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Critical experiences with sport and wellness technology digital coach – differences between young adults and young elderly

Eeva Kettunen [a], Tuomas Kari [b], Will Critchley[c] and Lauri Frank [a]

[a]Faculty of Information Technology, University of Jyväskylä, Jyväskylä, Finland; [b]Natural Resources Institute Finland (Luke) Helsinki, Finland; [c]University of Jyväskylä, Jyväskylä, Finland

ABSTRACT

Both young adults and young elderly people have been found to be at a high risk of disengagement with physical activity. This makes both groups important targets for health and exercise promotion. Since sport and wellness technology has become popular among regular exercisers, it is worth studying how personal wellness devices could help both target groups in becoming more physically active. This study explores critical experiences during the implementation phase of a sport and wellness technology digital coach among young adults and young elderly. This qualitative study is based on a thematic analysis of 60 participants' interviews conducted with the critical incident technique. The study reveals the experiences the users consider crucial during the initial phases of usage of sport and wellness technology digital coaching devices. The results show that positive critical incidents among young adults and young elderly are similar when learning about personal health and exercising. However, the role of supportive communication seems to be more important with the young elderly people. Functionality and usability issues play a big role in negative critical incidents. The findings highlight the importance of these critical experiences to the overall usage experience and their influence on users' motivation to improve their fitness.

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Digital coaching; sport and wellness technology; CIT; critical experiences; young adults; young elderly

1. Introduction

Young adults have been found to have a high risk of disengagement with physical activity (Cocca et al. 2014). The same goes for young elderly age group of 60–75-year-olds (Hughes, McDowell, and Brody 2008). Moreover, physical inactivity is a significant global problem due to its detrimental effects on health and wellness, while physical activity has significant health benefits and contributes to the prevention of non-communicable diseases in all age groups (WHO 2018). Thus, different kinds of means and plans to support physical activity and to prevent disengagement from physical activity have been introduced along with theories to explain these behaviours (e.g. Affective–Reflective Theory (ART) (Brand and Ekkekakis 2018)). Potential means include different physical activity promotion programmes or interventions that are complemented with sport and wellness technologies that can support physical activity e.g. (Gal et al. 2018; Kari, Makkonen, and Carlsson 2022). Prior studies have shown that sport and wellness technologies can promote physical activity also in individual use outside interventions and programmes e.g. (Romeo et al. 2019). One of the key features of these technologies is feedback to the users about their physical activities. Research has shown that feedback sources have higher efficacy and relevance during the early stages of a skill acquisition process and that their importance decreases as skill level increases (Winstein and Schmidt 1990). Therefore, the use of sport and wellness technologies is relevant, in addition to athletes, also among recreational exercisers whose skills and knowledge regarding physical activity and exercise are low and who are in the initial stages of skill acquisition (Liebermann et al. 2002). This and the lowering prices of such technologies have resulted in them becoming increasingly attractive to regular people interested in physical activity and exercise. Indeed, during recent years, there has been a remarkable increase in the popularity and use of such technologies in both personal use (e.g. Anzaldo 2015) and physical activity promotion programmes (Kari et al. 2020a; Stockwell et al. 2019), as well as in academic research (e.g. Brickwood et al. 2019; Lynch et al. 2020; Page et al. 2020). Sport and wellness technologies have the

CONTACT Eeva Kettunen eeva.k.kettunen@jyu.fi Faculty of Information Technology, University of Jyväskylä, 40100, Jyväskylä, Finland

possibility to improve the quality of physical activity training by giving related personalised feedback. This feedback can also promote the motivation towards physical activity by increasing the awareness level of personal physical activity (e.g. Chan, Ryan, and Tudor-Locke 2004; Cocca et al. 2014; Faghri et al. 2008; Kang et al. 2009; Kari et al. 2017a; Wang et al. 2016). However, the caveat is that such feedback may also lead to inappropriate adjustments to training, especially if the feedback is misinterpreted (Düking et al. 2016). Moreover, receiving unnecessary feedback, too much feedback, or inadequate feedback could cause the user anxiety and stress (Halson, Peake, and Sullivan 2016), while a mere 'number crunching' could lead to exercise feeling like work (Hassenzahl, Laschke, and Praest 2016). Hence, the feedback should be informative and match the user's level of understanding for its appropriate implementation into actions. This could be bolstered by complementing the feedback with personalised achievable goals and sufficient guidance. Further, receiving appropriate feedback and guidance on how to enhance or maintain physical activity and exercise can make the users more goal-oriented (e.g. Kari et al. 2016a; Kari et al. 2017b), which, in turn, can lead to increased motivation (Locke and Latham 2002; Shilts, Horowitz, and Townsend 2004).

In practice, this is often challenging as a typical problem with sport and wellness technology solutions is that they mainly focus on providing data and feedback from past performances, while neglecting to provide personalised feedback and instructions on what should be done next. One solution for this problem is digital coaching, which 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' (Kettunen and Kari 2018, 3). While typical sport and wellness technology devices and applications only provide feedback on past performances, a digital coach takes a look forward by providing personalised instructions, guidance, or training for the user (Kari and Rinne 2018). A digital coach can potentially identify the strengths and weaknesses of the user as well as his/her actions, and based on the recorded data, create a personalised training plan that can further be adapted based on the user's actions (Schmidt et al. 2015).

General interest towards digital coaching solutions related to physical activity is increasing, and their potential has been recognised also in academic research (e.g. Kari and Rinne 2018; Kettunen, Critchley, and Kari 2019; Kettunen and Kari 2018; Kettunen et al. 2018; Kranz et al. 2013). However, since commercial solutions are still relatively novel and rather few in number, the extant research, while growing, is limited. For example, studies focusing on the usage experiences with sport and wellness technology digital coaches are few. Few previous studies have addressed the influence of digital coaching related to psychological factors of behaviour change. It seems that users are more engaged with sport and wellness technology devices in general when the activities are related to promoting psychological needs of autonomy, competence and relatedness (Chang et al. 2016; Molina and Sundar 2020). More research is needed that focuses on how digital coaching can promote intrinsic motivation (Helmefalk, Marcusson, and Sell 2020) but also on how to design digital coaching functionalities to increase exercise motivation and better promote behaviour change (Sell et al. 2019). Thus, there is a clear need for more research on the efficacy of digital coaches and the usage experiences the users have with digital coaching solutions. The main purpose of this study is to address this increasing need by investigating the usage experiences of sport and wellness technology digital coach users. More specifically, as these solutions are rather novel, the focus is on novice users and the critical incidents they experience during the implementation phase. We also investigate how these incidents differ between novice young elderly and young adult users. The aim is also to uncover how these critical incidents influence the overall usage experience and physical activity motivation. This paper contributes to information systems (IS) and digital coaching research by answering to the following research questions:

(1) What are the central critical incidents that novice sport and wellness technology digital coach users experience during the implementation phase?
(2) How do critical incidents differ between novice young elderly and young adult users?
(3) How do the critical incidents affect the overall usage experience and physical activity motivation?

