journal of Affective Disorders*, *242*, 5–13. https://doi.org/10.1016/j.jad.2018.08.081

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471–499. https://doi.org/10.1348/014466601164939

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. Psychological Review, *84*(2), 191–215. https://doi.org/10.1037/0033-295x.84.2.191

Barber, T. X. (2013). *Pitfalls in human research: Ten pivotal points* (Vol. 67). Elsevier. https://doi.org/10.1016/c2013-0-02792-2

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, *380*(9838), 258–271. https://doi.org/10.1016/s0140-6736(12)60735-1

Beal, D. J., Cohen, R. R., Burke, M. J., & McLendon, C. L. (2003). Cohesion and performance in groups: a meta-analytic clarification of construct relations. *Journal of Applied Psychology*, *88*(6), 989. https://doi.org/10.1037/0021-9010.88.6.989

Birt L, Scott S, Cavers D, Campbell C, Walter F. (2016). Member checking: A Tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*. Jul 10. PMID: 27340178. https://doi.org/10.1177/1049732316654870.

Boudreau, F., & Godin, G. (2007). Using the Theory of Planned Behaviour to predict exercise intention in obese adults. *Canadian Journal of Nursing Research Archive*, *39*(2), 112–125.

Brand, R., & Cheval, B. (2019). Theories to explain exercise motivation and physical inactivity: Ways of expanding our current theoretical perspective. *Frontiers in Psychology,* 10. https://doi.org/10.3389/fpsyg.2019.01147

Brand, R., & Ekkekakis, P. (2017). Affective–Reflective Theory of physical inactivity and exercise. *German Journal of Exercise and Sport Research*, *48*(1), 48–58. https://doi.org/10.1007/s12662-017-0477-9

Braun, V., & Clarke, V. (2022). Thematic analysis. *Encyclopaedia of Quality of Life and Well-Being Research*, 1–7. https://doi.org/10.1007/978-3-319-69909-7_3470-2

Ceci, L. (2023). U.S. health and fitness app users 2018–2022. Statista. Retrieved on Retrieved July 13, 2023, from https://www.statista.com/statistics/1154994/number-us-fitness-health-app-users/#statisticContainer

Cheval, B., Radel, R., Neva, J. L., Boyd, L. A., Swinnen, S. P., Sander, D., et al. (2018). Behavioural and neural evidence of the rewarding value of exercise behaviours: A systematic review. *Sports Medicine*. 1–16. https://doi.org/10.1007/s40279-018-0898-0

Collado-Mateo, D., Lavín-Pérez, A. M., Peñacoba, C., Del Coso, J., Leyton-Román, M., Luque-Casado, A., Gasque, P., Fernández-Del-Olmo, M. Á., & Amado-Alonso, D. (2021). Key factors associated with adherence to physical exercise in patients with chronic diseases and older adults: An umbrella review. *International Journal of Environmental Research and Public Health*, *18*(4), 2023. https://doi.org/10.3390/ijerph18042023

Conroy, D. E., & Berry, T. R. (2017). Automatic affective evaluations of physical activity. *Exercise and Sport Sciences Reviews*, *45*(4), 230–237. https://doi.org/10.1249/jes.0000000000000120

Conroy, D. E., Yang, C. H., & Maher, J. P. (2014). Behaviour change techniques in top-ranked mobile apps for physical activity. *American Journal of Preventive Medicine*, *46*(6), 649–652. https://doi.org/10.1016/j.amepre.2014.01.010

Damaševičius, R., Kim, J., & Dourado, V. Z. (2022). Editorial: use of smartphone applications to increase physical activity and fitness. *Frontiers in Public Health*, 9. https://doi.org/10.3389/fpubh.2021.713306

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, 11, 227–268. https://doi.org/10.1207/s15327965pli1104_01

Deci, E. L., & Ryan, R. M. (2008). Self-Determination Theory: A macro theory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne*, 49, 182–185. https://doi.org/10.1037/a0012801

Eades, M. T., Tsanas, A., Juraschek, S. P., Kramer, D. B., Gervino, E., & Mukamal, K. J. (2021). Smartphone-recorded physical activity for estimating cardiorespiratory fitness. Scientific Reports, *11*(1). https://doi.org/10.1038/s41598-021-94164-x

