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Author(s): Kettunen, Eeva; Kari, Tuomas

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Can Sport and Wellness Technology be My Personal Trainer? – Teenagers and Digital Coaching

EEVA KETTUNEN & TUOMAS KARI

Abstract The attention towards digital coaching solutions has increased among users of sport and wellness technologies, the related industry, the healthcare and wellness sector, and among scholars. However, as the commercial digital coaching solutions are rather novel, the number of studies about their influence or the usage experiences is still rather limited. Another topic that is lacking research is the relationship of teenagers and sport and wellness technology. Since using the internet and technological devices on a daily basis has become the norm for teenagers, it is worth paying attention to how technology could be developed in order to better motivate them towards a healthier lifestyle. The purpose of this study was to find out the perceptions of teenagers regarding sport and wellness technology and especially of digital coaching. According to the findings, teenagers perceive digital coaching positively. They prefer instructional guidance and advice especially related to physical activity and nutrition.

Keywords: • Digital coaching • Teenagers • Adolescence • Sport technology • Wellness technology • Digital wellness •

CORRESPONDENCE ADDRESS: Eeva Kettunen, M.Sc, Ph.D. student, University of Jyväskylä, Faculty of Information Technology, P.O. Box 35 40014 Jyväskylän yliopisto, Finland, e-mail: eeva.k.kettunen@jyu.fi. Tuomas Kari, D.Sc., Postdoctoral researcher, University of Jyväskylä, Faculty of Information Technology, P.O. Box 35 40014 Jyväskylän yliopisto, Finland, e-mail: tuomas.t.kari@jyu.fi.

1 Introduction

The physical activity levels of teenagers and children over 10 years of age is decreasing and sedentary behaviour is becoming more common (Brodersen et al., 2007; World Health Organization (WHO), 2018). According to WHO already over 80% of the world's adolescence population is not physically active enough. Therefore, engagement with physical activity and health related issues is important especially for this age range. During adolescence, health related habits such as physical activity, nutrition and sleep related behavioural patterns are being established. These learned patterns are usually maintained throughout a person's entire life (Kumar, Robinson and Till, 2015). Promoting healthy behaviours during the teenage years has therefore a great impact on the overall quality of people's lives right through to adulthood. Promoting physical activity and enabling exercise participation can foster personal improvement and competence. This will help teenagers to achieve personal control over their intentions regarding physical activity, which is important to encourage long-term healthy behaviours (Hagger, Chatzisarantis & Biddle, 2001).

Since many teenagers are constantly online and use various technological devices and applications daily, it is reasonable that technology could also be used in promoting health and physical activity. Unfortunately, there is a gap in the research about how teenagers use internet, mobile applications and wearable technology for health related purposes (Wartella et al., 2016). Technology can be a useful tool when promoting a healthier and more physically active lifestyle to teenagers. However, many sport and wellness technology products such as wearable fitness devices are mainly designed for adults. They tend to engage people who are already relatively active and interested in improving their lifestyle or their sport performance (Carrino et al., 2014). In order to use sport and wellness technology in health behaviour change campaigns directed to teenagers, it is important to understand what is relevant for this target group.

According to Wartella et al. (2016) one of the most often downloaded health applications among teenagers are fitness applications. Teenagers who were more active and had lower body mass index (BMI) tended to use these applications more often than less active teenagers. However, the study also highlighted that despite teenagers often downloading mobile health applications, they much more seldom actually use them. This indicates that these applications are not able to hold the attention after initial use and therefore further research is needed related to this target group's preferences and needs. Understanding the preferences of teenagers related to this area is important in creating products and applications that could sustain their engagement long term and thus positively affect their health.

Sport and wellness technology products designed for teenagers are still missing from the market. Some technology wearables have been created especially for the teenage population but these devices have been focused on connectivity or game related elements (Carrion et al., 2015). Providing a fashionable look for health, sport and wellness technology products could attract the teenage population. The importance of fashionable

and trendy appearances was highlighted in a study by Toscos et al. (2006) where they focused on the use of pedometers integrated with teenage girls' fashion garments and accessories.