As mentioned, the focus of this study is on the critical incidents the users experience during the implementation phase. A critical incident is an experience that a person 'perceives or remembers as unusually positive or negative' (Edvardsson and Roos 2001, 253). A focus on critical incidents is warranted for several reasons (Salo and Frank 2017): critical incidents are generally highly powerful in terms of human behaviour (Flanagan 1954), they can influence user's perceptions of products and services, and greatly affect use continuance (Edvardsson and Strandvik 2000; Flanagan 1954). Hence, investigating critical incidents is important. The implementation phase, as described by Rogers

(2003), refers to the phase where the user implements an innovation (such as a technology) into use and determines its usefulness. Hence, the implementation phase is a crucial stage in the technology adoption process.

This exploratory study follows a qualitative approach. More precisely, it is based on a thematic analysis of interview data collected from 60 novice users of sport and wellness technology digital coach by using the critical incident technique (CIT) (Flanagan 1954). All the participants were provided with a sport and wellness technology device including a digital coach feature.

The main contribution of this study is the increased understanding on the usage experiences with sport and wellness technology digital coaches. From a practical standpoint, the findings provide the industry with insights that can be utilised in designing and developing better sport and wellness technology digital coaches and subsequently in delivering the users with meaningful positive experiences with such solutions.

2. Background

2.1. Critical incidents

Critical incident is an experience that a person 'perceives or remembers as unusually positive or negative' (Edvardsson and Roos 2001, 253). Critical incidents are particularly influential for human behaviour (Flanagan 1954). As an example, a single critical negative incident may overrule a set of average positive incidents and lead to undesirable behaviours, such as use discontinuance with the used product or service (Cenfetelli 2004), switching or word-of-mouth (Salo and Frank 2017). Prior research has demonstrated that critical incidents have a significant role in forming user perceptions towards products and services as well as their providers, and subsequently, in forming customer relationships (Edvardsson and Strandvik 2000; Payne, Storbacka, and Frow 2008). Studying critical incidents can provide important implications for both research and practice. Previous research has examined critical incidents in several IS-related contexts, for example, self-service technologies (Meuter et al. 2000), online shopping (Holloway and Beatty 2008), mobile services (e.g. Gummerus and Pihlström 2011; Salo et al. 2013) and mobile applications (Salo and Frank 2017), augmented reality (Kari 2016b), and exergames (Kari et al. 2020b). However, to our best knowledge, only one study has focused on sport and wellness technology digital coaches (Anonymized). The present study uncovers central critical incidents occurring with sport and wellness technology digital coaches, thus providing important implications on the use of both sport and wellness technologies and digital coaches.

2.2. Implementation phase

Implementation phase is a stage of the innovation-decision process presented in the innovation diffusion theory (Rogers 1962; Rogers 2003). Implementation in itself has been a widely included variable in different theories and models concerning information technology (e.g. Ely 1990; Ely 1999; Ensminger et al. 2004). The innovation-decision process represents the decision-making process concerning the adoption of an innovation, and is defined as 'the process through which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision' (Rogers 2003, 475).

The process includes five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. It begins with the knowledge stage, where the individual becomes aware of the innovation. Next is the persuasion stage, where the individual seeks information regarding the innovation and also forms an attitude towards the innovation. In the following decision phase, the individual makes the initial adoption/rejection decision, that is, whether s/he starts using it or not. This decision is influenced by the perceived characteristics of the innovation and the attitude towards the innovation. What follows (an initial decision to adopt) is the implementation phase, where the individual implements the innovation into use (i.e. starts using it) and determines its usefulness. Following the initial decision to adopt and the implementation phase, is the confirmation stage, where the individual makes the final confirmation on whether to continue or discontinue using the innovation. In general, if the individual's positive perceptions of using the innovation are strengthened, for example through positive experiences, the use is likely to continue. Whereas if the individual faces conflicts with the initial decision to adopt, for example through negative experiences, it can switch into rejection. The less conflicts there are, the more likely the individual continues the use. In some cases, if the perceptions influencing the initial decision are positively strengthened, the initial decision to reject can be overruled and a later adoption occurs.

Overall, the innovation-decision process comprises different choices and functions, which can extend to a longer period of time. In addition to the five stages, Rogers (Rogers 2003) describes prior conditions that

affect the process. These are related to the individual user and include: previous practice, felt needs, innovativeness, and norms of the social system. Rogers (Rogers 2003, 15–16) also defines five perceived characteristics of an innovation that influence the individual's evaluation of it: (a) Relative advantage – 'the degree to which an innovation is perceived as better than the idea it supersedes', (b) Compatibility – the 'degree to which an innovation is perceived as being consistent with the existing values, past experiences, and need of potential adopters', (c) Complexity – the 'degree to which an innovation is perceived as difficult to understand and use', (d) Trialability – the 'degree to which an innovation may be experimented with on a limited basis', and (e) Observability – the 'degree to which the results of an innovation are visible to others'. Innovations that the individual perceives to have a greater relative advantage, greater compatibility, greater trialability, greater observability, and lesser complexity will more likely be adopted.

For further reading on implementation, we refer the reader to Ensminger et al. (Ensminger et al. 2004), in which they examined previous literature on variables related to the implementation and factors contributing to its success regarding technology innovations in general. In the context of sport and wellness technology, several studies (e.g. Kononova et al. 2019; Lazar et al. 2015) have suggested that disengagement with such solutions is typical during the first months of use, that is, during the implementation phase. Kari et al. (Kari et al. 2016b) investigated critical incidents during the implementation phase of a physical activity-related self-tracking technology and found that critical incidents can influence the final adoption decision. They also found that positive experiences on the technology's usefulness in self-improvement during the implementation phase are particularly meaningful for the user. Considering the aforementioned, it is apparent that critical incidents during the implementation phase can have a significant influence on the future use also with sport and wellness technology digital coaches, and eventually their success both in terms of providing the user with a tool for self-improvement and commercial. Hence, different aspects and challenges connected to the implementation phase are important matter to study.

