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RESEARCH ARTICLE

The Motivational Impact of Wearable Healthy Lifestyle Technologies: A Self-determination Perspective on Fitbits With Adolescents

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ABSTRACT
Background: Considerable numbers of young people are not meeting physical activity guidelines. Wearable fitness devices can provide opportunities for physical activity promotion. **Purpose**: The aim of the study was to explore whether wearable healthy lifestyle technologies impacted on adolescents' (13- to 14-year-olds) motivation for physical activity. **Methods**: The study was a mixed method sequential design. Participants were 84 adolescents (44 girls, 40 boys) from 6 physical education classes. Pupils were issued with a Fitbit to wear for 8 weeks and completed pre-/posttest questionnaires that assessed motivational regulation and psychological need satisfaction. Adolescents also engaged in focus group interviews after wearing the Fitbit for 8 weeks. Quantitative data were analyzed using a repeated measures multivariate analysis of variance (MANOVA) to explore differences between gender and time. Qualitative data analysis was conducted deductively using self-determination theory. **Results**: The quantitative findings identified significant reductions in need satisfaction and autonomous motivation and significant increases in amotivation after 8 weeks. Qualitative evidence suggested short-term increases in motivation through feelings of competition, guilt, and internal pressure. **Discussion**: Findings suggest that healthy lifestyle technology may have negative motivational consequences. **Translation to Health Education Practice**: Certified Health Education Specialists should support young people to personalize health targets in order to critically engage with normalized health targets.

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Background

Studies show that considerable proportions of young people do not meet the national guidelines for daily physical activity.[1,2] Approximately 50% of young people engage in sufficient physical activity to achieve positive health benefits.[3] Echoing calls of international health and physical activity organizations[4] the United Nations Educational, Scientific, and Cultural Organization[5] recently stressed that substantial action was required to address rising levels of youth physical inactivity and the substantial increase in associated noncommunicable diseases. Health interventions are particularly important because they provide the foundation for an active lifestyle.[6,7] Schools are suitably positioned as a site to promote physical activity, given the staff, equipment, facilities, and duration of time that young people spend there. Yet, over a number of decades, physical activity interventions targeting young people in schools have only produced modest effects.[8] Finding new ways to motivate young people to be active is therefore vital.

Although technology has been associated with physical inactivity,[9] healthy lifestyle technologies, such as wearable fitness devices (eg, Fitbits) and mobile health applications (apps; eg, Fitbit app or MyFitnessPal), are suggested to provide new and exciting opportunities for physical activity promotion.[10-13] It is suggested that access to personalized data on physical activity behaviors and the ability to track, compare, and monitor behavior has huge potential for impacting cognitions and emotions and, in turn, increasing levels of physical activity.[14-17] Given that young people are becoming increasingly tethered to their mobile devices,[18] alongside reports that they are increasingly turning to technology for health information,[19] healthy lifestyle technologies should be considered as tools to address physical inactivity in young people.[20,21]

Though most empirical evidence on healthy lifestyle technologies is based on assessing quality and validity,[22] an emerging evidence base in young adults demonstrates that commercial wearable fitness trackers and their associated apps increase physical activity levels and impact motivational constructs of enjoyment, challenge, affiliation, and positive health motivation.[23] Young people (age 11–12) have also reported finding features of real-time feedback and competition from

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the commercial Fitbit motivating,[24] suggesting that promotion of self-monitoring and goal-setting behaviors can increase physical activity levels.[25,26] Yet the evidence base on the health-related impact of young people's (age 13–14) use of healthy lifestyle technologies is limited.[14,20,21] A recent systematic literature review on adolescents and young adults (age 12–25 years) identified only 2 empirical studies that measured the health-related effects of using nutritional or physical activity apps.[21] Further, the limited evidence base is inconclusive. For example, though a noncommercial app used with obese patients (age 11–15) resulted in weight reduction and improvements to intrinsic and extrinsic motivation,[27] other nonrandomized interventions (age 12–25) report no significant differences in diet/nutrition or physical activity behaviors.[21] In an account of young girls' (age 11–15) experiences of commercial health apps and wearable devices (eg, Popsugar Active or Strava), heightened levels of body dissatisfaction were reported[14]—a known variable evidenced to impact negatively on physical activity behaviors.[28] Research that determines the health-related impacts of wearable devices and apps would contribute to an emerging evidence base on the role of digital technologies in the health of young people.

Self-determination theory

Self-determination theory is a widely applied theoretical framework in the study of youth physical activity[29] and has been used to guide understandings on the motivational impact of digital technologies on youth physical activity behaviors.[30,31] Self-determination theory provides an understanding of the initiation and maintenance of physical activity.[32] The theory proposes that in order for individuals to be optimally motivated, behaviors should be self-determined; in other words, volitional. Individuals display more self-determined forms of motivation as they internalize to a greater degree the reasons for engaging in the behavior, thus engaging in a behavior out of interest or for their own sake as opposed to the outcomes of the activity. In contrast, behaviors are less self-determined when an activity is undertaken as a means to an end that lies outside participation in the activity itself. More self-determined forms of motivation are associated with physical activity adoption and adherence.[33]

Six different types of motivation are proposed to exist along a continuum ranging from lower to higher levels of self-determination,[34] which can further be divided into autonomous motivation, controlled motivation, and amotivation.[35] Autonomous motivation is the most self-determined and is a combination of intrinsic motivation (undertaking an activity for the inherent pleasure), integrated regulation (undertaking an activity through choice to obtain a personal goal), and identified regulation (when the outcome of the behavior is valued such as the health benefits of physical activity). Thus, autonomous motivation is based on the values or personal interests of the individual. In contrast, controlled motivation is less self-determined and based on demands that are externally or internally posed.[29,32] Controlled motivation is a combination of introjected regulation (an individual engages in a behavior to avoid guilt or obtain social approval) and external regulation (an individual engages in a behavior to avoid punishment or obtain a reward).[32] Finally, amotivation is at the end of the continuum and is evident when an individual is neither intrinsically nor extrinsically motivated and thus lacks motivation and volition with respect to a particular behavior.[36] More self-determined forms of motivation lead to positive physical activity outcomes[37]; thus, youth physical activity programs that promote autonomous motivation are recommended.[38]