According to the study of Carrion et al. (2015), for teenagers the most attractive features of wearable sport and wellness technology devices were calorie consumption, step counters and sleeping time. These features were related to physical activity and were therefore already familiar to the target group, and were also highly associated with individual achievement and goal setting. The teenagers also associated the need of wearable devices with a serious goal and a strong purpose for achieving it. Therefore, they felt these devices were mainly targeted to sports people, older people or people with health conditions. The most important issues affecting teenagers' choice about potential use of sport and wellness wearables is the combination of utility and appearance. These aspects include, for example, the overall appeal, good design, small size, comfort, customizability, entertainment value, a tactile screen and informative elements. The design seems to play an important role affecting overall first impressions. However, whereas with teenage boys the importance of design seems to be replaced with usability and wearability factors, design becomes even more dominant for teenage girls as they start using the device more (Carrion et al. 2015). When talking about sport and wellness related mobile applications it is important to notice that both girls and boys seem to have similar wants and needs regarding mobile technology (Rees & Noyes, 2007). Therefore, the preferences and expectations of sport and wellness applications may not vary significantly between genders.

Despite the lack of studies regarding teenagers and sport and wellness technology, there have been several studies that have focused on sport and wellness technology in general. These studies have found, for example, that the feedback these technologies provide can improve awareness of personal physical activity and motivate towards increasing it (e.g., Chan, Ryan & Tudor-Locke, 2004; Faghri et al., 2008; Kang et al., 2009; Kari et al., 2016b; Kari et al., 2017a; Wang et al., 2016). While the tracking of wellness related data with suitable technologies may lead to better awareness of everyday activities, it may however, not be sufficient to maintain the use of those technologies (Miyamoto et al., 2016), which can also influence maintaining wellness routines (Warraich, 2016). Therefore, providing use guidance and achievable goals for using these technologies would likely increase the adherence of using them. Subsequently, this helps users to create and maintain wellness related routines such as regular physical activity, good nutrition and adequate sleep and recovery.

A common problem with sports and wellness technologies is that they mostly provide feedback through numbers and graphs instead of providing actual guidance and instructions for the related wellness task. Previous research indicates that wellness technology users want relevant, clear, and easy-to-understand information from their devices and software concerning their activities. Further, they feel the need to receive feedback and instructions on how they should go about their physical activity and other wellness related actions. This would likely lead to the technology use being more goal-

oriented (e.g., Kari et al. 2016a; Kari et al. 2017b), which is generally beneficial (Locke & Latham, 2002; Shilts, Horowitz, & Townsend, 2004). Therefore, by providing the users with concrete and manageable steps, for example, in the form of a personalized exercise plans, the technologies could add to the possibility of making both their use and the behaviour of the users more goal-oriented and motivated. One prospective solution to cover this is digital coaching. The demand for digital coaching to address goal-driven and personalized support of fitness goal achievement has also been recognized by Schmidt et al. (2015).

Digital coaching refers to a service on a technological device that not only gives feedback but also offers advice, suggestions and future steps for a user to follow in the pursuit of their wellness and fitness goals. As described by Schmidt et al. (2015) a digital coach can identify the weaknesses and strengths of the user and generate a training plan based on the received user information. Whereas traditional sport and wellness technology products aim at improving the user's self-awareness based on their own fitness data, a digital coach takes it one step further by creating a personalized training plan for the user to follow. The acceptance of using a digital coach in an exercise setting as well as its motivational potential was also highlighted in the study of Kranz et al. (2013).

The attention towards digital coaching solutions has been increasing among various stakeholders. Nevertheless, as commercial digital coaching solutions are rather novel, the number of studies about their influence or the usage experiences is still quite limited. The purpose of this study is to address this research gap by finding out how teenagers think about digital coaching in a sport and wellness technology setting. The paper also addresses teenagers' perceptions about sport and wellness technology in general in order to serve as background information leading to discussion about digital coaching. As a qualitative study, the aim is to understand how digital coaching would be accepted within this target group, what kind of features teenagers' ideal digital coach would include, what kind of information the digital coach should offer and in what form the message should be delivered. By investigating these questions, we aim to assess whether digital coaching could be useful for this target group in order to motivate and help them in the pursuit of a healthier and more physically active lifestyle. Moreover, the purpose of this research is also to serve as a catalyst to further research regarding digital coaching.

