Game Mechanics to Further Engagement with Physical Activity

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Abstract. A lot of work required for physiotherapy is done between the actual therapy sessions. Patients receive instructions for exercises to be practiced on a daily basis to regain mobility in their injured joints. These exercises are often tedious and uncomfortable, hence motivation for daily repetition is sought-after. Games may be an answer to this challenge, however, they need to be well-designed as to not support incorrect execution of exercises and at the same time be engaging enough to keep up long-term engagement. In this paper we discuss guidelines for designing game mechanics aimed at increasing compliance in physiotherapy and for encouraging physical activity for older adults.

Keywords: Ageing, game design, engagement, physiotherapy, game mechanics, older adults, physical activity

1 Introduction

Playing digital games is seen as a common pastime for younger people whereas games are often overlooked when designing experiences for an older generation. The upcoming generation of older adults, however, is digitally literate and has been using technology for a large part of their lives [1]. While they might not often consider playing games in their spare time, many are open to playing games when they are personally suggested to them or as a means to increase engagement with certain activities in their everyday lives [2, 3].

One example is physiotherapy and physical activity in general. While the need for physiotherapy is by far not limited to an older generation, certain surgeries with long recovery time are occurring more frequently for older adults. Physiotherapeutic rehabilitation is a long and often tedious process that yields the best results, when patients follow their training routine regularly. Games seem to be a medium well suited to motivate people to do their exercises and return for their daily bouts of training [4-7], in physiotherapy as well as physical activity in general. However, even the best-designed game can only go so far to keep players motivated and engaged enough to repeat difficult or hurtful movements on a daily basis and over a long period of time [7].

Current gaming technology offers a wide variety of interaction possibilities, ranging from a traditional keyboard-and-mouse setting, to using mobile devices (e.g.

smart phones), handheld controllers (e.g. Playstation controllers), controllers with motion tracking (Nintendo Switch Controllers), free form motion tracking via sensors (Kinect) and even using everyday objects as controllers (e.g. an electric guitar). This variety provides for ample opportunities to design games for a physiotherapeutic context. With that in mind, we set out to create mini-games for home practice between therapy sessions. However, by working with game designers and physiotherapists, we realised that we needed to shift our attention away from solely looking at games that support daily rehabilitation. Our work revealed that a more holistic approach is necessary to better support a patient's physiotherapeutic treatment. Even though older adults doing physiotherapy might adopt games easily at the start due to curiosity and fresh motivation, we saw the need to include situated design approaches to embed these games deeper into the patient's everyday practices and keep up their engagement even after the first boost of motivation has faded.

To this end we interviewed physiotherapists for a broader understanding of the context, conducted a workshop with older adults to find out more about their daily routines and their use of technology, and organised two workshops with game designers who brainstormed ideas for lasting engagement. In this work, we will present the main outcomes of these interviews and workshops. The result is a series of overarching game design guidelines. These guidelines present “intermediate level-knowledge” or “strong concepts” [8], which are a means to understand and characterise a specific design space. We then translate these guidelines into applicable game mechanics to encourage physical activity.

2 Related Work

Baranowski et al. [9] describe game mechanics as the means (or the “how”) of delivering the serious aspect of a game for health. Several stricter definitions of game mechanics exist in game studies describing game mechanics as verbs [10], as the actions needed to succeed in a game [11] and as essential activities repeatedly performed by players [12]. These definitions all focus on the player perspective. Juul [13] defines gameplay as the interaction between players and the rules of a game. Game dynamics [14] describe the run-time behaviour of game mechanics and how the game reacts to player input. For this paper we employ a broader view of the term game mechanics including gameplay and game dynamics into our perspective on prolonging engagement in games for health.