It is argued that social factors influence self-determined motivation through the satisfaction of 3 psychological needs.[39] The 3 antecedents of competence, autonomy, and relatedness are proposed to influence an individual's motivational state. In order for optimal motivational functioning to occur along with subsequent positive outcomes, these 3 psychological needs should be satisfied.[40] The need for autonomy relates to an individual's perception of choice in his or her behavior. This can be expressed as an individual's need to feel like the originator and not the pawn of their behaviors.[41] The need for competence relates to a desire to feel capable and confident when executing a behavior.[42] Finally, a need for relatedness is associated with an experience of connectedness with others.[43] Experience of autonomous or controlled forms of motivation within a particular context is dependent upon the extent to which these fundamental needs are satisfied.[44] If healthy lifestyle technology is to promote optimal motivational functioning, then the basic psychological needs of competence, autonomy, and relatedness should be satisfied through the Fitbit features. Examples of some specific Fitbit features include elements within the app such as goal setting, feedback on performance, and the messaging features.

Need-supportive environments have 3 main characteristics: autonomy supportive, competence facilitating (or well structured), and relatedness supportive.[42] Autonomy supportive contexts involve providing a clear rationale for an activity, offering encouragement, hints, and feedback on performance.[45] Competence-facilitating environments provide positive feedback on performance[46] and clear guidelines and expectations.[47] Relatedness-supportive environments allow individuals to feel socially connected with and accepted by others.[48] The benefits of physical activity environments that are need supportive have been well established in young people.[49]

Healthy lifestyle technology and self-determination theory

The healthy lifestyle technology explored in this article is the Fitbit device; specifically, the Fitbit Charge physical activity wristband and the associated app. The wristband has a visual display that assesses steps taken, distance traveled, calories burned, floors climbed, and distance traveled. Data can be synchronized with the Fitbit app that can be downloaded onto a mobile device. The Fitbit app allows users to monitor physical activity progress, tailor physical activity goals, record workouts, share and compete with friends, earn badges, and log food and track sleep patterns. In reference to self-determination theory, these functions demonstrate clear potential for positive impact on competence, autonomy, and relatedness.

Competence could be positively satisfied by the Fitbit providing feedback on physical activity performance through badges, alerts, and prompts. For example, when an individual achieves 10 000 daily steps—a predetermined physical activity level of the Fitbit—his or her Fitbit will vibrate and flash to signify that this physical activity goal has been achieved. Further, the individual can gain certain badges—which are displayed on the app—for meeting different types of physical activity targets, such as walking the accumulated distance of the Serengeti. In relation to self-determination theory, positive feedback on physical activity behaviors can increase perceptions of competence and positively impact self-determined motivation.[46,50]

Autonomy can be satisfied by the Fitbit device and app by the potential to personalize physical activity targets. Individuals may alter the predetermined daily step goal, distance traveled, and active minutes to suit their individual physical activity needs. In addition, the Fitbit device and app do not prescribe the activities through which these goals should be achieved. Research consistently suggests that autonomy-supportive environments, in which young people have a sense of choice over their physical activity behaviors, lead to higher levels of physical activity.[51]

Relatedness could be satisfied through the social features on the app. For example, the app allows individuals to form Fitbit friends (which may be within or outside of peer groups), communicate with these friends (via emojis or text), and challenge their friends to physical activity competitions. Evidence suggests that relatedness can be satisfied through both face-to-face interactions and online communications,[52] demonstrating potential for this Fitbit app to address this motivational construct. This is a powerful feature, given that when young people perceive a high sense of relatedness, they are more likely to exhibit higher engagement in physical activity behaviors.[53] In terms of the competitive element offered through the app, when individuals willingly engage in competition, intrinsic motivation is enhanced through feelings of relatedness.[54]

Purpose

The relationship between the constructs of self-determination theory (ie, competence, autonomy, and relatedness) and the features and functions of the Fitbit device and app highlight clear potential for healthy lifestyle technologies to positively influence young people's motivation for physical activity. New research that provides evidence-based insights on the motivational impact of healthy lifestyle technologies will provide urgently needed understandings on the role of technology in health and physical activity promotion in young people. The purpose of this article is to explore whether wearable healthy lifestyle technologies influence adolescents' motivation for physical activity. Data are presented from an exploratory mixed methods sequential research design. The primary objective of the study is to examine whether adolescents' (age 13–14) motivation for physical activity and basic psychological need satisfaction change over an 8-week period while they wore a Fitbit device and used the associated Fitbit app. Using self-determination theory as a guiding theoretical framework it was hypothesized that after wearing the Fitbit participants would experience greater need satisfaction, greater self-determined forms of motivation, and less amotivation.

Methods

The study was a mixed methods sequential intervention design. The study applied pre-/posttest quantitative questionnaires, followed by qualitative focus group interviews at the end of the 8-week period. Through this design, the methods sought to measure impact on motivation and capture details of context, alongside user perceptions. Given that most empirical insights into healthy lifestyle technologies lack qualitative insights into how users engage and use apps and devices,[21] this research design serves to provide nuanced and broader understandings on the role of healthy lifestyle technologies in physical activity promotion in young people, by considering both objective and subjective insights. Prior to data collection, university ethical approval was granted and informed consent or assent was obtained from participants. A detailed account of the ethical procedures followed can be accessed in previous publications.[55] Fitbit's terms and conditions were also consulted and followed during this study.