2 Theoretical Background

The theoretical framework for this study comes from the social cognitive theory of Alfred Bandura (1986). This theory has often been used as a framework in studies regarding physical activity and motivation. According to social cognitive theory, the reactions, actions, and social behavior of an individual are influenced by actions they have seen by observing other people. The theory emphasizes the role of observational learning and social experience in personality development. In his theory, Bandura also introduced the concept of self-efficacy, which refers to the person's beliefs in their capabilities of performing a specific task. Whereas people with low levels of self-efficacy might avoid doing a task they perceive difficult, people with higher levels of self-efficacy are more

likely to see difficult tasks as challenges and therefore perform better (Bandura, 1986). Self-efficacy is also related to motivation. If a task is perceived too easy or too difficult compared to their perceived own skills, the level of motivation to continue can decrease. However, moderately challenging and difficult tasks can produce satisfaction through the experience of achievement (Bandura, 1998)

Another well-known theory that is often connected to exercise motivation is the Self-determination theory by Ryan & Deci (2000). According to the theory the three important components affecting motivation are the needs of competence, relatedness and autonomy. The need for competence refers to a person's need to effectively interact within the surrounding environment and being able to complete given tasks. The need for relatedness refers to a person's need to be connected with other people, while the need for autonomy refers to the need of being able to self-regulate the personal behavior. All these needs together or individually can facilitate intrinsic motivation, which is the motivation behind behaviors that are driven by internal rewards. In the context of physical activity, a high level of intrinsic motivation has been often connected with the formation of exercise habits in pursuit of a more physically active lifestyle.

The term proxy agency is also derived from Bandura's social cognitive theory. The theory of proxy agency is based on the idea that people play an important and active role in their self-development, self-renewal and adaption by using mechanisms called agencies. In this context an "agency" means acts which are done on purpose. According to Bandura there are three types of agencies: personal, collective and proxy. In the case of personal agency, the person itself acts as an agency. In the case of a collective agency an agent means a group or community. The third agency, proxy agency, refers to a situation where a third party acts as an agent on someone's behalf (Beauchamp & Eys, 2007, Bandura, 1982). When talking about physical activity, for example, a fitness group or a team can act as a collective agent whereas a proxy agent could be a personal trainer, coach or in the case of teenagers, a teacher or parent.

Bandura has outlined three reasons people use proxy agency. First, people might feel they do not have the knowledge or the needed skills to reach their desired outcome. Second, people might perceive that a third person will be more capable of facilitating the journey toward the desired outcome. Third, even though people would have all the needed knowledge and skills to pursue their goal, they may want to give control over to another person because they do not want have the responsibility of direct control (Bandura, 1997). In a physical activity and exercise setting the use of a proxy agent, such as a personal trainer, can help a person to manage task and environment demands as well as offer extra help in controlling and regulating exercise behavior. It can also help in developing new skills as well as give support in lifestyle management (Beauchamp & Eys, 2007). Having a proxy agent can also provide social support, which may increase positive outcomes and increasing the likelihood of focus, enjoyment and full involvement (Jowett & Lavalley, 2007). In physical activity settings the role of a proxy agent is often performed by a trainer or a coach who is able to affect their trainee's self-efficacy in different ways. These ways include for example vicarious experiences, which refers to experiences received through

observing other people. Another way a proxy agent can affect self-efficacy is verbal persuasion, which means providing comments, instructions and feedback.

In this study, the role of proxy agency theory is examined from a digital coach point of view. Therefore, the proxy agent in this study refers to a sport and wellness technology device or application combined with digital coaching features. As in the case of a human proxy agent, a sport and wellness technology device is also able to affect the feeling of competence by providing instructions, feedback and verbal persuasion as well as collecting and showing data regarding performance accomplishments. By providing a tool for social comparison and social sharing, a digital coach is also able to affect the feeling of relatedness. According to Shields and Brawley (2006), a long-term use of a proxy agent might lower the user's self-regulatory skills, which are important regarding the independent management of physical activity and sport participation. Using a digital coach as a proxy agent, compared to using a personal trainer or a coach as a proxy agent, requires the user to have a certain amount of self-regulatory skills and independence. Therefore, using a digital coach encourages the user to practice independence while still in the proxy context and that way affects also the feeling of autonomy.

3 Methodology

This study followed a qualitative approach. The study included 34 teenage participants of whom 18 were girls and 16 were boys. The age group was between 13 to 15 years old. The participants were recruited from two local junior high schools. The recruitment was made with the help of the schoolteachers as well as the local sports club. The invitation was sent to approximately 500 students. All the students who expressed their interest were selected to the study. Since participants were under-aged, all the participants were asked to bring a signed approval from their parents in order to approve their participation.