By engagement we mean the desire or willingness to play a game over a longer period of time. Huizinga [15] described the process of engagement in games as ‘absorbing the player intensely and utterly’. Brown and Caims [16] refer to engagement as the first and lowest level of involvement with a game. Sustaining engagement is a regularly discussed issue in games for health literature. Supporting extrinsic and intrinsic motivation of players can both be means of increasing engagement with a game. Often-replicated game elements such as points or rewards are extrinsically effective. Deci et al. [17] discuss the issue of using extrinsic motivators towards intrinsic goals and argue that intrinsic motivation might be lessened by such strategies. Hence, one could ensue that extrinsic motivators do not

always achieve the desired result of keeping players interested over a longer timespan. Still, if used as informational feedback, points can also help to support intrinsic motivation [18]. Mekler et al. [19] state that extrinsic incentives need not decrease engagement as they positively influence the quantity of use, however, they do not increase quality, which is an important factor, especially in health-related applications.

As stated in Ryan and Deci's Self-determination Theory [20], competence, relatedness and autonomy are key aspects to keep up a person's intrinsic motivation. Peters et al. [21] discuss a contextual model of well-being, which situates motivation and engagement between spheres of analysis such as technology adoption, the interface and interaction, technology-supported tasks and behaviour, and an individual's life. Also along the lines of self-determination, Biddiss and Irwin [22] found in a meta review that self-initiation and choice played a vital role in keeping young people motivated. Additionally, other strategies that have previously been used to uphold long-term engagement are adaptive challenges [23-25], individualisation [24], social play and competition [23, 24, 26, 27], goal setting [28, 29], creating a state of flow [30], diversity of scenario and gameplay [25] and feedback [22, 24]. Consolvo et al. [31] discuss strategies to keep up engagement in behaviour change technology, such as unobtrusiveness, controllability and comprehensiveness.

There is a solid body of work on games for health, but using games to support patient engagement in health care is under-researched [32-34]. There is also a lack of long-term studies [35]. We use the term 'long-term' for studies, which run for longer than the mostly standard three month periods [e.g. 36].

There has been a keen interest in adapting video games to suit the need of older adults and some work has been put into creating guidelines for games for older adults. Luckner et al. [2] found that even though older adults often show reluctance when asked about their gaming habits and deny being gamers, they often enjoy gaming in a social setting. This reluctance to play games is also discussed in Sayago et al. [3]. Among other results Luckner et al. [2] found competition, self expression, tangible interfaces, musical play and social play to be amongst the most important game elements for older adults. Kayali et al. [37] identified a list of elements of play to use in games for older adults: autobiographical play, musical play, collaborative play, role play, kinaesthetic play, object-based play and adaptive play. Voida and Greenberg [38] discuss guidelines for social, intergenerational group play involving different levels of challenges, games for different skill sets and preferences, or downplaying competition. Marston [39] presents design recommendations for games for an older audience regarding content and interaction. For example, interactions should be simple, intuitive and related to real-world experiences, and content should be presented in mini-games of different difficulties with a purpose and user-generated materials. Kayali et al. [40] present design considerations for long-term engagement in games for health revisiting three different projects with participants across different generations. They highlight the importance of creating a feeling of social connectedness, showing progress, and using mobile platforms as medium. De Schutter [41] discusses casual games as more suitable for older adults but shows that there is a mix of casual and hard-core gamers among this age group. He also states that social play leads to longer playing time, however, that most participants in his study played solitarily.

Much work concerning games and play for older adults is written in regard to exergames. Biddiss et al. [22] show in a meta-review that exergames encourage activity but acknowledge a lack of data on long-term engagement. Mueller and Isbister [42] present a series of design guidelines for movement-based exergames validated with expert game designers. These include design strategies such as focussing on social fun, facilitating self expression, focusing on the body, or highlighting rhythmic interaction. Lohse et al. [4] cite interdisciplinary evidence for choice, rewards and goals to increase engagement with exergames. Lyons [43] discusses the role of rewards as ambivalent with regard to engagement and concludes that special care has to be taken when using reward mechanics in exergames. She further emphasizes feedback and challenges as important design choices. On a higher more philosophical level Mueller and Young [44] outline five lenses for designing games to further personal growth through exergaming. These lenses move away from the game mechanics level and focus on the concepts of pleasure, humility, the sublime, being one with one's body, and appreciating solitude.

