ABSTRACT
While studies point to the positive potential of games for health to increase patient engagement and to a need to consider longer-term perspectives, there is a lack of more tangible knowledge on how to design for long-term engagement in games for health. This paper makes a contribution in this space by drawing a reflective arc across three games for health projects from areas such as rehabilitation, prevention and chronic disease. We discuss the projects using a research through design lens and reflect on user research data and design artifacts from the perspective of the involved game designers. The results are design considerations towards long-term engagement in games for health. These considerations present a body of intermediate-level knowledge [19] oriented towards maximising the potential of the design space in early stages of games for health projects. The considerations are structured into those relevant to gameplay, research design and application context.

CCS CONCEPTS
• Software and its engineering → Interactive games; • Human-centered computing → HCI design and evaluation methods; • Applied computing → Health informatics;

KEYWORDS
Games for Health, Long-Term Engagement, Game Design, Design as Research

1 INTRODUCTION
There is a fast-growing body of research on games for health, but how to design games for long-term use in health applications is sparsely documented. This has been pointed out in systematic reviews on games and gamification in health care, e.g. by by Lister et al. [35] and Kharazzi et al. [31], and more directed measures towards maintaining player engagement are needed [13]. Areas such as chronic disease, rehabilitation and disease prevention all need patients to commit to routine tasks over longer periods of time. The heterogeneity of target audiences, the need for adaptivity in relation to health or treatment changes, and individualisation options for different player types make the already hard challenge of designing for long-term engagement even harder. Games for health need to be regarded as complex, contextual and highly individual experiences [8] to make them work in the long-term.

This paper tries to establish a base of considerations how to design for long-term engagement in games for health. As Seaborn and Fels [48] discuss the need for more practical explorations and theoretical deliberations in their survey of gamification literature, we aim at turning practical design knowledge into actionable theoretical considerations. With this paper we open up a design perspective for games for health, which goes beyond the strictly medical view of validating a specific game design in relation to clinical outcome measures. While such research without doubt is of high importance (e.g. see Kato [24]), there is little documented knowledge how to approach the design of a game for health in the first place, before it can be a subject of validation. In design research Höök and Löwgren [19] call this type of contribution ’intermediate-level knowledge’ resulting in ’strong concepts’ which lead to an understanding of design characteristics for a clearly delineated problem. In our case this intermediate-level knowledge is relevant when using a priori insights from formative user and stakeholder research to design a game for health towards a desired medical outcome. As we show in the related work section, there is little structured design knowledge on how to address long-term engagement. The strong concepts we present in this paper consist of design considerations towards furthering engagement with games for health with the aim that designers can use them in practice [20] so that they can maximise the potential of the design space in early stages of a project.

We draw together insights from three games for health projects with a long-term orientation to present a structured series of design considerations for long-term engagement with reference to application contexts, gameplay and research design. Authors of this paper were the lead designers of these games. We reflected the designs based on a research through design approach [58] and group discussions of user research data, design artifacts and preliminary observations, evaluated through thematic analysis [10]. The three presented projects span different areas and target audiences: compliance with physical therapy exercises for the knee, hip and shoulder areas for a general audience; preventive behavior to delay or slow the onset of dementia with older adults; and health monitoring of children and young adolescents after cancer treatment. We present the resulting games and prototypes and reflect on our
design decisions in relation to long-term engagement and prior formative research.

For members of the games for health research community this paper provides tangible design insights and structures design considerations so that they can be more easily applied in different contexts. We start with discussing literature on how to design for long-term engagement with games for health. We then present each of the three projects and discuss design considerations individually. In the discussion we merge, abstract and structure these considerations into strong design concepts with the intent that future designers of games for health in the areas of chronic disease, rehabilitation and disease prevention can build on them.

2 RELATED WORK

This paper uses the term engagement as a means of expressing a desire and willingness to stick to a game for a longer time frame. As opposed to the deeper states of engrossment and total immersion, engagement is described as the first and lowest-level of involvement with a game [4]. Meta-reviews by Johnson et al.[22], Primack et al. [42] and Kato [23] have all outlined the positive potential of games and gamification to improve health outcomes. In both rehabilitation and disease prevention, games need to support routine behaviour and continuous engagement with repetitive and possibly otherwise boring tasks (e.g. see [7]).