Elbe, A. M., Krippl, M., Melzer, M., & Teubel, T. (2013). Development and analysis of the test control criteria of the AnMS-Sport questionnaire which assesses the sport-specific affiliation motive. *Sportwissenschaft*, *43*, 102–115. https://doi.org/10.1007/s12662-012-0278-0

Elliot, A. J., & McGregor, H. A. (2001). A 2× 2 achievement goal framework. *Journal of Personality and Social Psychology*, *80*(3), 501–519. https://doi.org/10.103//0022-3514.80.3.501

Emm-Collison, L. G., Jago, R., Salway, R., Thompson, J. L., & Sebire, S. J. (2019). Longitudinal associations between parents' motivations to exercise and their moderate-to-vigorous physical activity. *Psychology of Sport and Exercise*, 43, 343–349. https://doi.org/10.1016/j.psychsport.2019.04.007

Evans, C., & Lewis, J. (2018). Analysing semi-structured interviews using thematic analysis: Exploring voluntary civic participation among adults (pp. 1–6). SAGE Publications Limited. https://doi.org/10.4135/9781526439284

Eynon, M., Foad, J., Downey, J., Bowmer, Y., & Mills, H. (2019). Assessing the psychosocial factors associated with adherence to exercise referral schemes: A systematic review. *Scandinavian Journal of Medicine & Science in Sports*, *29*(5), 638–650. https://doi.org/10.1111/sms.13403

Frederick, C. M., & Ryan, R. M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. *Journal of Sport Behaviour*, *16*(3), 124–147.

Gavin, J., Keough, M., Abravanel, M., Moudrakovski, T., & Mcbrearty, M. (2014). Motivations for participation in physical activity across the lifespan. *International Journal of Wellbeing*, *4*(1), 46–61. https://doi.org/10.5502/ijw.v4i1.3

González-Cutre, D., & Sicilia, Á. (2012). Motivation and exercise dependence: A study based on self-determination theory. *Research Quarterly for Exercise and Sport*, *83*(2), 318–329. https://doi.org/10.5641/027013612800745194

Gupta, R., Mohan, I., & Narula, J. (2016). Trends in coronary heart disease epidemiology in India. *Annals of Global Health*, *82*(2), 307–315. https://doi.org/10.1016/j.aogh.2016.04.002

Graham, H. L. (2021). Exercise adherence. *Encyclopaedia of Gerontology and Population Aging*, 1739–1743. https://doi.org/10.1007/978-3-030-22009-9_807

Green, L. W., & Glasgow, R. E. (2006). Evaluating the relevance, generalization, and applicability of research. *Evaluation & The Health Professions*, *29*(1), 126–153. https://doi.org/10.1177/0163278705284445

Hagger, M. S. (2019). Advances in motivation in exercise and physical activity. *The Oxford Handbook of Human Motivation*, 462–486. https://doi.org/10.1093/oxfordhb/9780190666453.013.25

Harwood, C. G., & Thrower, S. N. (2020). Motivational climate in youth sport groups. In M. W. Bruner, M. A. Eys, & L. J. Martin (Eds.), The power of groups in youth sport (pp. 145–163). *Elsevier Academic Press*. https://doi.org/10.1016/B978-0-12-816336-8.00009-3

Hardeman, W., Johnston, M., Johnston, D., Bonetti, D., Wareham, N., & Kinmonth, A. L. (2002). Application of the theory of planned behaviour in behaviour change interventions: A systematic review. *Psychology and Health*, *17*(2), 123–158. https://doi.org/10.1080/08870440290013644a

Hermsen, S., Frost, J., Renes, R. J., & Kerkhof, P. (2016). Using feedback through digital technology to disrupt and change habitual behaviour: A critical review of current literature. *Computers in Human Behaviour*, 57, 61–74. https://doi.org/10.1016/j.chb.2015.12.023

Huang, G., & Ren, Y. (2020). Linking technological functions of fitness mobile apps with continuance usage among Chinese users: Moderating role of exercise self-efficacy. *Computers in Human Behaviour*, *103*, 151–160. https://doi.org/10.1016/j.chb.2019.09.013