Two systematic reviews of studies on older adults using exergames confirm that there is potential in increasing engagement for exercising through games; Bleakley et al. [45] point out that there is proof for the efficacy of exergames, but that more high-quality evidence is needed. Chao et al. [46] state that exergames on the Wii console hold potential for improving physical functions, cognition and psychosocial outcomes. Regarding platforms, Grosinger et al. [47] found that older adults are reluctant to spend too much time in front of the PC and instead found that using tablet computers is well accepted. Murata et al. [48] further argue that tablet computers have fewer age-related usability issues regarding pointing tasks. Additionally, Harley et al. [49] emphasize the importance of social factors in games for older adults. Gerling and Mandryk [50] present a review of motion-based games for older adults. They present a categorisation of work about exergames in augmenting sports and activity, physical therapy, rehabilitation and exertion and call for further studies concerning long-term player engagement. We also see this topic as vital and necessary to investigate further [e.g. 6].

3 Methods

The focus of this work was to better understand the design space of physiotherapeutic digital games for an older generation and extrapolate design guidelines and game mechanics aimed at prolonging engagement. The research presented here was driven by an *explorative design approach* in which the design process itself acts as a means of knowledge construction. The concept of explorative design originates from Dewey's Theory of Inquiry [51], where he introduces the concept of 'doing for the sake of knowing'. It was extended by Donald Schön [52], who observed that much knowledge integral to the design is not known a priori but acquired as a result of interacting with the object to be designed.

We used interviews, a focus group and workshops as a basis to inform a set of design explorations along with specific game mechanics. To better understand practices in physiotherapy, we conducted three *in-situ, 60-90 minute interviews with*

physiotherapists. Topics covered in the interviews were information about the physiotherapists' work routines; a patient's first visit, anamnesis and establishing an individual trainings schedule; how mobility and flexibility of joints are measured; treatment progression; and patient engagement. The interview environment of the physiotherapists' practices helped to put their work in context, for example one interviewee got up and visually explain how and where they taught their patients to correctly perform new exercises. Two of the interviewees were working in solo practices whereas one worked in a joint practice with a shared room for performing exercises. While we could have learned most of the general information gained from the interviews from related literature (e.g. basic routines of a physiotherapist), we gained invaluable information by actively seeing different practice setups and an assortment of possible exercises with detailed explanation as to how to correctly do them, their timing and how to prevent additional injuries while doing them. These very practical insights illustrated a range of motions and constraints important for designing games for a physiotherapeutic context. The interviews were then evaluated using the thematic analysis approach according to Braun and Clarke [53] and their results directly informed the game designers' workshops.

To gain more insights into the daily lives of older adults, we conducted a *focus group session with participants aged 60+*. Of the 6 participants 4 were male and 2 female. We asked the participants to share, which technology they were using and where in their household the technology was mostly located. This information was collected to provide deeper insight into how technology was already established in the participants lives and where said technology was mostly used. Furthermore, participants were asked to document their daily routine on their "average" day. These routine sheets were later evaluated to extract information about where and how most daily routines were practiced. The results were used as examples for the game designer workshop to spark ideas in a brainstorming phase.

To put the insights from these expert interviews and focus group into a game design context, we then organised *two workshops, each with four professional game designers* and two workshop moderators. Each workshop consisted of four phases: The first phase was a briefing with the themes resulting from the interviews and information collected in the focus group session; the second phase consisted of a design session, in which pairs of participants were asked to brainstorm games that could be used as part of a daily physiotherapy routine; in the third phase the participants were asked to consider how to supporting engagement of older adults doing physiotherapy. The workshop was concluded by the fourth phase - a lengthy discussion about the topic of long-term engagement.

Throughout each of these methods - interviews, focus group and expert workshops - we continuously documented the outcomes by taking notes on our first-hand experiences and pictures of settings and participants at work. Additionally, the interviews were recorded and retrospectively summarised by the interviewers. In the focus group as well as the workshops, participants created materials, which we later used as an additional information source for our evaluation. For example, these materials include each focus group participant's handwritten daily schedule, a household map with marked locations where they use technology, or a collection of moderation cards with brainstormed game ideas from the expert workshops.

We first evaluated each of the methods independently, the results of which are presented in the next section. Eventually, we combined our insights to draw out common topics, connections and interrelations. This analysis of common themes was again informed by thematic analysis [53] and constitutes the base of the guidelines presented in the discussion.