Participants

One hundred 13- to 14-year-olds (53 females, 47 males) were invited to participate in the study. Participants were recruited from 6 randomly selected physical education classes within 2 schools. Class sizes ranged from 10 to 16, with an average class size of 14. The schools were selected based on a convenience approach. One school was based in the southeast United Kingdom and the other school was based in the northwest United Kingdom. The 2 schools differed in their socioeconomic demographics; school 1 was a nonselective private school and school 2 was a comprehensive state school. Parental consent and pupil assent were obtained for all participants.

Intervention

Participants were provided with a Fitbit Charge to wear for 8 weeks. An 8-week duration was selected because this period allows for the identification of behavior change in step-based programs.[56] The Fitbit Charge was used as the object of the intervention. Fitbit profiles were provided to participants using personalized e-mail addresses and passwords. Instructions were provided on the functional capabilities and operational features of the device and the app. Participants were instructed to wear the Fitbit for the 8-week period.

Data generation

Motivational regulation

Prior to being issued with the Fitbit device (pre) and at week 8 (post), pupils completed the Behavioural Regulations in Exercise Questionnaire II.[57] The questionnaire was adapted to replace the term *exercise* with *physical activity* in order to assess motivation toward physical activity. The Behavioural Regulations in Exercise Questionnaire II consists of 19 items that represent 5 different subscales that include amotivation (eg, I don't see why I should have to do physical activity), external regulation (eg, I feel under pressure from my friends/family to do physical activity), introjected regulation (eg, I feel guilty when I don't do physical activity), identified regulation (eg, I value the benefits of physical activity), and intrinsic regulation (eg, I do physical activity because it's fun). Participants were asked to respond to each item on a 5-point scale ranging from 0 (*not true for me*) to 4 (*very true for me*). For data analysis, mean scores for autonomous motivation, controlled motivation, and amotivation were calculated. Scores for autonomous motivation were calculated by calculating the mean scores of intrinsic and identified items. Scores for controlled motivation were calculated using the mean scores of introjected and external regulation items.

Need satisfaction

Pupils also completed the Psychological Need Satisfaction in Exercise scale, modified to the physical activity context[58] pre- and postintervention. This measure consists of a 16-item scale that assesses the basic psychological needs of competence (eg, I feel I am able to complete physical activities that are personally challenging), autonomy (eg, I feel free to do physical activity in my own way), and relatedness (eg, I feel attached to my physical activity companions because they accept me for who I am) in a physical activity context. Participants were asked to respond to statements on a 6-item scale of 1 (*false*) to 6 (*true*).

Context and user perceptions

To generate contextual understandings on how pupils used the Fitbit device and app and their perceptions on the role of this technology in physical activity promotion, data were generated from 9 focus group interviews (4–6 members) in week 8 (post). Groups for interviews were selected by the class teacher to be representative of different pupil interests and variations in physical activity abilities across the respective classes. Interviews were conducted by the researchers using an adapted version of the nominal group technique[59] in a semi-structured format. Each pupil was asked to respond to 10 statements that related to their experiences of using the Fitbit. For example, "I would recommend using the Fitbit to other people my age because ..." and "I would not recommend using a Fitbit to people my age because. ..." Following the individual responses to each statement, the groups were then prompted to share their thoughts and perceptions on the responses until they reached a level of agreement. This process was repeated for all 10 statements.

Data analysis

Data from the need satisfaction and motivational regulation questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 22 (IBM Corporation, Armonk, NY). Descriptive statistics were calculated for all dependent variables using mean and standard deviations. In order to assess the motivational differences pre and post Fitbit and the differences between sex and interactions between sex and time, a repeated measures multivariate analysis of variance (MANOVA) was conducted. Gender was included in the MANOVA model due to the differences in physical activity levels of boys and girls.[49] The MANOVA was used to explore the 2 independent variables of sex and time and the multiple dependent variables (autonomous motivation, controlled motivation, amotivation, competence, autonomy, and relatedness). Statistical significance was determined by $P < .05$. Cronbach's alpha levels for all subscales at pre- and posttest exceeded .70, meeting acceptable criteria (Table 1).

Concepts from the framework of self-determination theory were used to analyze the focus group data. The process was therefore deductive and encompassed 2 aims: (1) identifying how the constructs of competence, autonomy, and relatedness existed in the qualitative data and (2) locating the form of self-determination that was experienced by the participants; that is, lower to higher levels of self-determination. These 2 aims ensured that the authors remained focused on the overarching objective of the article: to examine whether adolescents' (age 13–14) motivation for physical activity and basic psychological need satisfaction change over an 8-week period during which they wore a Fitbit device and used the associated Fitbit app.

The first step involved both authors reading the interview transcripts to identify important segments that related to competence, autonomy, and relatedness and lower or high levels of self-determination. In the second step, the authors identified appropriate analytical questions related to the self-determination framework to analyze the segments of data:

- How does the Fitbit and app support or hinder competence?
- How does the Fitbit and app support or hinder autonomy?
- How does the Fitbit and app support or hinder relatedness?
- What types of self-determined forms of motivation do the Fitbit and app support or hinder?

After the questions were identified, the authors coded the data related to these questions. In keeping with the deductive approach, the data sets were reorganized into separate documents in relation to the different analytical questions. Data not related to the analytical questions but deemed important by the authors were placed in an additional document. The third step involved a peer examination strategy where the authors discussed and shared their independent analyses and their answers to the analytical questions from the data. In this process, the data were moved into different categories and subcategories and the authors described their justifications to each other on the placement of data. No strong disagreements between the authors occurred during this process.