Huberty, J. L., Ransdell, L. B., Sidman, C., Flohr, J. A., Shultz, B., Grosshans, O., & Durrant, L. (2008). Explaining long-term exercise adherence in women who complete a structured exercise program. *Research Quarterly for Exercise and Sport*, *79*(3), 374–384. https://doi.org/10.1080/02701367.2008.10599501

Islam, M. A., & Aldaihani, F. M. F. (2022). Justification for adopting qualitative research method, research approaches, sampling strategy, sample size, interview method, saturation, and data analysis. *Journal of International Business and Management*, *5*(1), 01–11. https://doi.org/10.37227/jibm-2021-09-1494

Ivanova, N., & Korostelev, A. (2019). The impact of competitive approach on students' motivation in sport. Amazonia Investiga, *8*(18), 483–490. Retrieved from https://amazoniainvestiga.info/index.php/amazonia/article/view/362

Jekauc, D. (2015). Enjoyment during exercise mediates the effects of an intervention on exercise adherence. *Psychology*, *6*(01), 48–54. https://doi.org/10.4236/psych.2015.61005

Kang, S., Lee, K., & Kwon, S. (2020). Basic psychological needs, exercise intention and sport commitment as predictors of recreational sport participants' exercise adherence. *Psychology & Health*, *35*(8), 916–932. https://doi.org/10.1080/08870446.2019.1699089

Kari, Tuomas; Piippo, Jenni; Frank, Lauri; Makkonen, Markus; and Moilanen, Panu, "to gamify or not to gamify? Gamification in exercise applications and its role in impacting exercise motivation" (2016). BLED 2016 Proceedings. 20. https://aisel.aisnet.org/bled2016/20

Kesenheimer, J. S., Sagioglou, C., Kronbichler, A., Gauckler, P., & Kolbinger, F. R. (2023). Why do people cycle (a lot)? A multivariate approach on mental health, personality traits and motivation as determinants for cycling ambition. *Journal of Applied Sport Psychology*, 1–21. https://doi.org/10.1080/10413200.2023.2166157

Knittle, K., Nurmi, J., Crutzen, R., Hankonen, N., Beattie, M., & Dombrowski, S. U. (2018). How can interventions increase motivation for physical activity? A systematic review and meta-analysis. *Health Psychology Review*, *12*(3), 211–230. https://doi.org/10.31234/osf.io/upmy8

Krebs, P., & Duncan, D. T. (2015). Health app use among us mobile phone owners: a national survey. *JMIR MHealth and UHealth*, *3*(4), e101. https://doi.org/10.2196/mhealth.4924

Kuklina, E. V., Tong, X., George, M. G., & Bansil, P. (2012). Epidemiology and prevention of stroke: A worldwide perspective. *Expert Review of Neurotherapeutics*, *12*(2), 199–208. https://doi.org/10.1586/ern.11.99

Lovell, G. P., Gordon, J. A., Mueller, M. B., Mulgrew, K., & Sharman, R. (2016). Satisfaction of basic psychological needs,

self-determined exercise motivation, and psychological well-being in mothers exercising in group-based versus individual-based contexts. *Health Care for Women International*, *37*(5), 568–582. https://doi.org/10.1080/07399332.2015.1078333

Maehr, M. L., & Zusho, A. (2009). Achievement Goal Theory: The Past, Present, and Future. In *Handbook of Motivation at School* (pp. 91–118). Routledge. https://doi.org/10.4324/9781315773384-11

Malterud, K., Siersma, V., & Guassora, A. D. (2016). Sample size in qualitative interview studies. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Marin, D. P., Polito, L. F. T., Foschini, D., Urtado, C. B., & Otton, R. (2018). Motives, motivation and exercise behavioural regulations in CrossFit and resistance training participants. *Psychology*, *9*(14), 2869–2884. https://doi.org/10.4236/psych.2018.914166

Maslow, A. H. (1943). A dynamic theory of human motivation. *Psychological Review*, *50*(4), 370–96. https://doi.org/10.1037/11305-004

Middelweerd, A., Mollee, J. S., van der Wal, C. N., Brug, J., & Te Velde, S. J. (2014). Apps to promote physical activity among adults: a review and content analysis. *International Journal of Behavioural Nutrition and Physical Activity*, *11*(1), 1–9. https://doi.org/10.1186/s12966-014-0097-9