4 Results

The results of the methods were condensed and used to inform three explorative designs, two games using a Kinect for measurement and player interaction, as well as a companion app to be used on a smartphone throughout the healing process.

4.1 Interviews

According to the interviews, the average physiotherapy course consists of 6-10 sessions with one or two encounters per week. During the first meeting, the therapist examines a patient's joints regarding mobility, strength and coordination and creates a therapy schedule together with the patient. This schedule is organised around practical goals, e.g. "I want to be able to ride my bike again". The goals are formulated by the patient and sense checked by the therapist. Usually, patients doing physiotherapy are driven by the desire to again be able to tackle everyday activities free of pain. They start their therapy with high engagement and it is the physiotherapist's task to walk the line between guiding them towards achievable goals to keep up engagement but push them hard enough to advance their recovery.

In each follow up session, the physiotherapist and patient work on exercises that the patient is asked to practice at home. These consist of mainly repetitive motions of the injured joint that are rhythmically conducted. The homework usually includes only up to three exercises to not overburden the patient. While patients are asked to regularly do their exercises at home, they are also warned not to overdo them and to spread them out over the day instead of doing all at once. They are cautioned not to put too much strain on the injured joint to avoid renewed damage.

4.2 Focus group

The most relevant outcome of the focus group was to learn that the use of technology is already deeply embedded in the older adults everyday practices. While not all of our participants own or regularly use a personal computer, smartphones are everyday gadgets they take along wherever they go. While at home, however, mobiles are mostly not carried around but stored in certain places, such as the hallway, bedroom or office.

Concerning their everyday activities, four of the six participants start their day with basic stretching and fitness activities to mobilise their joints and activate their bodies, followed by measuring blood pressure or taking their daily medications. While the rest of their day was largely depending on their live circumstances, such as visiting

their relatives, walking their dog or attending educational workshops and seminars, most workshop participants mentioned certain times of the day set aside for reading and writing emails or doing organisational work using technology.

4.2 Games Design Sessions

The two game design sessions resulted in 31 game and 25 long-term engagement ideas. In a conceptual design meeting with the project partners, some were selected for prototyping: a puzzle, a helicopter game, and a companion app as a prototype for providing context for the long-term engagement. The selection process was based on how ideas potentially increase physiotherapeutic compliance and on the diversity of approaches. However, the ideas were not geared towards certain injuries but intentionally chosen to be applicable to different physiotherapeutic exercises.

Most of the game ideas centred on repetitive, progressive play with adaptive visual feedback. The game designers were concerned with creating too engaging, competitive games due to the given constraint that players were not to overdo motions and worsen their injuries. Another self-induced constraint was that games should not punish players for mistakes as that could be seen as juxtaposed to the idea of healing.

Most of the long-term engagement strategies centred on the idea of a metaphoric re-/construction of structures and or growing and time passing. To keep up engagement the ideas employed compliance streaks (reward compliance over streaks of a number of consecutive days) and a connected reward system; showing progress of individually set goals over time; additional information for patients or an additional value by sharing data with the physiotherapist; and stripping down the effort it takes to start, stop and track an exercise to the bare minimum. The discussion encompassed possible situations that might prevent players from playing on a daily basis, be it because of other activities that substitute daily exercises like biking to work, or situations that make digitally playing impossible, like holidays. While still employing compliance streaks, the game has to account for such possibilities and not punish players for missing instances of daily practice.

While describing each of the resulting game ideas would be too extensive for the scope of this paper, we will focus on those that best represent the translation of results into practical mechanics. Following is a short description of these ideas. More detailed mechanics will be introduced later in the Discussion in connection to the represented guidelines they constitute.

4.3 Game ideas

Puzzle. Pictures used in this puzzle game can be chosen by the gamer or uploaded by their social circle to surprise them with new pictures on complying with their exercises. Each repetition of an exercise fits a piece of the puzzle in place. If the exercise is not completed correctly, the current piece drops out of the frame and has to be refitted by repeating the exercise correctly. The puzzle idea provides the advantage that it is a known concept and does not need much explanation beyond how the interaction with the system works. Additionally, it provides a metaphor - each

repetition of the exercise is a piece closer to the goal - and visible feedback in that one gets closer to the goal over time and the user sees if they do the exercise correctly or not. This can serve as motivation to reach one's goal. User-generated content, especially if provided by relatives and friends, can increase engagement through novelty and inciting the players curiosity.