Though a level of author bias is acknowledged as a limitation of the analytical process, the qualitative analysis revealed themes related to (1) competence, (2) relatedness, (3) controlled motivation, and (4) short-term motivation. The qualitative data did not reveal detailed insights into the concept of autonomy. Short-term motivation was not a key focus of the analytical questions but was identified by both authors as important in relation to the overarching objective of the article. The importance of presenting short-term motivation as a theme was further cross-referenced with the quantitative data. The authors agreed that this theme should be included due to the added value of offering an explanation to the quantitative data. Other important segments of the data were identified, such as calories and definitions of health as fitness. These data, however, did not relate to the objective of the article

Table 1. Mean, standard deviation, and Cronbach alpha values for motivation and need satisfaction scores for boys, girls, and all pupils pre- and post-Fitbit.

	Pre-Fitbit				Post-Fitbit			
	Boys	Girls	All		Boys	Girls	All	
Variable name	M (SD)	M (SD)	M (SD)	Cronbach's alpha	M (SD)	M (SD)	M (SD)	Cronbach's alpha
Competence	5.10 (0.76)	5.00 (0.79)	5.03 (0.78)	.90	4.79 (0.83)	4.92 (0.89)	4.86 (0.86)	.88
Autonomy	5.24 (0.81)	5.11 (0.93)	5.19 (0.87)	.88	4.70 (0.99)	4.87 (1.12)	4.79 (1.11)	.70
Relatedness	4.26 (1.24)	4.75 (1.02)	4.52 (1.18)	.90	4.00 (1.08)	4.48 (1.23)	4.25 (1.18)	.90
Amotivation	0.17 (0.32)	0.10 (0.24)	0.13 (0.28)	.78	0.65 (0.66)	0.33 (0.50)	0.48 (0.60)	.74
Controlled motivation	0.94 (0.68)	1.09 (0.56)	1.02 (0.62)	.70	0.96 (0.70)	1.15 (0.69)	1.06 (0.70)	.77
Autonomous motivation	2.93 (0.73)	3.07 (0.53)	3.00 (0.63)	.78	2.54 (0.83)	2.99 (0.60)	2.78 (0.75)	.79

and/or the constructs of motivation and was disregarded.

A relativist approach was used to guide the validity of this mixed methods design and the analytical processes.[60] Similar to previous work,[61] a relativist approach involved identifying criteria for validity based on an ongoing list of characterising traits that related to the context of the research and methods. In this study, the list included the following criteria: the worthiness of the topic, which was determined through reviewing contemporary literature in qualitative and quantitative research designs; the significant contribution of the work, which was understood through identified gaps in the evidence base on the effects of healthy lifestyle technologies on young people (age 13–14); and the comprehensiveness of the evidence that was achieved through qualitative and quantitative sources of data and data generation and analysis guided by an established theoretical framework; credibility, which was determined through the process of peer examination and opened up a dialogue between the authors about the fairness, appropriateness, and believability of the data and the use of previously validated questionnaires and procedures; and transparency, that occurred through ongoing dialogue between the authors. This study also aimed for coherence. In other words, how the study coheres in terms of purpose, methods, and results.[60]

Results

Pre–post changes in motivational regulation and need satisfaction

Descriptive statistics for need satisfaction and motivational regulation scores for boys and girls pre and post Fitbit can be found in Table 1. This table shows declines in competence, autonomy, relatedness, and autonomous motivation and increases in amotivation for boys, girls, and all pupils after wearing the Fitbit. A repeated measures MANOVA test was conducted to test the impact of the Fitbit on need satisfaction and motivational regulation. The results showed a significant difference in motivational outcomes across time, $F(6, 77) = 8.72$, $P = .00$, $\eta^2 = 0.41$ and sex, $F(6, 77) = 2.47$, $P = .03$, $\eta^2 = 0.16$. For all participants, after wearing the Fitbit competence decreased by 0.17, autonomy decreased by 0.40, relatedness decreased by 0.27, and autonomy decreased by 0.22. For all participants, after wearing the Fitbit amotivation increased by 0.35 and controlled motivation increased by 0.04. In relation to sex, autonomy was 0.13 higher in boys pre-Fitbit but 0.11 higher in girls post-Fitbit. In relation to sex, competence was 0.10 higher in boys pre-Fitbit but 0.13 higher in girls post-Fitbit. Amotivation was higher in boys by 0.07 pre-Fitbit and 0.32 post-Fitbit. Relatedness, controlled motivation, and autonomous were higher in girls pre-Fitbit by 0.49, 0.15, and 0.14, respectively. Relatedness, controlled motivation, and autonomous motivation were also higher in girls post-Fitbit by 0.48, 0.19, and 0.45, respectively. There was no significant interaction between sex and time, $F(6, 77) = 1.99$, $P = .07$, $\eta^2 = 0.13$.

In relation to need satisfaction univariate, analysis of variance tests revealed nonsignificant interaction effects between sex and time for competence, $F(1, 82) = 5.49$, $P = .06$, $\eta^2 = 0.02$, autonomy, $F(1, 82) = 2.04$, $P = .16$, $\eta^2 = 0.24$, and relatedness, $F(1, 82) = 0.00$, $P = .93$, $\eta^2 = 0.00$. Univariate tests indicated that there were no significant differences in competence, $F(1, 82) = 0.02$, $P = .88$, $\eta^2 = 0.00$, and autonomy, $F(1, 82) = 0.09$, $P = .93$, $\eta^2 = 0.00$, between boys and girls; however, girls had significantly higher relatedness scores compared to boys, $F(1, 82) = 4.72$, $P = .03$, $\eta^2 = 0.05$. Univariate tests identified significantly lower competence scores, $F(1, 82) = 8.5$, $P = .005$, $\eta^2 = 0.91$, autonomy scores, $F(1, 82) = 13.49$, $P = .00$, $\eta^2 = 0.14$, and relatedness scores, $F(1, 82) = 5.81$, $P = .02$, $\eta^2 = 0.07$, postintervention.