2.3. Research on sport and wellness technology digital coaches

As the general interest towards digital coaching solutions related to physical activity has increased during the previous years, the same has happened to academic interest, and the research on the use of digital coaching – also referred to as eCoaching (e.g. Adams and Niezen 2016) or virtual coaching (e.g. Blok, Dijkhuis, and Dol 2017) – to support physical activity has been on the rise.

Regarding digital coaching in the physical activity context, Kettunen and Kari (Kettunen and Kari 2018) found that among teenagers, digital coaching is generally perceived as interesting as it was able to provide desired guidance and information on following a healthy lifestyle. Using a digital coach solution also seemed to positively affect physical activity behaviour (Kettunen and Kari 2018). Kari and Rinne (2018) found a digital coach application to be beneficial for physical activity motivation and behaviour among physically inactive young adults. Further, the benefits also spurred other aspects of physical wellness as the users started to pay more attention to daily life between the instructed training sessions (Kari and Rinne 2018). Broekhuizen et al. (2016) found digital coaching potential to increase physical activity among inactive older adults. These studies provide evidence about the potential of digital coaches to promote physical activity among different age groups, however, certain design considerations need to be acknowledged for the digital coaching solutions to be successful. In a scoping review, Lentferink et al. (2017), identified key components of self-tracking and persuasive digital coaching (eCoaching). They found that the following key components and their specific design had the potential to positively affect both technology usage and health-related behaviour: reduction (by setting short-term goals to eventually reach long-term goals), personalisation of goals, praise messages, reminders to input data, use of validity-tested devices, and integration of self-tracking and persuasive digital coaching. Petsani et al. (2019) conducted a study with an emphasis on identifying design considerations for increased physical activity adherence among older adults. They note that digital coaching solutions can add value, among others, by incorporating high-quality prompts, motivators, and feedback, and by simplifying and personalising the end user experience. However, they also note that the design challenges go beyond the mere information technology domain, as developing a successful persuasive digital coaching solution requires co-creation and co-design with end users, and the implementation of persuasive strategies and behaviour change techniques which, in addition, are appropriate among the target population (Petsani et al. 2019). Mezei, Sell, and Walden (2020) further highlight the significance of exercise programmes and goal-setting functionalities.

While these studies provide important insights into sport and wellness technology digital coaches and

their use, it seems only one (Anonymized) has investigated critical incidents in this context. Overall, research on critical incidents with sport and wellness technology digital coaches during the implementation phase is warranted.

3. Methodology

A qualitative research approach was chosen for the study because answering our research questions required detailed data about users' real-life experiences with sport and wellness technology digital coaches. Therefore, we conducted our study using the CIT (Flanagan 1954). This approach was considered appropriate due to its usefulness in providing highly contextualised accounts of individuals' actual, influential incidents with IS (Gremler 2004; Meuter et al. 2000). To ensure all the participants were familiar and had use experiences with relevant digital coaches, we provided all the participants with a sport watch including a digital coach feature.

3.1. The digital coach used in the study

The device with a digital coach feature that was provided to the participants was the Suunto 3 Fitness sport watch (Suunto 2018). The key features include heart rate measurement (either wrist-based or via chest strap), fitness level estimation, stress and recovery measurements, 24/7 activity tracking with sleep monitoring, step and calorie counting, and a digital coach, all of which, in addition to other features, can be synced with Suunto's mobile app. The device does not have an integrated GPS but can receive GPS data from a paired smartphone through the mobile app. The digital coach feature is an adaptive training coach that provides training plans and real-time training guidance directly on the watch interface.

The creation of a personalised training plan is based on a user first receiving an estimation of his/her fitness level. To estimate the fitness level, the device can use previous exercises or alternatively, the user can conduct a particular guided training session using the device's heart rate monitor and the GPS tracking from a paired smartphone. Secondly, after receiving the fitness level estimate, the user may select a fitness goal from three options: (a) maintain, (b) improve, or (c) boost. Both improve and boost aim to enhance the fitness level, but boost aims to do it quicker than the improved programme. The made choice affects the training load the watch will recommend. Thirdly, based on the user's fitness level, the selected goal, and training history, the device's digital coach will create a 7-day training programme plan. The programme will recommend to either take a rest day or conduct a training session, for which it provides a training load target in a measure of time (in minutes) along with a recommended intensity (easy, moderate, or hard). The watch will display the recommended schedule for the upcoming 7 days, both as a list showing the training sessions and in graphics. As an example, it may show: 'Monday – Easy – 1:00, Wednesday – Hard – 0:40, Saturday – Moderate – 0:45'. The data resulting from the conducted training sessions is continuously used to update the fitness level of the user and to adapt future training sessions, making them easier or harder based on the changing fitness level and conducted activities. For example, if the user conducts a different kind of a training session than the one recommended, the watch will adapt the training plan to maintain appropriate training loads.

The watch also provides real-time guidance when performing the recommended training session. The real-time guidance is based on staying in the recommended heart rate zone. The watch has visual indicators showing if the user is training in the appropriate zone. A progress bar also shows the progress through the training session. If the user's heart rate leaves the recommended zone (i.e. gets too high or too low), the watch will provide notifications in the form of sounds, watch vibration, and messages on the screen instructing the user to increase or decrease the intensity. The user will also be notified when s/he has successfully completed the training session. It is to be noted that the participants were not provided with a chest strap for heart rate measurement, and thus, they used the device's wrist-based heart rate measurement.

At the time the study was conducted, digital coaches were still relatively new. However, similar digital coaches to Suunto 3 Fitness did exist already at the time. Digital coaches that had a similar personalised adaptive training plan were for example: Fjuul – Fjuul Premium phone application, Huami Amazfit Stratos, Huawei Watch 2, Huawei Fit, Jabra Elite Sport (headphones), Jabra Sport Pulse Special Edition (headphones), Montblanc Summit 2, PulseOn and the Samsung Gear S (Firstbeat, Firstbeat consumer products 2023). Since then the variety of digital coaches has become larger.