Many applications of games for health have long-term objectives. What is perceived as long-term strongly depends on the particular application context of a game for health. For the purpose of this paper we regard long-term as exceeding the often standard three-month evaluation time span (e.g. see the overview by Rahmani and Boren [43]). In a 14-month study, positive effects of virtual reality games on anxiety and depression of young cancer patients were observed [34]. Other studies have shown positive effects of active video games in reducing children’s weight over a period of six months [37] and sustained engagement for one year with a game for asthma education of children [49]. In another example of a longer-term study Simons et al. [51] evaluated the use of games to encourage physically active gaming and doing sports over one year with healthy children aged 12 to 18, and they identified long-term engagement and continued use as the biggest challenge.

Intrinsic motivation can play an important role in sustained engagement with games for health. Games often primarily focus on extrinsic motivators such as rewards. The danger of extrinsic motivation is that, while necessary and a good motivator in itself, it potentially harms intrinsic motivation, as shown in a meta-study by Deci et al. [12]. To support intrinsic motivation, game design can build on the concepts of competence, relatedness and autonomy from self-determination theory [46] to make a game engaging in the long-term. Informational feedback [44] such as points and game goals can also be used to support intrinsic motivation. Intrinsic motivation further helps health-beneficial behaviors to persist beyond the context of a game for health used to train or sustain them. A systematic review of studies on active video games that promote physical activity in children and youth, also describes self-initiation and choice as the most important factors for sustained engagement [3]. Game-based approaches related to self-determination theory can also be drawn from behaviour change technology (BCT) [1] [11] [9]. A BCT approach related to self-determination theory, for example, is goal setting [39]), where players are allowed to define their individual health and in-game goals. Self-determination theory offers a good model for player engagement but does not easily translate into applicable design knowledge.

In more specific examples of game elements for furthering long-term engagement, Biddiss et al. [3] cite positive reinforcement, feedback, both immediate and prolonged, and ease-of-use as important factors for long-term motivation. Uzor et al. [53] recommend to communicate progress and to enable player choice in the design of exergames for older adults. A study on feedback in brain training games concludes that both positive and negative feedback increase the willingness for engagement with a serious game [6]. The study further describes that negative feedback rather triggers short-term motivation for engagement (e.g. to make good on mistakes) and that positive feedback increases long-term motivation by making players feel more competent and autonomous. In a qualitative three-year study with one player of the dancing game Dance Dance Revolution [32], Dubbels [15] identified a series of principles for long-term engagement of adolescents to become more physically active, which include social play and also self-determination. A 24 week study also used Dance Dance Revolution with younger adults and saw a decline in engagement with the game after 12 weeks. Participants cited group play, competitions, and greater gameplay variety as possible motivators for higher engagement [38]. Often-used elements to further long-term engagement also documented in the design of games for health include scoring [41], adaptive challenges [41] [55] [18], personalisation [18], social play and competition [18] [41], variation [55] and feedback [18].

All of the long-term studies presented earlier help in validating the use of games for health-related outcomes, and more are needed to grasp the role individual design elements play in sustaining engagement. In this paper we are more interested in an a priori design perspective, and in how we can translate health goals and the results of formative user research methods into actual game design. This type of research produces intermediate-level design knowledge as described by Höök and Löwgren [19]. A similar approach in establishing design considerations has been pursued by Isbister and Müller [21] for movement-based games. For games for health the most related approach was taken by Kelley et al. [30] who identified seven themes for the design of games for health in interviews with game design, behavioral health and games for health experts. Our research further presents a synthesis of design insights across projects with several age groups and various application areas. These different sources allow us to consolidate our insights into robust design knowledge, likely to be applicable in the design of games for health for different areas of application.

3 METHODOLOGY

The design considerations presented in this paper were developed in a three-stage process of design as research, reflection and consolidation.

Three of the authors of this paper are also the lead designers of the games presented and discussed in this paper. The authors have many years of experience in design and game design in particular as evidenced by their publication record [references removed for
review] in this space. As active design practitioners two of us also have commercial design and game industry experience and our work and games have been presented at venues such as GDC, The Independent Games Festival, IndieCade, Ars Electronica, CHI, CHI Play, DiGGRA, Games for Change and Games for Health Europe.