Helicopter game. A helicopter lifts building blocks on top of each other to build a tower (Figure 1). Each block represents one repetition of an exercise, its size and placement are determined by correctly executing and timing the exercise and hence give the player visual feedback of the quality of their training. Each house represents one day of doing exercises, so exercise compliance results in the player building a city skyline. This game contributes to player engagement by challenging players to do their exercises daily to see a complete skyline of their achievements. While still having day-long breaks between doing the exercises, this skyline should create the feeling of continuity or flow [30]. Ideally, players will also get a visual feedback of their progress by going from building small, imbalanced towers to building high and strong structures by perfecting their skill in doing the exercises correctly in timing as well as motion.

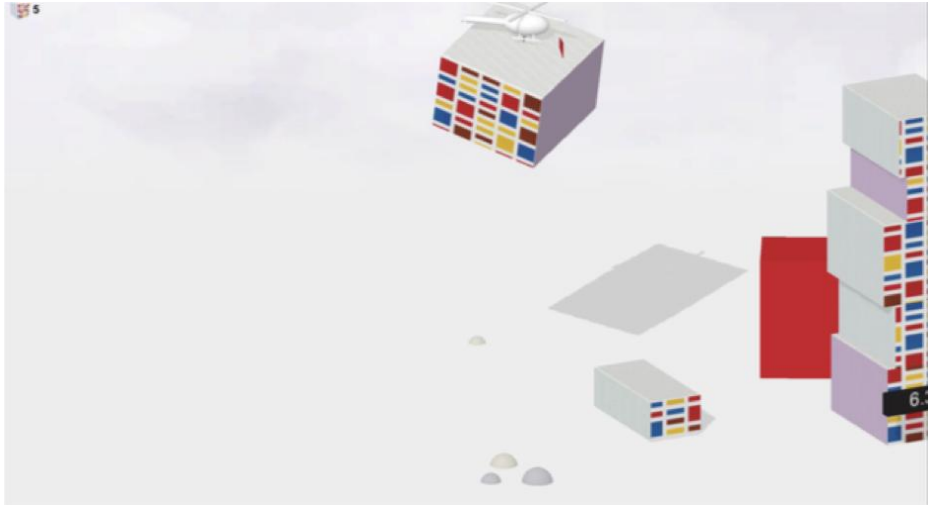

Fig. 1. Game prototype, where a helicopter is controlled through physical therapy exercises.

4.4 Long-term engagement ideas

Balloon challenge. Players define their starting and ending points on a map and, during their physiotherapy, travel along the path in pursuit of their goal. Traveling is shown by displaying photo or video material of locations on the trip collected online or uploaded individually. The trip is done in a basket attached to balloons, each balloon represents one day of exercise compliance. Each balloon stands for a trainings session and as such can also show the success of each session, e.g. a perfect run in

training will result in a huge balloon, while the size can vary on other runs and show areas of improvement.

Big band. With each day of finishing exercises a player unlocks a band member and a big band song is played. While the music is very sparse at first, over time the song becomes more and more intricate and elaborate. As soon as the big band is complete, the musicians' skill can be upgraded for higher quality music - the orchestra can for example develop from high school musicians to professionals. The quality and diversity of the music thus directly represents therapy compliance.

Companion app. The companion app is an explorative design probe emanating from the workshops and a way to declutter games and provide additional information about benefits of doing the exercises. While playing, the game is stripped down to its bare minimum as suggested in the workshops. The application adopts a supporting function as a daily reminder to engage players in a continuous rhythm of doing their exercises, and it stores progress. It can also be used to track other activity that would compensate for doing the daily exercises, which gives the player more freedom and facilitates self-determination.