3.2. Participant recruitment and data collection

The study included a total of 60 participants who were using the sport and wellness technology digital coach for 10–12 weeks. The study was conducted in Finland in two parts. The first part and data collection were conducted during the autumn and winter of 2018–2019. In this first part, the target group was young adults (20–40-year-olds) whose level of physical activity was low or

sedentary but who were looking to increase their level of physical activity. The participants were recruited among the students in the authors' University by placing an invitation in a student online magazine. The invitation was aimed at those who categorised themselves as 'being either sedentary or currently non-regularly active exercisers and feeling the need to increase their level of physical activity'. After presenting interest to sign up for the study, the potential participants were asked to further explain their current physical activity and exercise habits to make sure they fit to the target group based on their current physical activity level. Physical activity level was selected as a selection criterion since the digital coach used in the study was considered less suitable for athletes and active people but more suitable for people with less exercise experience. In total, 49 people expressed their interest in taking part. Those who met the criteria of low or sedentary physical activity level were taken into the study in a first come, first served basis until 30 participants were recruited. The physical activity criterion was that selected participants did not meet the physical activity recommendations from the UKK Institute which is a centre for health promotion research in Finland. The weekly recommendations of the UKK Institute are a minimum 2h30 min moderate exercise or 1h15min vigorous exercise per week (UKK Institute 2020). Limiting the number of participants to 30 was due to the number of available digital coach devices. The devices were provided to the participants by the authors for the usage period of the study (10–12 weeks). Participants were asked to use the device in the way that best suited them in order to make the user experience as convenient and realistic as possible. All participants provided written informed consent.

The second part and data collection were conducted during the Summer of 2019. The target group in this second part was young elderly (60–75-year-olds). The participants were recruited from the Finnish University of the 3rd Age (UTA), which offers weekly scientific sessions and a meeting spot for elderly people. The participants were mostly recruited via a short presentation session that was held during a weekly UTA lecture. This resulted in the recruitment of 24 participants. We continued the recruitment by using the snowball method. In total, 62 people presented their interest in taking part, out of which 30 participants were randomly selected. Physical activity background was not a selection criterion when recruiting or randomly selecting young elderly participants. Unlike in the young adult participants selection process, participants' physical activity level was not used as a selectin criterion since the digital coach was perceived to be suitable for all young elderly participants despite their physical activity level. Similar to the first part, the number of participants was limited to 30 due to the number of available digital coach devices. Again, the devices were provided to the participants by the authors for the usage period of the study (10–12 weeks), and the participants were asked to use the device in the way that best suited them in order to make the user experience as convenient and realistic as possible.

For the data collection, we used qualitative interviews. More precisely, we chose a semi-structured interview, as we wanted to collect critical experiences related to the actual use of the digital coach. A semi-structured interview is the most used type of interview in qualitative IS research. A semi-structured interview typically includes an incomplete script, but a pre-formed structure that the interviewer follows is prepared (Myers and Newman 2007). This was the case also in the present study. The interview script comprised of several sections, one of which concerned the critical incidents. Some of the other sections gathered data for the purpose of another study. The sections used for this study included the background of the participants and the critical incidents. To collect the critical incident descriptions, the CIT (Flanagan 1954) was used.

After having completed the 10–12 weeks usage period, all the participants were interviewed as soon as possible, within the following weeks. 50 participants were interviewed separately in an individual interview. 10 participants were interviewed as pairs of two people because they came from the same households and therefore there was added value in interviewing these participants together. The interviews lasted between 36 and 81 min, with the average interview length being about 60 min. The interviews were recorded.

3.3. Critical incident technique

CIT (Flanagan 1954) has been widely used as a research method in different research disciplines (Butterfield et al. 2005). It is a well-established research method that enables the researcher to 'collect, content analyze, and classify observations of human behaviour' (Gremler 2004, 66). CIT is not a single rigid set of rules leading to data collection, but rather 'a flexible set of principles which must be modified and adapted to meet the specific situation at hand' (Flanagan 1954, 336). CIT has been proven to be a sound research method and is well suited for providing highly contextualised accounts of individuals' actual experiences and gaining insights on a previously undiscovered phenomenon (Gremler 2004; Meuter et al. 2000). Hence, CIT fits the purpose of the present study well.

In planning the interviews, we followed prominent and widely cited CIT papers (Bitner, Booms, and

Tetreault 1990; Meuter et al. 2000). Following the CIT, the participants were asked to describe one single critical incident that occurred with the digital coach during the usage period in as much detail as possible. The participants were first asked to 'think of a time when you had an outstandingly positive or negative experience [when using the device]', and then asked: 'Was this a positive or a negative experience?' We then used the following open-ended questions to let the participants describe the incident in their own words (translated from Finnish to English): (1) Describe in as much detail as possible: what were you doing and what happened?, (2) What exactly caused the positivity/negativity of the experience?, (3) Why do you feel that this was a significant experience for you?, and (4) As an outcome of the experience, how did you feel?.

3.4. Analysis

To analyse the collected data, we used thematic analysis, which is the most widely used analysis method in qualitative research (Guest, MacQueen, and Namey 2012). Thematic analysis is typically used for 'identifying, analyzing and reporting patterns within data' (Braun and Clarke 2006, 79). It can be used to describe and organise the data in rich detail and to interpret various aspects and exceptions related to the research topic. During the analysis, we followed the guidelines by Braun and Clarke (Braun and Clarke 2006). As suggested, these guidelines were applied in a flexible manner to fit the research question and data. The analysis process was not a linear phase-to-phase process but a recursive one, which allowed us to move back and forth between the different analysis phases and to reach a deeper understanding and more detailed view of the data. The analysis started by transcribing the relevant parts of the interviews and getting familiar with the data. The analysis continued by categorising all the reported critical incidents into positive and negative categories. After that, the focus was on identifying recurring themes and similarities in participants' critical experiences. This was done separately between positive and negative incidents. As themes and tendencies were identified, they were reflected upon previously identified themes. After careful examination, the report highlighting the central themes and their features was produced.

4. Findings

4.1. Background information of the participants

This study included a total of 60 voluntary participants comprising of two groups of 30 people. The first group were young adults who considered themselves being either sedentary or having low physical activity levels. The second group were young elderly people. Overall, the participants were aged between 20 and 76. The average age among the young adults group was 31 and 68 years in the young elderly group. In both groups, 20 of the participants were female and 10 were male, resulting in a total of 40 female and 20 male participants. The participants in the young adults group were either doing their undergraduate, graduate, or doctoral degree and those in the young elderly group were either retired citizens or still working. A more detailed description of the participants can be found in the Appendices.