The data was collected in November and December 2017. The data collection was done in two phases. In the first phase, the participants filled a questionnaire regarding their current physical activity, motives for exercising and their experiences regarding the use of sport and wellness technologies. After this, all participants were given a free sport and wellness application, which they were asked to use for the next five weeks. The application was given to the participants in order to guarantee they would all have at least some experience with sport and wellness technology before the interviews and before the second round of questionnaires took place. With the help of this experience, the participants gained insights of the topic. With the help of this recent usage experience, the ideas and opinions regarding sport and wellness technology and digital coaching would be more clear in their minds. The application did not include digital coaching features. The second phase of data collection took place after the five-week use period. This time all the participants filled a questionnaire regarding their experiences with the sport and wellness application and their opinions about sport and wellness technology in general, followed by questions regarding digital coaching. All 34 participants filled the questionnaires and 18 of them also volunteered for an interview. The purpose of the interviews was to get more detailed answers and information regarding the topics covered

in the questionnaires. The interviews were recorded and notes were taken during the interviews. The interviews lasted on average 20 minutes. The data used in the study was based on the questionnaires as well as the interview notes.

The analysis method used in the study was thematic analysis. It is a method for “identifying, analyzing and reporting patterns (themes) within data” (Braun and Clarke, 2006, p. 79) and also describes the data set in rich detail. It is the most widely used analysis method in qualitative research (Guest, MacQueen and Namey, 2012). When performing the data analysis the guidelines by Braun and Clarke (2006) were followed, but as they suggested the guidelines were adjusted to fit the research purpose of this current study. The data analysis started with familiarizing oneself with the data and dividing the data into three themes: background information and exercise habits, experiences and preferences regarding sport and wellness technology, and finally, perceptions and preferences regarding digital coaching in a sport and exercise setting. After this, all themes were individually studied in order to find differences and similarities between the participants. Finally, the report was produced aiming to highlight all the aspects that the participants considered important regarding the themes.

4 Results

4.1 Background of the Participants

The participants’ physical activity background varied. Seven participants reported being physically active less than seven hours per week, 14 students reported to be active 7-10 hours per week and the remaining 13 students were physically active more than ten hours on a weekly basis. The reported physical activity time included active time in commuting to school, physical education classes as well as physical activity done in spare time. The physical activity recommendation for teenagers (ages 12-18) is 1-1,5 hours per day which equals 7-10 hours per week (Husu et al., 2011). Despite the fact that 79% of the participants reported being physically active enough to meet this recommendation, 56% of the participants felt they have to increase their physical activity levels.

The biggest reason that motivated the participants to be physically active was the good feeling that is associated with physical activity: “*exercising makes me feel good and it is fun*”. This intrinsic type of motivation was reported to be the main reason for exercising for 65% of the participants. The next most important motivation for exercising was gaining and maintaining better physical condition. Other sources of exercise motivation were related to appearance and weight loss, being able to spend time with friends and being able to challenge oneself. Only two participants reported to be physically active because they wanted to make sure they would stay healthy in their future life.

4.2 Sport and Wellness Technology

Before the study, most of the participants (88%) already had some previous experience with sport and wellness technology. However, in some cases the experience did not

include longer-term usage but was limited to a few times. Most of the participants had used either step counters or exercise and health applications that were usually already included on their mobile phones. Some participants had used wearable fitness trackers, sport watches or heart rate belts. The biggest reasons for using sport and wellness technology was reported to be the desire to see actual data regarding exercising. For some participants this meant tracking their step count, keeping an exercise diary or comparing their fitness to previous results. Some of the participants said the main reason to use sport and wellness technology is because it is entertaining and makes exercising fun.

Participants were also asked whether sport and wellness technology have had any influence on their exercise motivation. 38% of the participants stated no, whereas 53% of them stated the technology had increased their motivation to exercise. The most common features relating to increased motivation were goal setting, gamification and being able to see your results. Also, social pressure seemed to increase motivation for some participants. Despite the positive effects, participants felt that sport and wellness technology can also have a negative effect for exercising. The biggest negative effect was focusing too much on data and results instead of the actual performance. This might make exercising too competitive and performance oriented and also be an interruption during the actual exercise. Other negative effects were the need to carry the phone along or that having exercise data enables social comparison, which may lead feelings of inferiority. In general, the participants seemed to have relatively high trust for the information provided by sport and wellness technology. They also had high trust for themselves when it came to learning to use new exercise related technological devices and applications. Whereas the high trust for technology was almost equal between boys and girls, the level of self-efficacy regarding using new devices and applications was slightly higher among boys.