In relation to motivational regulation, univariate tests revealed significant interaction effects between sex and time for amotivation, $F(1, 82) = 4.98$, $P = .03$, $\eta^2 = 0.06$, and autonomous motivation, $F(1, 82) = 7.24$, $P = .01$, $\eta^2 = 0.08$. There was no significant interaction effect between sex and time for controlled motivation, $F(1, 82) = 0.36$, $P = .55$, $\eta^2 = 0.00$. Univariate tests indicated that girls had significantly higher autonomous motivation scores compared to boys, $F(1, 82) = 7.24$, $P = .01$, $\eta^2 = 0.08$, and girls had significantly lower amotivation scores compared to boys, $F(1, 82) = 5.73$, $P = .02$, $\eta^2 = 0.65$. Nonsignificant differences in controlled motivation scores were apparent between boys and girls, $F(1, 82) = 0.11$, $P = .74$, $\eta^2 = 0.02$. Univariate tests identified significantly higher amotivation scores, $F(1, 82) = 38.00$, $P = .00$, $\eta^2 = 0.32$, and significantly lower autonomous motivation scores, $F(1, 82) = 17.00$, $P = .00$, $\eta^2 = 0.17$, postintervention. There was no significant difference in controlled motivation scores postintervention, $F(1, 82) = 0.36$, $P = .55$, $\eta^2 = 0.00$.

Competence

Data suggested that nonpersonalized targets of, for example, 10 000 steps were undermining the pupils' sense of competence. Pupils commented that the standardized target of 10 000 steps was unfair, especially if you lacked the ability to achieve those targets: "You can feel under pressure to do a certain amount of steps or to be better than what you're maybe capable of" (school

2, focus group interview 3). The pupils also reported that though they strived to achieve this externally prescribed target, they were often unable to achieve this goal: "I did less than you're meant to, but more than I thought I would" (school 2, focus group interview 3). The pressure of not obtaining the steps also negatively impacted how the participants viewed themselves: "Then you sit there and you realise it's seven o'clock and you've got, like, ten steps, you feel really bad" (school 1, focus group interview 2). The pupils' uses of the Fitbit and the Fitbit app, therefore, had a negative influence on their perceptions of competence due to predetermined targets that were not relevant to their individual needs.

Relatedness

Competition with peers emerged as a key component function of the app that promoted social relationships. Pupils reported that they set up competitions in their peer groups and that these competitions encouraged them to engage in more physical activity: "I learnt that I was encouraged to do a lot more sports when I was wearing the Fitbit and I wanted to try and beat my friend's record" (school 1, focus group interview 1). The pupils also commented on how the Fitbit was a social device that promoted a sense of connection with peers who also had a Fitbit and who engaged with physical activity: "I normally went to one of my friends' houses because he had a Fitbit already and I was like, 'Oh, how many steps have you done in a day?' and how to get more steps and, 'What do you do?' and that" (school 1, focus group interview 1). In this sense, the Fitbit allowed the pupils to engage with discussions about physical activity and develop common understandings and behaviours. However, the pupils also acknowledged that competition did not always have positive implications: "It became a competition between people, which is sometimes good but sometimes bad" (school 2, focus group interview 4). The competitive element resulted in peer pressure to achieve goals: "Some people maybe feel peer pressure to do fitness, to keep their steps and stuff up" (school 2, focus group interview 2) and, in some cases, induced a sense of guilt: "You can sometimes feel guilty. Like when I first got this Fitbit, if I hadn't done 10 000 steps before I went to bed, I used to just walk up and down the corridor because I couldn't let someone else beat me" (school 2, focus group interview 4). Competition was therefore a central feature of the Fitbit device and app that pupils attended to. For some, the competitive element encouraged more physical activity, whereas for others, striving to beat their peers resulted in negative feelings of self.

Controlled motivation

The competition element was an external pressure to engage in physical activity. Pupils reported on how the competition encouraged them to be more active: "It makes you do a lot more walking because you want to try and beat your friends on it as well" (school 1, focus group interview 3). However, none of the pupils reported engaging in physical activity for fun during the 8-week period and strongly communicated that they were driven to engage in physical activity through competition: "If we had a competition, you're gaining exercise, doing more exercise to beat the other person" (school 2, focus group interview 5). It also emerged that the externally prescribed physical activity target of 10 000 steps was acting as a source of controlled motivation: "When you look at your steps, sometimes you think it's not high enough, so you do that or something, just to try and get your steps up. That's what quite a lot of people did" (school 2, focus group interview 1). The pupils commented on the external pressure of achieving the prescribed 10 000 steps: "It's good for features for walking and finding out what you do, but no as in it sets limits. It says you should do this and it pressurises you" (school 2, focus group interview 3). This evidence suggests that pupils were motivated to engage in physical activity through feelings that were not self-determined and that competition may act as a form of introjected regulation in which pupils engaged in physical activity through feelings of pressure or guilt.

Short-term motivation

The novelty effect was a key component to the Fitbit raised by pupils. It was consistently reported that after about 4 weeks pupils became bored with the Fitbit: "I used it for the first 4 weeks, then just gave up" (school 1, focus group interview 2) and "After about, like, 4 to 5 weeks, some weekends I'd just leave it on the table, like all day" (school 1, focus group interview 1). Though this novelty period made some pupils more physically active, following the first 4 weeks their reported physical activity levels declined; "It did for the first 4 weeks, and then the last couple of weeks I just sat at home all day" (school 1, focus group interview 2). Some pupils discussed how after the initial novelty period they were discouraged from engaging in physical activity "I feel like, in the first few weeks, I was motivated more, but then by the end I was just sort of discouraged by—It's not like I didn't do exercises, just—I don't know" (school 2, focus group interview 5). Overall, there was a strong sense that after this novelty period, pupils were less motivated to engage in physical activity: “It’s like you’ve got something new and use it for ages and then just, like, it doesn’t bother you anymore” (school 2, focus group interview 5). This evidence suggests that though the Fitbit serves to promote physical activity, for the pupils in this study, the Fitbit may have only produced modest and short-term effects.