The first step was to design the games in an exploratory design approach, in which the design process acts as the means of knowledge construction, also known as ‘design as research’ [5, 16]. In 2007, Zimmerman et al. first summarised the concept of research through design for HCI [58]. A related concept for exploratory design originated from Dewey’s Theory of Inquiry [14], where he introduces the approach of doing for the sake of knowing. It was extended by Donald Schön [47], 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. For game research, Stapleton describes a similar approach as the “RADDAR”-method; an iterative loop, where he reflexively defines research as design and design as research [52]. He describes an ongoing dialectic between academic research and game design practice, which also influenced our reflective approach to the games for health projects presented in this paper. We documented the design process through notes, design concepts and by preserving analogue and digital design artifacts.

The second step was a reflective analysis where we revisit the three games for health projects individually. For each of the games we reviewed (i) the user and stakeholder data collected a priori, (ii) the design artifacts (concepts, prototypes and games) and (iii) preliminary observations how the games were used ‘in the wild’. The results of these reviews were then evaluated using thematic analysis [10] resulting in three main themes comprising a series of specific design considerations. In a third step we reviewed and then consolidated the design considerations across the three projects, which comprises the meta-level of our thematic analysis.

4 REVISITING THREE GAMES FOR HEALTH PROJECTS

In this section we describe the three game projects, Mirror, Lebensnetz, and INTERACCT, and then present the results of our reflective analysis in the form of design considerations for long-term engagement with games for health.

The design processes from which we abstract the design considerations all build on a mix of mostly qualitative formative research methods conducted before the design of each of the presented games for health projects. The use of formative qualitative research in designing games for health has been described as beneficial to the final product [2], in particular regarding acceptance of players, stakeholder support and sustainability [13]. For each project we give references to previously published formative research results and describe the resulting games. All three of the games presented here were financed through industry funding. There were clear deadlines to finish the games and little access afterwards. Thus none of the games were subject to long-term validation.

4.1 Mirror

The Mirror research project explored the use of 3D-sensor technology for physical therapy. Due to the use of the 3D-sensor, and because we had other prototypes that use a mirrored screen, we used screen-based interaction despite shortcomings of this setting such as gaze fixation. As part of the project a series of game prototypes [26] were created with the aim of supporting compliance with therapeutic exercises in knee, hip and shoulder rehabilitation. Often joint rehabilitation can be a longer process involving setbacks, thus the prototypes were oriented towards long-term compliance with daily exercises. They were not aimed at a specific age group.

4.1.1 Background. Formative research done to support the creation of the prototypes consisted of interviews with physiotherapists and two design workshops with professional game designers, which built on the interview results. These methods led to the understanding that while the daily games must be engaging to stay interesting, the main focus should be on the long-term motivation via either social connectedness or conveying the feeling of progress or completion within the game context [26].

Building on these foci a series of prototypes was created during the Mirror project. Figure 1 shows a prototype where a helicopter is used to stack blocks. Each block represents one repetition of a particular exercise, while its size and placement are determined by how correctly the exercise is timed and executed. Another example is a companion app created to visualise both game and rehabilitation progress, which generates additional value by providing medical information and pointing out the specific benefits of each exercise.

Figure 1: Game prototype from the Mirror project, where a helicopter is controlled through physical therapy exercises.

4.1.2 Design Considerations.

- One game prototype used goal setting of players together with their therapist. Players then travel across the world using a basket carried by balloons. Over the course of the therapy the rehabilitation process is represented by the progress of the balloon basket towards its goal.
- The same example also illustrates the use of metaphors; by doing their exercises players inflate the balloons necessary to carry them towards their goal. Each balloon stands for a training 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. We chose this universal metaphor for representing A peer-reviewed publication detailing the formative research results also is currently in preparation by members of the Mirror project. It is expected that it will be available for citation once this paper will be published.
The goal of the Lebensnetz project was to create a game or playful activity that allows users to organise memories in a structured yet playful manner. The project’s target audience are older adults who do not yet have symptoms of dementia. As reminiscence work is considered as stressful for persons suffering from dementia, Lebensnetz is designed in a way that helps slow cognitive decline.

4.2 Lebensnetz

The goal of the Lebensnetz project was to create a game or playful application for weekly use over longer time frames (one year or longer) to help slow cognitive decline. The project’s target audience are older adults who do not yet have symptoms of dementia.

4.2.1 Background. Formative research for the Lebensnetz prototype consisted of focus groups with older adults, relatives, clinicians, care personnel and aging experts [40] as well as a comparative analysis of game elements currently used in games for older adults [25]. Building on these methods design workshops with game design experts were used to generate ideas for the project [36]. The results of these methods manifested in a focus on cognitive and social activities as well as reminiscence and the decision to create a game about life history and imagination.