None of the participants had previous experiences related to digital coaching in the context of physical activity, meaning they were novice users. However, 80% of the young adults and 67% of the young elderly participants had at least some previous usage experience related to sport and wellness technology. However, for most of them, this usage experience was mostly limited to a short time use or trying some technology. The most used types of sport and wellness technologies were activity trackers and applications as well as heart rate monitors. The biggest motivators for the participants to conduct physical activity and exercise were maintaining or improving their health and the positive feeling induced by exercising. For almost all participants, physical activity and exercising were not goal-oriented in a way that they would have aimed to improve their shape for any particular purpose. Rather, especially for the young elderly, the goal-orientation was mostly connected to maintaining the current physical condition and ability to function. Most of the participants believed they had a decent knowledge related to overall health and training. However, most of them also said that their related knowledge could also be better.

Out of the 60 critical incident descriptions, 28 were positive and 32 were negative. Among the young adults group, the division was 13 positive and 17 negative incidents, whereas among the young elderly group, the number of positive and negative incidents were equal. In addition to the open-ended questions concerning the incident, all the incidents were asked to be rated on their criticality in a scale of 1–5 where 1 represented no particular feelings and 5 represented very strong positive or negative feelings. Both the positive and negative critical incidents got an average of 3.8 in both groups, suggesting these indeed were meaningful experiences based on their criticality. The positive and negative critical incidents of both the young adults and the young elderly are presented in the following two sub-sections.

4.2. Critical incidents experienced by the young adults

4.2.1. Positive critical experiences

Most of the positive critical incidents occurred in the early usage stages of the device, where the participants' perception of their own fitness level was a central theme. These included the initial discovery of the measurement of their current physical activity and aerobic fitness level, or further, that their fitness score was measured higher than the participant expected, However, in one case, the participant claimed her/his perceived aerobic fitness level to be higher than reported by the digital coach. All the participants considered the increased awareness on their personal fitness as a positive factor.

The second most common positive incidents were related to a feeling of overcoming one's expectations. These had occurred in a situation where the participants had to do a training session they were not comfortable with, but they still did the training session as instructed by the digital coach. For example, two reported incidents concerned a training session having occurred at an unusual time for the participants. After the training, the participants reported of feeling proud of themselves. Another two reported incidents concerned participants coming out of their comfort zone to do something new and different. For example, one reported incident concerned a regular running session having changed to a more intense interval session, due to the feedback of the digital coach. In another case, the participant decided to try running for the first time, as running was suggested to him/her by the digital coach. In these cases, the participants were unsure if they could perform the training session as instructed by the digital coach. They experienced a positive incident when they noted that they achieved the workout or even continued the training for longer than instructed. All of these positive critical incidents described the feedback by the digital coach being closely associated with the encountered positive experiences.

The data provided by the device also created various positive critical incidents. For example, one participant found it interesting when they followed their heart rate while giving a public speech. Another participant experienced pleasure from discovering the actual length of her normal walking route and the speed at which she could walk it. One participant's experience was linked to tracking their commute as a physical activity as well as tracking their daily routines, like walking to the school or to the movies.

Only one positive critical incident concerned the functionality of the digital coach watch. One participant reported having negative opinions about the digital coach concept prior to use. These were changed by the first update of the participant's personalised training plan by the digital coach. As a result, the participant received confidence in the digital coach and its ability to give personalised exercise instructions, and finally caused the participant to perceive the digital coach as being useful.

In general, the majority of the reported positive critical incidents were linked to the participants' feelings. These feelings included, for example, satisfaction, excitement, or positive surprise. The participants also reported that the experienced critical incidents had a positive effect on their intentions to continue to use the digital coach watch. They also reported increased motivation towards being physically active and an increased belief in their ability to get into better shape.

4.2.2. Negative critical experiences

For the young adults, the most common negative incidents were related to the functionality of the digital coach or the watch. Thus, in this respect, the reported negative critical incidents differed from the positive critical incidents. The most common negative issue reported was a lack of trust in the data being presented. The majority of these cases were reports of inaccurate heart rate data. As most of the provided information by the digital coach is based on or linked to the measured heart rate, it means most of the other information was also not considered reliable. After encountering this, most of the participants stopped following the heart rate-based information completely or in some cases even stopped using the digital coach entirely. Other negative critical incidents linked with the functionality were difficulties in starting the recordings of training sessions, and the lack of ability to modify the training data.

The participants reported some negative critical incidents related to the real-time feedback during exercise. Some participants tried using real-time feedback during human-guided group sport sessions or during horseback riding. During the guided gym training, for example, one's own intensity level could not be adjusted, because the training instructions were given by the instructor of the training session. As a result, these participants stopped using the real-time feedback feature in a similar environment. Some of the negative critical incidents were related to the timing of the real-time feedback, as the feedback sometimes seemed bothersome or stressful rather than helpful. These participants would rather 'have listened to their own body and feelings' instead of being interrupted by the real-time feedback of the digital coach. After experiencing

these negative incidents, the participants stopped using the real-time feedback and felt that the digital coach should be more sensitive with its timing of providing the real-time feedback. The digital coach should be more aware, for example, when no feedback at all is desired. Sometimes, the person exercising would rather make their own decisions on the intensity of a workout, rather than being guided solely by the digital coach.

Two of the reported negative critical incidents were related to having to use sports technology at all during physical activity. These participants perceived using a technological device – in this case the digital coach device – to diminish their exercise enjoyment, which in turn led to a decrease in their motivation to use the technology.

In total, the majority of the reported negative critical incidents were associated with anger, disappointment, distress, frustration, or feelings of annoyance. Out of these, frustration and annoyance were felt most commonly by the participants. The negative critical incidents were most common in the early stages of use of the device, which is actually similar to the experienced positive critical incidents.

4.3. Critical incident experienced by the young elderly

4.3.1. Positive critical experiences

The most frequently reported positive critical incidents related to the feedback the watch provided. Most often it related to getting some sort of positive feedback on an activity the participants had just performed. The feedback was usually in the form of a compliment, trophy, or a smiley face and it made the users feel proud of themselves and feel competent. Participants appreciated the fact that they would immediately receive motivational encouraging feedback about the effort they put in and how it is positively impacting their health. Some participants highlighted that since they did not usually have anybody to give them credit for hard work, it felt good that at least the watch would recognise the work they had just done. It was also appreciated that the watch cared how the participants were doing by asking after an exercise what was their current feeling. This motivational feedback and support made participants feel more positive about themselves, about their exercising, and also about using the digital coach device in the future.