Discussion

The purpose of this study was to examine whether healthy lifestyle technologies impact young people’s motivation for physical activity. In using self-determination theory as a guiding theoretical framework, it was hypothesized that after an 8-week period of wearing the Fitbit and using the Fitbit app, participants would experience greater need satisfaction, greater self-determined forms of motivation, and less amotivation. The results, however, identified significant declines in competence, autonomy, and relatedness, alongside reduced levels of autonomous motivation. Furthermore, following the 8-week period, significant increases in amotivation were observed. In contrast to previous literature suggesting that healthy lifestyle technologies can impact young people’s motivation for physical activity,[24-26] data demonstrate that healthy lifestyle technologies may impact negatively on students’ motivation for physical activity.

In examining the relationship between the Fitbit and young people in further detail, data suggested that peer comparison was a key factor in undermining levels of competence, autonomy, and relatedness. For example, it is reported that when individuals lose in competitions, perceptions of competence and intrinsic motivation decrease.[62] The competitive element provided the participants with competence/incompetence information through the social comparison of performance. Due to the leader board nature of the competitions offered on the Fitbit, inevitably, more young people are likely to receive incompetence information because only one person can be top of the leader board. Similarly, the predetermined 10 000-step goal may actually lead pupils to feel less competent when they do not achieve the daily goal, as was supported through the focus groups.

Although it was previously argued that feelings of autonomy could be increased through the tailoring of physical activity goals on the Fitbit app, the decreased feelings of autonomy experienced may have been a result of the predefined targets within the device; for example, 10 000 steps. This was reflected in the qualitative evidence in which pupils focused on achieving this goal, and there was little acknowledgement toward adjusting their physical activity targets. Furthermore, it is argued[54] that competition may undermine self-determined motivation through the impact on perceived autonomy and competence. Specifically, in this study, pupils engaged in step count competitions with their peers, both informally through discussions and formally through the “7 Day Steps” leader board on the Fitbit app that allows you to compare you performance with your Fitbit “friends.” If individuals feel pressured into competition or engagement, then a loss of autonomy will follow and self-determined motivation will be reduced. The qualitative evidence supports the proposed mechanism that pressure and guilt may be the process through which autonomy was undermined.

Although previous research has highlighted how both face-to-face interactions and online communications can promote relatedness,[52] it may have been the unique features of the online communications offered through the Fitbit app that led to reductions in need satisfaction. The competitive elements may create isolation from peers and thus undermine relatedness. Although the qualitative evidence suggested that some pupils found the competitive element engaging, there was also an awareness from some individuals that the competition element could also be detrimental and that engagement in physical activity could be the result of external pressure from peers.

Theoretically, the role of competition can be explained by the compromising of the basic psychological needs that could have resulted in the evidenced reductions to autonomous motivation and increases in amotivation. Although increases in controlled motivation were not significant, data indicate that the Fitbit acted as a source of external pressure (through the achievement of goals) and internal pressure (guilt). Indeed, when individuals engage in behaviors through feelings of guilt or social approval, their behavior is controlled through introjected regulation.[44] In turn, when behaviors are regulated by controlled motivation, individuals are less likely to engage in long-term maintenance of behaviors.[44,63] From this perspective, the observed short-term motivational effects can be attributed to the competitive element that promoted controlled rather than autonomous motivation.

Future directions

The study has several limitations that could be developed in future research. Firstly, although the Fitbit resulted in negative motivational outcomes, the study did not include an objective assessment of physical activity; thus, the implications for actual physical activity levels cannot be established. Though data were gathered from the Fitbit as part of the wider study, data capture was inconsistent among participants and data reporting was limited due to ethical procedures adopted as part of the institutional ethical review process. Data from the Fitbit, therefore, did not yield robust and credible insight that could be reported on in this article. Future research should use a pre- and posttest assessment of physical activity in a randomized controlled trial design in order to identify how healthy lifestyle technologies influence behavioral outcomes. Empirical investigations should also consider identifying the period at which the novelty effect becomes apparent—that is, 4 weeks—and engage with weekly assessments of motivational regulation and objective physical activity assessments. Future research should also consider sampling strategies that recruit schools from a diverse range of sociodemographic backgrounds. Furthermore, multiple intervention groups could be used in future studies, in order to assess the effectiveness of different levels of educational support. For example, a comparison across no educational support and educational support of different frequencies—for example, weekly vs fortnightly goal setting and feedback activities.

Translation to Health Education Practice

Finding new ways to motivate young people to be active is a clear international agenda.[5] Healthy lifestyle technologies have been presented as one solution, given the increased availability and accessibility of wearable devices and health apps, alongside young people's widespread use of, and engagement with, mobile technologies.[12,20] Despite this, few insights have been provided on the impact of healthy lifestyle technologies on young people's motivation for physical activity. Data from this study demonstrated that though clear potential exists, healthy lifestyle technologies negatively impact young people's motivation for physical activity. Competition, peer comparison and social comparison to normative predetermined targets result in only short-term motivational effects. In order to promote autonomy in young people, practitioners should support children in personalizing their physical activity goals and encourage self-referenced comparisons of performance, as opposed to engaging in normative comparisons with peers or established public health discourses. This evidence suggests that young people negatively relate to dominant public health discourses of, for example, 10 000 steps, that are promoted through consumer-oriented technologies. It also highlights that peer influence through digital technologies may play a negative role in physical activity promotion in young people. This research provides evidence for practitioners to support and educate young people regarding the personalisation aspect of these devices. Finally, evidence is required from a wider sample to be able to make more substantive claims about the role of healthy lifestyle technologies in young people's physical activity behaviors.