The result is a tablet application or software toy that forgoes many elements of games such as clear goals and rules but maintains a playful approach by challenging users to structure their memories in an open-ended manner. While originally intended as a game the focus group results led us to deviate from that plan. This led us to orient the game more towards playfulness, exploration and self-expression. The app centres around organising pictures of one’s personal life as a structured way of reminiscence and thus a preventive measure against cognitive decline. Users can align pictures along a timeline (see Figure 2) in relation to well known past events. And they can also choose to arrange them on an open canvas to create a family tree or ‘life network’ (a literal translation of the German term ‘Lebensnetz’). They can also use the pictures to play mini-games such as Memory.

4.2.2 Design Considerations.

- Lebensnetz builds on the use of auto-biographical play to organise memories in a structured yet playful manner. The structured engagement with inserting pictures into a timeline is aligned with research on reminiscence as an activity that helps slow cognitive decline.
- Interaction with Lebensnetz can be individually different for each user. Users can choose how to interact with the application by either choosing a timeline or canvas view to organise their memories. They also can use the canvas for reminders and notes and can choose to just browse and play simple mini-games instead of adding contents.
- As a result of auto-biographical play and individualisation the contents created in Lebensnetz are highly personalised and, thus, further attachment.
- Lebensnetz moved to tablets as a platform, because they provide more ease of use and are personal devices, as opposed to the original idea of creating a gesture-based game using the Kinect sensor.
- As reminiscence work is considered as stressful for persons suffering from dementia, Lebensnetz is designed in a way that rewards success but avoids confronting users with failures.
- Although originally conceptualised as a game, many game features such as goals and scoring were left out not to discourage failed efforts. Instead we focused on an overall playful experience [50]. We also integrated mini-games such as a memory game using the pictures uploaded into the game.
- Lebensnetz revolves around the life history of one particular person but its use has many social aspects. In field trials we saw that adding pictures to the app involves help of care personnel and relatives, which leads to interesting discussions between them. Also Lebensnetz has been used to support telling stories of one’s life to others.
4.3 INTERACCT

The goal of the INTERACCT game is to let medical experts observe changes in young patients’ health status by assessing data entered into an electronic health record. Patients are six to eighteen years old and are in hematopoietic stem cell transplantation (HSCT) aftercare for a long period of 12 to 36 months. The game was made to support compliance with daily entry of medical data over this period.

4.3.1 Background. HSCT is a high-risk procedure mostly done as cancer therapy. It is associated with risks such as multiple organ failure due to a weakened immune system. Therefore it is important that compliance with recording medical data is high, so that possible crises can be predicted and treated as early as possible. For this reason data entry is coupled with a game with the idea to increase long-term compliance.

Formative research in INTERACCT has been conducted using a mixed-method approach including exploratory design, surveys on gaming preferences and qualitative proxy design sessions [27, 28]. The results pointed to a focus on adventure, exploration and fighting gameplay with a preference for fantasy and animal characters [29].

The INTERACCT game is played by children on a smartphone or tablet. It consists of a medical data entry part and a game world of islands that can be freely explored in a rogue-like fashion using avatars that we call ‘pets’. We use common traits of rogue-like games, including randomly-generated environments and permanent failure (meaning the loss of all items collected during a run). A player chooses an island they want to explore and their current pet is transferred into a side-view of the island (see figure 4). They can take different paths to find a way through the island, while fighting enemies, solving environmental puzzles and/or discovering secrets. While moving on the island, the player can collect items to temporarily ease the journey and to improve the skills of the pet. At the exit, the player is awarded a persistent item that can support compliance with daily entry of medical data.

4.3.2 Design Considerations.

- We further used the two-currency system found in most online social games, where there is one currency that can be obtained through gameplay and a second one that can be bought with real money. We replaced the second currency with medical compliance, which can be used to buy unique otherwise not available game items.
- We use fighting as part of the gameplay because it is a metaphor commonly applied in cancer treatment. This integrates the game better with other efforts to coach children in this difficult situation.
- The progression system of the game is built on interacting feedback and reward loops. Simply put, completing data entry may, for example, reward a new pet. Unlocking skills for that same pet then requires both playing the game and compliance with medical data entry.
- The game uses elements from role-playing games such as levelling, upgrades and skill trees, as well as increasing the difficulty of challenges with respect to the level and abilities of a player’s character. These elements allow players to indefinitely progress in the game.
- Procedural content generation is used to help with content shortage. The dynamic generation of islands allows new content on a daily basis.
- The game gives a choice of gameplay styles, mainly between exploration and fighting. This allows individual players to play according to their preferred style (e.g. following Yee’s [56] motivations for play in online games), and it allows player to switch up gameplay styles when they are bored and want to try something new.