4.3 Digital Coaching

Participants had mixed perceptions when asked whether they could see themselves using a sport and wellness technology device or application as their personal trainer. 41% of the participants answered yes, whereas 35% of them answered no. The remaining 24% had mixed feelings. The main benefit for having a digital device or application as their personal trainer was the easiness and the low cost. This coach would be present all the time and therefore be better able to motivate and provide support. Some participants even thought that technology would be able to provide more information and more personalized information than an actual human being and therefore be more useful. The negative aspects of using sport and wellness technology as a personal trainer were related to the lack of human aspect. According to some participants, a device or an application is not able to give enough personalized information, which lowers the level of reliability. Some participants felt it would be easier to cheat the digital coach or just ignore it. Some of them also said that unlike humans, a digital coach is not able to analyse their exercise movements or correct them and cannot ensure that the training is being done in a safe way.

The participants were also asked to imagine a technological device or application that they could see themselves using as their personal trainer. The most occurring imagined product was a mobile phone application. This was seen as the easiest option since it is something that they always carry along. The second most popular option was a watch or an activity tracker, which were perceived easy to use and wear especially during exercise. The use of a heart rate monitor was often also connected to the application or watch usage. Some participants wanted wireless headphones to enable real time audio feedback whereas some participants imagined their personal trainer as a robot that could analyse and even assist them during their gym training. In order to be motivating, the participants in general perceived that the digital personal trainer needs to be supportive as well as easy and fun to use. It would have to give reminders when it is time to exercise but also not be too pushy. Gamification elements were also seen as motivational. Other issues seen as motivational for the participants were related to appearance. The device or applications needs to be colourful, trendy and small enough. However, as only 15% of the received answers were related to appearance, it can be seen as a less important factor than features related to usability and gamification. Some participants also highlighted some technical issues such as accuracy, reliability and low battery consumption, which are also important regarding the level of trust and usability.

Participants were also asked to describe what kinds of features their ideal digital coach would have. The most common feature the participants reported was the personalized guidance and suggestions related to exercising. The participants wanted support regarding how much they should exercise and what would be the best forms of exercising to a person at their age. Most also wanted a personalized training program that would also provide them different options of what to do and how to do it. They also wanted real time feedback on whether they are doing the exercise correctly and if they are at the right pace or intensity: *“If I run too fast the device should tell me to slow down”*. Receiving a personalized exercise plan and suggestions about different exercise possibilities and instruction on how to do them was perceived as a very important part of exercise guidance.

Other important but slightly less reported features regarding exercising was the ability to set goals and track performance. Some of the participants also wanted the digital coach to remind them when it is time to exercise. After exercise guidance the next biggest feature participants wanted was related to eating and nutrition. Half of the participants wanted to receive information about the right type and amount of foods to eat, including calorie consumption: *“I want to know what is the right type of diet for a person my age”*. Another important feature regarding nutrition was that some of the participants wished the digital coach would remind them when it is time to eat or drink water. Few participants also wanted to receive more information about nutritional values of different foods and what factors they should pay attention to considering their growth period. Other less often mentioned features were related to gamification, sleep tracking, recovery, music or blood pressure. A few of the participants wished their digital coach would be able to remind them also about other issues not directly related to eating or exercising: *“If I go outside in the evening, it would be nice to get a reminder when it is so dark that I should wear a*

reflector”. Participants were also asked whether they would want the digital coach to give them information regarding mental health. 39% of them said yes, however, they were not able to describe in more detail what kind of issues this information should cover.

The participants were also asked about how they would like to communicate with their digital coach and especially how they would like to receive feedback and instructions. The most desired way of receiving feedback and instructions was text. Other popular options were numbers, emojis and actual voice feedback, all three of which were perceived as equally attractive. Other, less often mentioned feedback methods were pictures and videos. Participants were also asked what kind of messages they would want to receive as feedback. The participants were given three example messages, out of which one was supportive: *“Good job, that’s the way to go!”*, one was informational: *“You ran 5,4km in 42 minutes. This was 2 minutes faster than the last time!”* and one was instructional: *“Today you were training in a high heart rate zone. In order to recover from this training, tomorrow do a lighter exercise or have a rest day!”*. The most preferred feedback was instructional which was chosen by 44% of the participants. The second most preferred feedback was informational (35%), while the supportive feedback (21%) was the least preferred.