The second most common positive incidents were related to the digital coach providing users with new types of data about their exercising they had not received before. This objective, informational feedback, for example, related to heart rate, distance, speed, or recovery, opened up a new understanding on their health and fitness. This new data also provided them a tool to observe their exercising more closely, provide tools for goal setting, or even enable competing against themselves. Most participants had never received this amount of data before, and it let them understand themselves in a new way and generated interest in developing their exercise habits. These participants also started to see the usefulness of combining sport and exercise technology devices into their training.

The third most common type of critical incidents was also related to the objective data the users were seeing. However, now the positive feeling did not come from seeing numeric information about their previous performance but from seeing how, according to the watch, their fitness had measurably improved due to exercising and following the digital coach. Users were happy to see clear evidence that their hard work was actually giving clear benefits. This had a rolling effect of making users further interested in the digital coach and what it will recommend in the future. Those who appreciated the measurable improvements also showed increased interest in purchasing one of these devices for themselves. It may be unsurprising to see that when users received good news about their fitness, they were pleased with both themselves and the device.

In general, most of the positive incidents were related to different types of feedback and data received from the digital coach device. This information made the participants feel pleased, happy, proud, or even positively surprised. Most of the positive critical incidents took place in the very early stages of the usage period. However, the incidents related to the improved fitness level occurred in the latter phase of the usage period.

4.3.2. Negative critical incidents

For the young elderly, the most common negative incidents were a result of the device not performing the way the users expected. This most often included technical errors, such as the heart rate data or sometimes even the entire exercise not being recorded properly. Some of the mismatch regarding the expectations and device performance was related to feature limitations, such as the need to carry their phone with them to get their GPS data, which also resulted in the battery running out of the phone. This was found annoying. Some participants had hoped that the digital coach would, for example, recognise the performance as an exercise or a race. In a race situation, it was annoying that the digital coach constantly asked to slow down in the middle of the race. Overall, when the watch did not work the way the users expected, their attitude towards using the

watch at all decreased, and they were less inclined to continue using it.

The second most common type of negative critical incidents was related to the accuracy of the data. Some participants noticed their heart rate fluctuated widely even though the intensity of the exercise stayed the same. They also felt that sometimes the data was incorrect when considering how they felt, for example, when the training session was quite easy but the heart rate was registering as very high. Understandably, when the data provided appeared to be inconsistent and inaccurate, users tended to have less trust in what they were seeing and increased doubt towards the digital coach in general. In these cases, the participants might have still used the device, but they were less likely to pay attention to its feedback or to follow the instructions of the digital coach.

The third common negative critical incident was related to the general use of the digital coach device, as for some participants the device proved to be too difficult to use. Having to seek out guidance or a manual when starting to use the device, sometimes also in the later phase of the usage, felt annoying and uncomfortable. Users described it was frustrating and disappointing to have an experience that the digital coach is not as easy to use as they hoped. This led to feeling uncertain about using sport and wellness technology in general and increased the level of worry when trying to use the device, which also could lead to lower level of enjoyment during an exercise.

The fourth common critical incident was related to the participant's fitness level. Similar to positive experiences, the users whose watch told them they were less fit than expected experienced feelings of disappointment from the feedback they were getting. Concerning these incidents, the participants did not particularly trust the feedback received from the watch because their own perception of their physical fitness did not match the feedback. Participants also reported that since the watch started giving them instructions based on the watch-defined fitness level, most of the recommended exercises appeared to be too easy and not productive. In these cases, also the real-time feedback was often perceived as annoying since it always encouraged the participants to slow down even though they were used to a faster pace. This made the users feel like this particular device was not useful nor right for them.

In general, most of the negative incidents were related to the functionality or accuracy of the device. Like with positive critical incidents, also most of the negative incidents took place in the early stages of the usage period and therefore had time to affect the later usage of the digital coach. The negative incidents resulted in feelings of frustration, annoyance, mistrust, uncertainty, and negative surprise.

5. Conclusions

The main purpose of this qualitative exploratory study was to investigate novice users' critical incidents during the implementation phase of a sport and wellness technology digital coach. We also investigated how these incidents differ between novice young elderly and young adult users. The research questions were: (1) What are the central critical incidents that novice sport and wellness technology digital coach users experience during the implementation phase? (2) How do critical incidents differ between novice young elderly and young adult users? and (3) How do the critical incidents affect the overall usage experience and physical activity motivation? The main theoretical contribution of the study comes from answering these questions, and thus, increasing the understanding of the critical usage experiences with sport and wellness technology digital coaches in two different age groups.

5.1. Central critical incidents and differences between young adults and young elderly

Concerning research questions 1 and 2, with the young adults, the central positive incidents were mainly related to learning new things through seeing one's own exercise data or to feeling proud of accomplishing something physically demanding. With the young elderly, the central critical incidents were related to the motivational feedback received from the digital coach and receiving objective data about their physical activity and performance. It is evident that both younger and older adults find the data they receive about their health and fitness interesting because they can learn more about themselves and their health. It also seems that for older people the importance of positive messaging by digital coach plays an important role. Further, all of the positive critical incidents for the young elderly group related to their own fitness or related data. This was also mostly the case for the younger adults, but there were also some positive critical incidents for this group relating to the functioning of the device.

In both groups, the central negative incidents were mainly related to the functionality, usability, and accuracy of the digital coach. For example, in many negative incidents, the data was perceived as unreliable, which then lowered the interest towards the digital coach. Another issue that caused negative incidents was the feeling that the device was too difficult to use. Although the first reason was slightly more common with the

Table 1. Summary of critical experiences for the young adults.