5 Discussion

The results from the interviews, the focus group, workshops and explorative design sessions can be condensed to 9 game design guidelines for games for physiotherapy for older adults: goal setting, use of metaphors, conveying a feeling of completion, avoiding competition, avoiding punishment, showing progress, social connectedness, additional values, and embedding in daily routines. In the following, each of these guidelines is described and reflected in a number of specific game mechanics. While the guidelines are geared at games for older adults, they can easily be adapted and used for a wider audience of people doing physiotherapy.

Goal setting. Goal setting is a vital part of physiotherapy and acts as a touchstone to determine its progress. This practice of individual and adaptive goal setting can also be reflected in therapy-supporting game environments. A goal needs to be challenging but realistic at the same time as to provide sufficient engagement for the player but be reachable. This design guideline reflects validated practice in behaviour change technology [27] and individual goal setting is known to increase intrinsic motivation [20, 29]. It is also reflected in the goal-setting and task motivation theory discussed by Locke and Latham [29] who argue how complex goals can create a feeling of anxiety but self-efficacy and goal-driven tasks can lead to the discovery of strategies to surmount said goal. It also adds to a finding by Sayago et al. [3] in that older adults were not interested in finishing in-game goals unless the goals were of interest to them. The Balloon challenge embraces this game mechanic by letting players set a real life location as their goal and work their way across the globe to reach it.

Metaphors. Metaphors are a useful tool to depict a goal or transfer an idea from theory into something graspable. Progress should not be presented to the patients in disjunct numbers, e.g. the knee can bend to a certain angle, but rather in graspable, motivating metaphors, such as the player has already walked a certain distance while

training their joint. Consovo et al. [31] argue that an abstraction of the applications raw data helps users to better reflect on their actions and provides an explanation and representation of their activities. Games can provide players with an individually chosen metaphor to fit their interests. The Balloon challenge translates this by depicting a journey as a metaphor for the rehabilitation process. Game mechanics-wise, by doing their exercises, players inflate the balloons necessary to carry them towards their goal.

Feeling of completion. A strategy to sustain player engagement is to attract players with the feeling of completion on a daily basis after finishing a session, but also on the long run by reaching a rehabilitation goal. This guideline can be connected with Consovo et al.'s [31] trending or historical strategy, where users generate motivation from seeing previously achieved goals. The game mechanic of completion is depicted in the Big Band game context. The band plays for the player once a day after they are done with their exercises, which is the daily sign of having completed a workout. Additionally, the band goes from an incomplete conglomerate of inexperienced musicians to a well trained team of professionals over the course of the therapy. The puzzle game translates this in its mechanic of only showing the whole picture when the daily exercises are completed.

See progress. A point repeatedly made by physiotherapists was that it is often hard to see progress whilst in the middle of a physiotherapy. Patients seem to get the feeling of stagnation or of having reached an insurmountable plateau. This is where technology can play an active role in tracking and showing progress, as Uzor et al. [5] have also shown for elderly users. When zooming out in the Helicopter game that was developed during the project, a patient can see all previously completed exercises and ideally notice improvements in the representation of their towers, which should become more durable, uniform and steady over time. This is also a direct representation of the player's compliance streak and shows gaps where exercises were left out or forgotten. The Balloon challenge also shows a player's progression across the map which translates to progress in therapy.

Social connectedness. Another point that we took from expert interviews and related literature [1, 2] was the importance of "not being alone in this", to get a feeling of social connectedness. As Dubbels [26] has previously illustrated for learning games, it might not be possible to find a "recovery buddy" in the real world, but the interconnected online world offers a platform to socially connect with other people who are in a similar position. As mechanic, it can be built into a game like the Helicopter game, where you can share your skyline with other players to get a feeling of social connectedness. It can be used as a tool of bragging about a new personal achievement or getting positive support through your social network. Harley et al. [49] also state that social factors contribute to older adults' motivation to stay with a game. The puzzle game provides another mechanic, where the pictures can be uploaded by friends and family who can surprise the player daily with emotionally-charged images. Using user-generated content is also presented as beneficial in the design recommendations by Marston [39] and Mueller and Isbister [42] also highlight the importance of "facilitating social fun" in exergames.