References

1. Dudley D, Goodyear VA, Baxter D. Quality and health-optimizing physical education: using assessment at the health and education nexus. *J Teach Phys Educ*. 2016;35:324–336.
2. Farooq MA, Parkinson KN, Adamson AJ, et al. Timing of the decline of physical activity in childhood and adolescence: Gatehead Millennium Cohort Study. *Br J Sports Med*. Published Online: March 13, 2017 (doi:10.1136/bjsports-2016-096933).
3. Husson H, Tirilis D. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database Syst Rev*. 2013;(1):CD007651.
4. HM Government. Sporting Future: a new strategy for an active nation. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486622/Sporting_Future_ACCESSIBLE.pdf. Published December 17, 2015. Accessed December 12, 2016.
5. United Nations Education, Scientific, and Cultural Organization. *Quality Physical Education (QPE) Guidelines for Policy-Makers*. Paris, France: UNESCO Publishing; 2015.
6. Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2010;7:40. doi:10.1186/1479-5868-7-40.
7. Timmons BW, Leblanc AG, Carson V, et al. Systematic review of physical activity and health in the early years (aged 0–4 years). *Appl Physiol Nutr Metab*. 2012;37:773–792.
8. Lubans DR, Smith JJ, Peralta LR, et al. A school-based intervention incorporating smartphone technology to improve health-related fitness among adolescents: rationale and study protocol for the NEAT and ATLAs 2.0 cluster randomised controlled trial and dissemination study. *Br Med J Open*. 2016;6:e010448.
9. Pratt M, Sarmiento OL, Montes F, et al. The implications of megatrends in information and communication technology and transportation for changes in global physical activity. *Lancet*. 2012;380:282–293.
10. Chung AE, Skinner AC., Hasty SE, et al. Tweeting for Health: a novel mHealth intervention using fitbits and Twitter to foster healthy lifestyles. *Clin Pediatr*. 2016;56:26–32.
11. Lupton D. Data assemblages, sentient schools and digitized health and physical education (response to Gard). *Sports Educ Soc*. 2015;20:122–132.
12. Rich E, Miah A. Mobile, wearable and ingestible health technologies: towards a critical research agenda. *Health Sociol Rev*. 2017;26:84–97.

13. Zach S, Raviv T, Meckel Y. Using information communication technologies (ICTs) for motivating female adolescents to exercise/run in their leisure time. *Comput Human Behav*. 2016;60:593–601.
14. Depper A, Howe PD. Are we fit yet? English adolescent girls' experiences of health and fitness apps. *Health Sociol Rev*. 2017;26:98–112.
15. Lewallen J, Behm-Morawitz E. Pinterest or Thinterest?: social comparison and body image on social media. *Social Media & Society*. 2016;2:1–9.
16. Silk M, Millington B, Rich E, et al. (Re-)thinking digital leisure. *Leisure Studies*. 2016;35:712–723.
17. Williamson B. Algorithmic skin: health-tracking technologies, personal analytics and the biopedagogies of digitized health and physical education. *Sports Educ Soc*. 2015;20:133–151.
18. Tuckle S. *Alone Together: Why We Expect More From Technology and Less From Each Other*. New York, NY: Basic Books; 2011.
19. Wartella E, Rideout V, Zupancic H, et al. *Teens, Health and Technology: A National Survey*. http://cmhd.northwestern.edu. Published June 2015. Accessed December 12, 2016.
20. Casey A, Goodyear VA, Armour KA. Rethinking the relationship between pedagogy, technology and learning in health and physical education. *Sports Educ Soc*. 2017;22:288–304.
21. Dute DJ, Bemelmans WJE, Breda J. Using mobile apps to promote a healthy lifestyle among adolescents and students: a review of the theoretical basis and lessons learned. *JMIR mHealth uHealth*. 2016;4(2):e39. doi:10.2196/mhealth.3559.
22. Sasaki JE, Hickey A, Mavilia M, et al. Validation of the Fitbit wireless activity tracker for prediction of energy expenditure. *J Phys Act Health*. 2015;12:149–154.
23. Brice MR, Ball JW, McClaran S. Technology and physical activity motivation. *Int J Sports Exerc Psychol*. 2016;14:295–304.
24. Schaefer SE, Ching CC, Breen H, et al. Wearing, thinking, and moving: testing the feasibility of fitness tracking with urban youth. *Am J Health Educ*. 2016;47:8–16.
25. Lewis ZH, Lyons EJ, Jarvis JM, et al. Using an electronic activity monitor system as an intervention modality: a systematic review. *BMC Public Health*. 2015;15:585. doi:10.1186/s12889-015-1947-3.
26. Ridgers N, McNarry MA, Mackintosh K. Feasibility and effectiveness of using wearable activity trackers in youth: a systematic review. *J Med Int Res Mhealth Uhealth*. 2016;3(4):e129. doi:10.2196/mhealth.6540.
27. Schiel R, Kaps A, Bieber G. Electronic health technology for the assessment of physical activity and eating habits in children and adolescents with overweight and obesity IDA. *Appetite*. 2012;58:432–437.
28. Kerner C, Haerens L, Kirk D. Body image in physical education: current knowledge and future directions. *Eur Phys Educ Rev*. Published Online: February 13, 2017 (doi:10.1177/1356336X17692508).
29. Van den Berghe L, Vansteenkiste M, Cardon G, et al. Research on self-determination theory in physical education. *Phys Educ Sport Pedagogy*. 2014;19:97–121.
30. Baert H, Winiecki T, Madden M, et al. Tom: using digital technology in physical education to transform pedagogy. In: Casey A, Goodyear VA, Armour KM, eds. *Digital Technologies and Learning in Physical Education: Pedagogical Cases*. London, UK: Routledge; 2016:191–212.
31. Goodyear VA, Blain D, Quarmby T, et al. Dylan: the use of "mobile" "apps" within a tactical inquiry approach. In: Casey A, Goodyear VA, Armour KM, eds. *Digital Technologies and Learning in Physical Education: Pedagogical Cases*. London, UK: Routledge; 2016:13–30.
32. Ryan RM, Deci EL. Intrinsic and extrinsic motivation in exercise and sport. In: Hagger MS, Chatzisarantis NLD, eds. *Intrinsic Motivation and Self-determination in Exercise and Sport*. Champaign, IL: Human Kinetics; 2007:1–19.
33. Teixeira PJ, Carraca EV, Markland D, et al. Exercise, physical activity and self-determination theory: a systematic review. *Int J Behav Nutr Phys Act*. 2012;9:78. doi:10.1186/1479-5868-9-78.
34. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. *J Pers Soc Psychol*. 1989;57:749–761.
35. Haerens L, Kirk D, Cardon G, et al. Motivational profiles for secondary school physical education and its relationship to the adoption of a physically active lifestyle among university students. *Eur Phys Educ Rev*. 2010;16(2):117–139.
36. Deci EL, Ryan RM. *Intrinsic Motivation and Self-determination in Human Behaviour*. New York, NY: Plenum; 1985.
37. Owen KB, Smith J, Lubans DR, et al. Self-determined motivation and physical activity in children and adolescents: a systematic review and meta-analysis. *Prev Med*. 2014;67:270–279.
38. Aelterman N, Vansteenkiste M, Van Keer H, et al. Development and evaluation of a training on need-supportive teaching in physical education: qualitative and quantitative findings. *Teach Educ*. 2013;32:305–320.
39. Vallerand RJ. Toward a hierarchical model of intrinsic and extrinsic motivation. In: Zanna MP. eds. *Advances in Experimental Social Psychology*. New York, NY: Academic Press; 1997:271–360.
40. Vansteekiste M, Niemiec CP, Soenens B. The development of the five mini-theories of self determination theory: an historical overview, emerging trends, and future directions. In: Urdan TC, Karabenick SA, eds. *Advances in Motivation and Achievement: The Decade Ahead*. Bingley, UK. Emerald Publishing; 2010:105–165.
41. DeCharms R. *Personal Causation: The Internal Affective Determinants of Behaviour*. New York, NY: Academic Press; 1968.
42. Skinner EA, Belmont MJ. Motivation in the classroom: reciprocal effects of teacher behavior and student engagement across the school year. *J Educ Psychol*. 1993;85:571–581.
43. Baumeister RF, Leary MR. The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychol Bull*. 1995;117:497–529.
44. Deci EL, Ryan RM. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychol Inq*. 2000;11:227–268.