Type of positive incident	The role of the digital coach	Feeling after the incident	Possible effects on future usage
Becoming more aware of own physical activity level	Educating the user	Excited, surprised	Increasing the motivation to use the digital coach
Being able to overcome one's own believes about themselves	Showing proof of an achievement important for the user. Giving positive feedback	Satisfied, proud, successful	Increasing the motivation to use the digital coach
Being able to receive detailed information about daily physical activity (distance, steps, seeing the improvement)	Showing detailed data about the training performance and providing training history for tracking the development	Happy, satisfied	Increasing the feeling of usefulness of the digital coach. Encouragement to keep on improving
Being able to see the digital coach modifying instructions based on the user's data	Showing personalised feedback and instructions	Delighted, surprised	Increasing the feeling of reliability for the digital coach
Type of negative incident	The role of the digital coach	Feeling after the incident	Possible effects on future usage
Perceiving received data as unreliable	Watch not being able to measure heart rate correctly leads to false instructions from the digital coach	Disappointed, annoyed, frustrated	Decreasing or even stopping the usage for exercise purposes
Perceiving the watch / digital coach as difficult to use	Being too complicated	Anger, distressed, frustrated	Continue exercising without the watch / digital coach
Being disappointed and interrupted by real-time feedback	Causing inconvenience during the training	Annoyed, stressed, frustrated, helpless	Stopping or modifying the use of the real-time feedback feature of the digital coach

younger adults, the second reason occurred more among the young elderly group. Overall, with both groups, the positive incidents were primarily related to performance and physical activity whereas the negative incidents were more related to usability factors. It is also notable that certain types of negative incidents (see Table 1) can lead the user to stop using a certain feature of the digital coach or even to stop using the digital coach entirely. This was especially apparent among young adults.

The central positive and negative critical incidents have been categorised in Table 1 for the young adults and in Table 2 for the young elderly. The types of incidents are presented in the order of how common each category of incidents was among the participants (the most common on top and the least common at the bottom).

5.2. Effect on the overall usage experience and physical activity motivation

Concerning research question 3, it seems that by providing meaningful information about training data and personal improvement and by giving positive encouragement, a digital coach may increase the awareness of the user's current physical activity level, create positive user experiences that encourage for future usage, and increase motivation towards physical activity and exercise. Learning new information about one's performance and/or seeing improvement can increase the feeling of competence, which is an important part of motivation. Another issue increasing the level of competence was motivational feedback received from the device. The role the feedback in increasing motivation was especially important with the older participants. It could be the case that the level of exercise self-efficacy is generally lower with older people and therefore motivational feedback or structural feedback in the form of performance data can further affect the self-efficacy of older people.

However, it also seems that a mismatch between the functionality of a device and the expectations of the user together with the perceived low accuracy of the provided data can lead to mistrust and lack of interest to use the device in the future. If the data cannot be trusted, it is harder for users to learn about their own physical fitness. Therefore, they will not necessarily experience the increase in motivation that can occur after learning something new about themselves. Difficulties related to usage can also decrease motivation to use the digital coach and the motivation to exercise. The reason for the decrease in exercise motivation can be due to the stress, worry, and frustration experienced while training due to technical issues, which could decrease the enjoyment of exercise. It is worth noting that with the young elderly the uncertainty and frustration towards using the digital coach also sometimes caused a lack of interest towards using the device at all.

Most of the critical incidents with both groups took place in the early stages of the usage period. Both the positive and negative critical incidents in many cases had an effect on the future usage intentions of the digital coach. Whereas some negative critical incidents were mostly related to technical or functional aspects, most of the positive incidents seemed to be related to overall development and realizations of own fitness or performance or received instructions and feedback. It seemed that the role of the digital coaching feature itself was

Table 2. Summary of critical experiences for the young elderly.

Type of positive incident	The role of the digital coach	Feeling after the incident	Possible effects on future usage
Receiving positive and meaningful feedback about performance creating a feeling of competence	Giving the user positive and motivational feedback on the hard work they were doing	Pleased, Happy, Proud	Increasing motivation to continuing exercising and using the digital coach
Receiving objective data on exercise that was formerly not available	Learning something new about exercise and performance, and how to most effectively develop.	Excited, Interested,	Increased interest towards the digital coach.
Being able to see measurable, objective improvement in their fitness	Getting proof that the work they are doing is having a measurable improvement on their health.	Successful, Surprised	Increased interest towards following the instructions of the digital coach. Interest in buying a similar device for themselves
Being able to see proof that their physical fitness was good	Digital coach showed that participants were able to receive high heart rates and also that heart rate was able to fluctuate fast	Proud, Surprised	Realizing that the device is able to detect and share useful information
Type of negative incident	The role of the digital coach	Feeling after the incident	Possible effects on future usage
Being frustrated with the technical requirements of the device	The device did not function the user expected or wanted it to.	Frustrated, annoyed	Attitude towards using the watch changed, decreased interest
Accuracy of data provided appeared inconsistent	The watch did not provide consistent data, or did not match how the user was physically feeling	Surprised, mistrustful, disappointed	More skeptical of the information that was presented. Did not follow the instructions that were based on heart rate
Device too difficult or uncomfortable to use	Consistently needing guidance on how to even use the device.	Disappointed, uncertain	Increased worry, frustration and uncertainty when using the device
According to the watch the user's physical activity level was lower than expected.	The device's feedback did not match the user's own feeling, and resulted in an irritating experience	Surprised, disappointed, frustrated	Increased skepticism of the device, feeling that the device was not right for them.

more strongly highlighted in the positive critical incidents.

5.3. Summary

The results of the study support previous IS research on critical incidents. For example, the findings are in line with the studies (Salo and Frank 2017) and (Salo 2013) which note that providers may affect the likelihood of positive critical incidents and decrease the likelihood of negative critical incidents. The likelihood of incidents can be affected by ensuring the initial readiness, quality, and functionality of an application. As this study found most critical negative incidents to occur in the early stages of usage, and the incidents of being linked to technical issues, these findings of this study can be considered to support the findings of Salo and Frank (Salo and Frank 2017).

Further, following Tay and Ang (Tay and Ang 1994), the information technology adoption process depends on users' skills and abilities. The learning-related experiences, when using a new technology, are usually combined with positive and negative sentiments. In this study, the use of sports and wellness technology in the form of a digital coach was a new learning experience for the participants of this study. As to the positive critical incidents, sentiments related to experiences of learning something new or being able to excel oneself were highlighted by the participants. On the contrary, sentiments related to a lack of trust in the accuracy of data were stressed mostly in the negative incidents.

5.4. Managerial implications

The findings of this study can be used to improve the design and functionality of sports and wellness technology in general and digital coaches in particular. In general, developers should aim to generate desired positive critical incidents and avoid creating negative incidents. For example, by focusing on an improved design and functionality, developers can improve how the users and market welcome these technologies and systems. Also, physical activity-related professionals can make use of these findings as the findings provide insight into how critical experiences are related to sports and wellness technology use, and how they affect the usage experiences. These, in turn, have an effect on users' motivations to carry out physical activities and exercises.