Molina, M. D., & Myrick, J. G. (2021). The 'how' and 'why' of fitness app use: investigating user motivations to gain insights into the nexus of technology and fitness. *Sport in Society*, *24*(7), 1233–1248. https://doi.org/10.1080/17430437.2020.1744570

Molina, M. D., & Sundar, S. S. (2020). Can mobile apps motivate fitness tracking? A study of technological affordances and workout behaviours. *Health Communication*, *35*(1), 65–74. https://doi.org/10.1080/10410236.2018.1536961

Morse, J. M. (2015). "Data were saturated . . .." *Qualitative Health Research, 25(5), 587–588.* https://doi.org/10.1177/1049732315576699

Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative inquiry. *Qualitative Health Research*, *25*(9), 1212–1222. https://doi.org/10.1177/1049732315588501

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*(3), 328–346. https://doi.org/10.1037/0033-295X.91.3.328

Ntoumanis, N., Ng, J. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., ... & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behaviour, physical, and psychological health. *Health Psychology Review*, *15*(2), 214–244. https://doi.org/10.1080/17437199.2020.1718529

Pedersen, M. R. L., Hansen, A. F., & Elmose-Østerlund, K. (2021). Motives and barriers related to physical activity and sport across social backgrounds: Implications for health promotion. *International Journal of Environmental Research and Public Health*, *18*(11), 5810. https://doi.org/10.3390/ijerph18115810

Picha, K. J., & Howell, D. M. (2018). A model to increase rehabilitation adherence to home exercise programmes in patients with varying levels of self-efficacy. *Musculoskeletal Care*, *16*(1), 233–237. https://doi.org/10.1002/msc.1194

Pitsiladis, Y. P., & Wang, G. (2015). Genomics of Elite Sporting Performance. Routledge Handbook of Sport Expertise, 295–304. https://doi.org/10.4324/9781315776675-26

Qiu, Y., Tian, H., Lin, Y., & Zhou, W. (2019). Serious leisure qualities and participation behaviours of Chinese marathon runners. *International Review for the Sociology of Sport*, *55*(5), 526–543. https://doi.org/10.1177/1012690218822303

Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin*, *22*(1), 24–33. https://doi.org/10.1177/0146167296221003

Richard, M., Christina, M. F., Deborah, L. S., Rubio, N., & Kennon, M. S. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, *28*(4), 335–354.

Rivis, A., & Sheeran, P. (2003). Social influences and the theory of planned behaviour: Evidence for a direct relationship between prototypes and young people's exercise behaviour. *Psychology and Health*, *18*(5), 567–583. https://doi.org/10.1080/0887044032000069883

Rockmann, R., & Gewald, H. (2018). Activity tracking affordances: identification and instrument development. PACIS 2018 Proceedings. 232. https://aisel.aisnet.org/pacis2018/232

Rockmann, R., & Maier, C. (2019). On the fit in fitness apps: Studying the interaction of motivational affordances and users' goal orientations in affecting the benefits gained. *Wirtschaftsinformatik Und Angewandte Informatik.*

Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. New York, NY: Guilford. https://doi.org/10.1521/978.14625/28806

Scheid, J. & Lupien, S. (2021). Fitness Watches and Nutrition Apps: Behavioural Benefits and Emerging Concerns. *ACSM'S Health & Fitness Journal*, 21–25. https://doi.org/10.1249/fit.0000000000000644

Sport England, (2023). Adults' activity levels in England bounce back to pre-pandemic levels. Retrieved July 13, 2023, from: https://www.sportengland.org/news/adults-activity-levels-england-bounce-back-pre-pandemic-levels

Stoeber, J., & Becker, C. (2008). Perfectionism, achievement motives, and attribution of success and failure in female soccer players. *International Journal of Psychology*, *43*(6), 980–987. https://doi.org/10.1080/00207590701403850

Sullivan, A. N., & Lachman, M. E. (2017). Behaviour change with fitness technology in sedentary adults: A review of the evidence for increasing physical activity. *Frontiers in Public Health*, *4*, 289. https://doi.org/10.3389/fpubh.2016.00289