45. Reeve J, Jang H. What teachers say and do to support students' autonomy during a learning activity. *J Educ Psychol*. 2006;98:209–218.
46. Koka A, Hein V. The effect of perceived teacher feedback on intrinsic motivation in physical education. *Int J Sports Exerc Psychol*. 2005;36(2):91–106.
47. Sierens L, Vansteenkiste M, Goossens L, et al. The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning. *Br J Educ Psychol*. 2009;79:57–68.
48. Deci EL, Ryan RM. *Handbook of Self-determination Research*. Rochester, NY: University of Rochester Press; 2002.
49. Ntoumanis N. A prospective study of participation in optimal school physical education based on self-determination theory. *J Educ Psychol*. 2005;75:411–433.
50. Nicase V, Cogerino G, Bois J, et al. Students' perceptions of teacher feedback and physical competence in physical education classes: gender effects. *J Teach Phys Educ*. 2006;25:36–57.
51. Roemmich JN, Lambiase MJ, McCarthy TF, et al. Autonomy supportive environments and mastery as basic factors to motivate physical activity in children: a controlled laboratory study. *Int J Behav Nutr Phys Act*. 2012;9. doi:10.1186/1479-5868-9-16.
52. Downie M, Mageau GA, Koestner R. What makes for pleasant social interaction? Motivational dynamics of interpersonal relations. *J Soc Psychol*. 2008;148:523–534.
53. Zhang T, Solomon MA, Kosma M, et al. Need support, need satisfaction, intrinsic motivation and physical activity participation among middle school students. *J Teach Phys Educ*. 2011;30:51–68.
54. Vallerand RJ, Losier G. An integrative analysis on intrinsic and extrinsic motivation in sport. *J Appl Sport Psychol*. 1999;11:142–169.
55. Goodyear VA Social media, apps and wearable technologies: navigating ethical dilemmas and procedures. *Qual Res Sport Exerc Health*. 2017;9:285–302.
56. Lubans DR, Morgan PJ. Evaluation of an extra-curricular school sport program promoting lifestyle and lifetime activity. *J Sport Sci*. 2008;26:519–529.
57. Markland D, Tobin V. A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *J Sports Exerc Psychol*. 2004;26:191–196.
58. Gunnell KE, Wilson PM, Zumbo BDM, et al. Psychological need satisfaction in exercise scale: an investigation of measurement invariance. *Meas Phys Educ Exerc Sci*. 2012;16:219–236.
59. Macphail A. Nominal group technique: a useful method for working with young people. *Br Educ Res J*. 2001;27(2):161–170.
60. Burke S. Rethinking "validity" and "trustworthiness" in qualitative inquiry. In: Smith B, Sparks A. eds. *Routledge Handbook of Qualitative Research in Sport and Exercise*. London, UK: Routledge; 2016:330–339.
61. Smith B, Tomason JR, Latimer-Cheung AE, et al. Narrative as a knowledge translation tool for facilitating impact: translating physical activity knowledge to disabled people and health professionals. *Health Psychol*. 2015;34:303–313.
62. Vallerand RJ, Gauvin LI, Halliwell WR. Effects of zero-sum competition on children's motivation and perceived competence. *J Soc Psychol*. 1986;126:465–472.
63. Markland D, Ingledew DK. Exercise participation motives: a self-determination theory perspective. In: Hagger MS, Chatzisarantis NL, eds. *Intrinsic Motivation and Self-determination in Exercise and Sport*. Champaign, IL: Human Kinetics; 2007:23–34.