Avoiding competition. From the discussions with game designers, we understood the importance of avoiding competition in the resulting games. While we previously discussed social connectedness and sharing of progress, an inter-player comparison of

said progress is not advisable due to individually different healing processes. Also, competitive games themselves could invite players to overdo motions and hence overstrain or re-injure their joints, which could set back their therapy progress. This coincides with Lyons [43], who advises caution when using rewards because they (or their absence) can also feel discouraging. Additionally, Voida and Greenberg [38] discourage from using inter-player competition in their design guidelines for games for social group gaming, adding, however, that older adults are open for gameplay, where the whole social group works towards a common win or loss. However, Luckner et a. [2] found that an element of competition seems to be an important mechanic in games for older adults.

Avoiding punishment. In a similar notion, game designers advised to avoid game mechanics that work with punishment. Progress should be constantly moving forward rather than setting players back. This mechanic can be seen in the Puzzle game where it is possible to drop tiles if the exercise is not done correctly, however, the player can always retrieve these dropped pieces of the puzzle with one additional repetition to finish the image and get the feeling of completion. Consolvo et al. [31] discuss this notion in the context of technology needing to providing positive reinforcement to keep users interested during a long-term project.

Additional value. The perceived additional value of engaging with a rehabilitation game and consequently physical exercises is considered to be one of the determining factors for sustained use. Perceived value can be immediate, e.g. taking the form of feedback, or long lasting, e.g. by communicating the longer-term benefits of sustained exercising. We designed the companion app not only to better visualise progress but also to generate additional value by providing medical information and pointing out the specific benefits of each exercise. Apps are also in line with the acceptance of tablets by older adults [47]. The design lenses to focus on users' personal growth outlined by Mueller and Young [44] also are examples of providing additional value beyond a game's primary purpose.

Daily practices. Physiotherapists propose embedding exercises into the patient's daily practices, e.g. doing an exercise while brushing your teeth. Simultaneously, learning about daily practices of older adults in the focus groups showed that most already had time set aside for physical activity. Patients should be able to track activities that are equivalent to their assigned physiotherapeutic exercises and that happen outside of a game, thus replacing their daily session. For people who consider themselves gamers, it might also be interesting to embed physiotherapy into their daily gaming life, e.g. by doing an exercise, they can unlock rewards in the game of their choice, such as levelling up a game character. The companion app uses this design guideline in a mechanic to give location and time based reminders to do exercises. This ties in with the notion of reminding patients in-situ, e.g. while brushing their teeth, to engage in their daily exercises and also track their progress for later inspection and to update their general progress. Embedding exercises into daily practices is also supported by Kayali et al. [37] as well as in behaviour change and persuasive technology literature such as Consolvo et al. [31] who argue for unobtrusive, aesthetic technology for better results.

All of these design guidelines can be adapted and included in a wide array of different game mechanics to support physiotherapy. Discussions with physiotherapists and game designers showed that the games used for rehabilitation can be seen as a

medium, the message being a continuous motivation for therapeutic motion and movement. They provide patients with a diverse set of mini-games to cover different interests, break with the monotony of the exercises and provide multifaceted experiences throughout the duration of the physiotherapy.

6 Conclusion

Connecting and interrelating the outcomes of interviews with physiotherapists and the focus group with older adults provided a much-needed context for the game designers to work with and focus on during the brainstorming sessions. One of the most interesting results is the fact that the game designs need to be engaging and motivating, however, only to the point that they are not too addictive in order to prevent players from further injuries. Especially seeing how popular smartphones are amongst older adults and how they create time for the use of technology provided an insight into a modern older adults life. Learning about everyday routines of older adults presented multiple possible opportunities to include games in everyday practices, while learning about locations where technologies were frequently stored and used provided insight into what kind of technology could be useful to design for.

We identified nine game design guidelines to address the issue of ongoing engagement in games for health: goal setting, use of metaphors, conveying a feeling of completion, avoiding competition, avoiding punishment, showing progress, social connectedness, additional values, and embedding exercises in daily routines. For each of these guidelines we also describe specific game mechanics to illustrate how the guideline can be included in a game's design. These design aspects can be used by game designers and researchers as a basis for thinking about engagement in games for older adults, as well as as a foundation for building games for physiotherapy and for encouraging physical activity.

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