Sun, R. T., Han, W., Chang, H. L., & Shaw, M. J. (2021). Motivating adherence to exercise plans through a personalized mobile health app: enhanced action design research approach. *JMIR mHealth and uHealth*, *9*(6), e19941. https://doi.org/10.2196/preprints.19941

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of*

*Behavioural Nutrition and Physical Activity*, *9*(1), 1–30. https://doi.org/10.1186/1479-5868-9-78

Toner, J., Allen-Collinson, J., Jackman, P.C., Jones, L., & Addrison, J. (2023): 'I like to run to feel': Embodiment and wearable mobile tracking devices in distance running, *Qualitative Research in Sport, Exercise and Health*. https://doi.org/10.1080/2159676X.2023.2225516

Topolovec-Vranic, J., & Natarajan, K. (2016). The Use of social media in recruitment for medical research Studies: A scoping review. *Journal of Medical Internet Research*, *18*(11), e286. 779 https://doi.org/10.2196/jmir.5698

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, *16*(10), 837–851. https://doi.org/10.1177/1077800410383121

Tsai, Z., Kiss, A., Nadeem, S., Sidhom, K., Owais, S., Faltyn, M., & Lieshout, R. J. V. (2022). Evaluating the effectiveness and quality of mobile applications for perinatal depression and anxiety: A systematic review and meta-analysis. *Journal of Affective Disorders*, 296, 443–453. https://doi.org/10.1016/j.jad.2021.09.106

Valcarce-Torrente, M., Javaloyes, V., Gallardo, L., García-Fernández, J., & Planas-Anzano, A. (2021). Influence of fitness apps on sports habits, satisfaction, and intentions to stay in fitness centre users: An experimental study. *International Journal of Environmental Research and Public Health*, *18*(19), 10393. https://doi.org/10.3390/ijerph181910393

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, *23*(3), 263. https://doi.org/10.1037/a0032359

Vantage Market Research, (2022). Global fitness app market size & share to surpass $15.2 Bn by 2028. Retrieved July 13, 2023, from: https://www.globenewswire.com/en/news-release/2022/10/26/2541533/0/en/Global-Fitness-App-Market-Size-Share-to-Surpass-15-2-Bn-by-2028-Vantage-Market-Research.html

Vasileiou, K., Barnett, J., Thorpe, S. J., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC Medical Research Methodology*, *18*(1). https://doi.org/10.1186/s12874-817018-0594-7

Weinberg, R. S., & Gould, D. (2019). Foundations of sport and exercise psychology, 7e. Human Kinetics, Champaign, IL

Wilson, P. M. (2012). Exercise Motivation. Measurement in Sport and Exercise Psychology, 293–302. https://doi.org/10.5040/9781492596332.ch-026

World Health Organization. (2023). Physical inactivity. Retrieved July 13, 2023, from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3416

Wu, Y. K., & Huang, K. (2015). Gamification in Fitness Apps: How Do Leaderboards Influence Exercise? (2015). ICIS 2015 Proceedings. 14. https://aisel.aisnet.org/icis2015/proceedings/IShealth/14

Yang, Y., & Koenigstorfer, J. (2021). Determinants of fitness app usage and moderating impacts of education-, motivation-, and gamification-related app features on physical activity intentions: Cross-sectional survey study. *Journal of Medical Internet Research*, *23*(7), e26063. https://doi.org/10.2196/preprints.26063

Yerrakalva, D., Yerrakalva, D., Hajna, S., & Griffin, S. (2019). Effects of mobile health app interventions on sedentary time, physical activity, and fitness in older adults: systematic review and meta-analysis. *Journal of Medical Internet Research*, *21*(11), e14343. https://doi.org/10.2196/14343

Zhai, L., Zhang, Y., & Zhang, D. (2015). Sedentary behaviour and the risk of depression: A meta-analysis. *British Journal of Sports Medicine*, *49*(11), 705–709. https://doi.org/10.1136/bjsports-2014-093613

Zhang, X., & Xu, X. (2020). Continuous use of fitness apps and shaping factors among college students: A mixed-method investigation. *International Journal of Nursing Sciences*, *7*(Suppl 1), S80–S87. https://doi.org/10.1016/j.ijnss.2020.07.009