5 Conclusion

The purpose of this study was to explore teenagers’ experiences and preferences regarding sport and wellness technology as well as find out their perceptions regarding digital coaching.

The results of this study indicate that sport and wellness technology as well as digital coaching is generally perceived as interesting by teenagers and has potential to positively affect teenagers’ health behavior. This finding goes together with the findings of Wartella et al. (2016) who stated that providing teenagers with digital tools to further and better understand their health, can allow greater autonomy for their health and encourage them to pursue a healthy lifestyle.

According to the findings, the level of trust and level of self-efficacy for using sport and wellness technology is relatively high within most teenagers. The biggest reason for using sport and wellness technology was the desire to see their own exercise data. As highlighted by Hagger et al. (2001), exercise data can help teenagers to get personal control over their exercising. When looking at this from a theoretical point of view, providing teenagers an interesting and easy to use tool for monitoring their exercise performance can increase the level of autonomy over their own physical activity. And, by providing an opportunity for monitoring their results and development, a digital coach can increase perceived competence. As highlighted earlier, these two elements, together with the feeling of relatedness are key factors in developing long-term motivation for physical activity.

The teenagers in general seemed to have an open and positive attitude towards digital coaching and saw it as motivating, which also follows the results of Kranz et al. (2013). The most important reasons for having a digital coach were related to giving advice and instructions related to exercise as well as nutrition. In terms of the proxy agency theory, the teenagers reported they wanted to have a digital coach because they desired guidance and were interested in receiving more information on following a healthy lifestyle. They are aware and willing to admit they do not know everything. Therefore, the biggest motivational reason for using a digital coach is to increase their level of knowledge and skills. This is also supported by the finding that the most preferred way of feedback was instructional feedback. Many participants also saw that a digital coach could work as a reminder tool, such as informing them when to exercise. From this perspective the one motivation for using a digital coach was also to shift the responsibility from self to an external actor. Teenagers are also used to having guidance in many aspects of their lives and therefore it might feel natural for them to have extra guidance in their physical activity.

The biggest reasons why teenagers would prefer a sport and wellness technology device as their personal trainer over an actual person was related to lower costs and convenience. A digital coach is available to give advice whenever and wherever needed. However, the lack of human aspect was also seen as the biggest negative reason for having a digital coach, particularly because it would not be able to analyze exercise technique. According to these findings, the reasons and perceptions for using a digital coach vary between people. What attracts one person was not necessarily important to others. In previous research regarding teenagers and sport and wellness technology the importance of design and outlook was highlighted. However, this study found teenagers perceived the informational and usability factors as far more important. Also, the importance of social factors as a part of digital coaching was not considered particularly important by the teenagers.

The findings of this study suggest that sport and wellness technology and especially digital coaching features can be a motivating tool for physical activity and health. Digital coaching is able to bring elements to sport and wellness technology that are viewed as essential and attracts this target group. Therefore, those working on teenager health promotion interventions should consider utilizing digital coaching, as it can be an important tool. They can make interventions even more personalized and engage teenagers for physical activity for longer term by increasing their level of motivation. If teenagers are introduced to sport and wellness technology and encouraged to pursue a healthy lifestyle, it is more likely they will continue being physically active as adults and be more interested in integrating technology to their exercising. Therefore, in order to get more loyal customers, sport and wellness technology companies should focus on creating products that interest teenagers and market them in a way that catches their attention.

6 Limitations and Future Research

There are some limitations to the study. First, since the data is based on self-assessment questionnaires, the level of reporting in the questionnaires varied between participants. Second, regarding wellness and exercise behaviour related studies, there has been known to be challenges in research participants intentionally reporting their behaviour more positively compared to reality and thus biasing the responses. This is due to social desirability as well as deliberate misrepresentations (Sirard and Pate, 2001). However, in this study even though participants were asked to use sport and wellness technology applications for a five-week period, they were reminded that it does not matter how much they have used the application or how they used it. Instead, the application served only as a way for them to get familiar with the topic in order to being able to better express their perceptions about sport and wellness technology as well as digital coaching. This study is among the first ones to study the topic of teenagers and digital coaching, and more research in this field should be done. Future studies could focus on the effect digital coaching related sport and wellness technology would have on teenagers' physical activity levels or on their motivation regarding physical activity. Overall, the topic of teenagers and sport and wellness technology as well as digital coaching continues to be an important topic of research.

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