One of the key findings providing managerial implications is the effect of data reliability on the usage experience. This finding implies that digital coach developers should take extra care that the data provided by the systems and technologies is of high accuracy and relevance. Also, the instructions and feedback should be clear and easily understandable, and the digital coach should be easy to use. This is essential especially for those users who have less experience in training and/or knowledge in improving their fitness. Further, the training session instructed by the digital coach should not be too difficult or demanding for the user. By offering training sessions on an adequate level, the likelihood of generating positive feelings and success for the user can be maximised. In turn,

these positive perceptions lead to continued usage of the technology or system.

5.5. Limitations and future research

This study has some limitations that should be noted. Firstly, the two target groups in the study were young adults and young elderly, of which the young adults likely were more familiar with and interested in using novel technological solutions in general. Thus, some of the incidents among the young elderly in comparison to young adults could be more related to technology use in general rather than digital coaches per se. Potentially, younger populations may experience a sharper learning curve and thus have more positive experiences with this kind of technology during the implementation phase. It is also important to note that almost all the participants in the study were generally highly educated and therefore more likely to engage with physical activity (Shaw and Spokane 2008). It has also been shown that physical activity level can influence the attitude towards digital coaching so that those with higher levels of physical activity usually show more interest towards digital coaching (Sell et al. 2019). Secondly, in this study, the participants only used the device's wrist-based heart rate measurement instead of using a heart rate strap. This could have influenced the perceptions of data reliability as the wrist-based measurement is generally less accurate than measurement with a heart rate strap, and subsequently lead to negative critical incidents. However, the critical nature of the perceptions of unreliable data is still an important finding as perceptions of data reliability are important independent of the used measurement technology. Thirdly, the usage period of 10–12 weeks does not cover the whole typical usage life cycle of such devices, however, it can be seen as long enough for the users to experience a variety of critical incidents. Indeed, most of the reported critical incidents took place in the early stages of the usage period. Also, from a physical point of view, to which some of the incidents were related to, the usage period is considered long enough to be able to see changes in fitness level (Jürimäe et al. 1985). Fourthly, despite the many strengths of the CIT, it also has some limitations (Bitner, Booms, and Tetreault 1990; Gremler 2004). Namely, it collects only outstanding incidents instead of the more often occurring ordinary ones and focuses on a single incident. Therefore, it does not take into account the accumulation of incidents. However, the focus of the present study was specifically on critical incidents (Flanagan 1954; Gremler 2004). Further, as the reported incidents had taken place at least sometime before the collection of the data, there is a risk of recall and reinterpretation bias. To minimise this, we followed prominent CIT papers (Bitner, Booms, and Tetreault 1990; Meuter et al. 2000) in planning the interviews. We also instructed the participants to describe a single incident in as much detail as possible. Fifthly, the implementation phase is one of the most critical phases in the innovation-decision process, however, it is affected by numerous factors, such as one's awareness and past experiences as well as earlier stages of the innovation-decision process. For example, those who are aware or interested in adopting new technologies might feel less frustrated during implementation if they better understand the functionality or features of these products. In our study, we provided the digital coach directly to the participants. As a result, our study and research design do not accurately reflect the entirety and details of the whole innovation adoption.

It is important to note that participants within both study groups had wide ranges of previous experience related to the use of sport and wellness technology. However, none of the participants had had previous experience with digital coaching. Previous experience influences the implementation process of new technologies. However, it is also important to note that instead of analysing the influence of previous experience on current behaviour the qualitative approach aims to explore individual experiences (Myers and Newman 2007). The study did not want to use previous experiences related to sport and wellness technology use as a selection criterion since the goal was to receive a wide range of perception and usage experiences from the participants.

Despite these limitations, this study offers some highly valuable insights on the topic. Researchers can draw from the findings of this study when conducting future research. For example, it would be interesting to do a similar study with not only people from different age groups but also with people of different physical activity backgrounds and different goal-orientations, or among more advanced users. It would also be interesting to investigate critical incidents by using other methods besides interviews. Our findings suggest that digital coaching is the potential in supporting physical activity and exercise, but at the same time, it is evident that more research on this topic is warranted to further increase the understanding of digital coaching and its possibilities in physical activity promotion. Hence, we call for more research on digital coaching in physical activity and exercise context.

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No potential conflict of interest was reported by the author(s).

Ethics approval

We contacted the local ethical committee before the start of the study. They deemed that no separate ethical approval was needed for this study.

Data availability statement

The data is not publicly available due to the qualitative interview data containing information that could compromise the privacy of research participants. The participants of this study also did not give written consent for their data to be shared publicly.

ORCID

Eeva Kettunen http://orcid.org/0000-0002-7513-4973
Tuomas Kari http://orcid.org/0000-0002-5755-806X
Lauri Frank http://orcid.org/0000-0002-3003-3300

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Appendices

Appendix 1. Young adults group

	Male	Female	Total
N	10	20	30
Age			
<25 years	1	7	8
25–30 years	1	7	8
31–35 years	4	2	6
36–40 years	3	2	5
40< years	1	2	3
Physical activity background[a]			
Physically active for health	1	3	4
Active in commuting and non-exercise	6	11	17
Occasionally active	3	6	9
Sedentary	0	1	1
Degree under study			
Bachelor's degree	3	5	8
Master's degree	6	14	20
Doctoral degree	1	1	2
Study mode			
Full-time student	6	15	21
Part-time student	3	4	7
Other	1	1	2

[a]The physical activity categories were derived from the Finnish National Sport Survey (Finnish Sports Federation 2011) and include, ordered from the highest physical activity level to the lowest physical activity level, the following: competitive athlete, recreational sportsman, physically active for fitness, physically active for health, active in commuting and non-exercise, occasionally active, and sedentary.

Appendix 2. Young elderly group

	Male	Female	Total
N	10	20	30
Age			
60–65 years	4	3	7
66–70 years	3	12	15
71–75 years	2	5	7
75 < years	1	0	1
Socioeconomic status			
Working	1	1	2
Retired	9	19	28
Physical activity background[a]			
Fitness athletes	1	1	2
Fitness participants	5	6	11
Physically active for health	2	9	11
Active in commuting and non-exercise	1	3	4
Occasionally active	1	0	1
Sedentary	0	1	1

[a]The physical activity categories were derived from the Finnish National Sport Survey (Finnish Sports Federation 2011) and include, ordered from the highest physical activity level to the lowest physical activity level, the following: competitive athlete, recreational sportsman, physically active for fitness, physically active for health, active in commuting and non-exercise, occasionally active, and sedentary.