5 DISCUSSION

In following we discuss design considerations across all three of the projects presented earlier. Of course, due to the complexity stemming from varying application areas, user groups and contextual factors, these are not to be understood as universal guidelines, but instead as intermediate-level knowledge. They represent tangible starting points when designing a game for health. The resulting considerations can be broadly structured into those relevant to application context, gameplay and research design. All three of these
areas also overlap with several of the themes identified by Kelley et al. [30].

5.1 Application Context
Across all three case studies we saw a focus on personalised and individual experiences. The target audiences of games for health often are highly heterogeneous. Players of a game for health may share a life context but not a particular play style or preference for a certain genre. The strategies used to address this issue include the use of mini games to increase variety and building game environments in a way that caters to different play styles (e.g. different modes of interaction in Lebensnetz and the choice between exploration and fighting in INTERACCT). Furthermore, we used methods such as customisation and user-generated content to create more individualised experiences. Additionally, established practices such as individual goal setting not only increase motivation [39], they also make the overall experience feel more personal. Overall, we can confirm that offering ways for self-determination [46], self-initiation and choice in games for health helps create more personalised experiences.

All of the presented examples make an effort to relate to everyday habits and daily routines. The companion app in Mirror embeds exercises in daily practices. Lebensnetz allows custom reminders. INTERACCT is structured around routine uses where game-relevant events and rewards are aligned with scheduled entry of medical data. Another example is the integration of the Fitbit fitness tracker with the popular sports videogame NBA 2K17 [54]. The game gives rewards to players when they reach a daily step count threshold [17].

One of the premises in the design of all of the presented cases was to either provide additional value or increase perceived value of the respective game for health. Increasing perceived value goes hand-in-hand with giving good feedback on health-related progress (see above), which can, e.g., be augmented with medical information. Perceived value can be immediate, for example through feedback, or long lasting, e.g., by communicating the longer-term benefits of sustained exercising. Additional value can be created through the embedding in daily routines (e.g., reminders) and social factors (see below).

Across all three case studies we ended up using mobile platforms such as tablets or smartphones. They were either the lead platform for the respective game or provided additional value in the form of a companion app. Using mobile platforms provided several advantages, all of which relate to other design considerations mentioned above. A mobile device is personal and, thus, well suited for individualised use. Smartphones in particular are carried on a person and allow for tighter integration with everyday habits and daily routines. As such, they are also well suited to provide additional value through reminders and support repeated and periodic use with shorter sessions where necessary.

5.2 Gameplay
An integral part of games that serves a double function in games for health is feedback and consequentially representation of progress. Informational feedback in games for health on the one hand has to support gameplay and on the other hand responds to and represents progress of health-related behaviour. As such, it can also support the intrinsic motivation of players [44]. Where gameplay and health-related behaviour overlap, feedback can make use of metaphors relevant to both (see above). Showing progress has to convey a feeling of completion (e.g. see the band example in Mirror), but should also illustrate more open-ended possibilities to further advance in the game and, thus, maintain health-beneficial behaviour (e.g., the use of levelling and role playing game elements in INTERACCT). Lastly, it is known that while positive feedback tends to help sustain engagement [3], negative feedback, while often necessary gameplay-wise, can be discouraging long-term [6]. For this reason Lebensnetz has avoided negative feedback and forgone to include many of the originally planned game elements like challenges and tight rules.

In terms of using rewards to increase player attachment, Lewis et al. [33] discuss the use of motivational game design patterns. The patterns identified in online social games include design decisions to keep players in the loop and attached to game, e.g., sunk cost fallacy (continued play due to the already high time investment made into a game) or reinforcement schedules (usually a mixture of guaranteed and random rewards given to players to keep them interested). These patterns have been used in INTERACCT along with the multiple currency system used in online social games. The difference is that real money is replaced with medical compliance as currency, which in turn can be used for quicker game progress and unique rewards. Periodic reward schedules and interacting feedback and reward loops further increase player attachment and compliance with the entry of medical data. The use of these mechanisms also poses ethical questions as many of the design patterns outlined in [33] build on psychological "exploits" such as strategies used in gambling. Such ethical questions have also been raised by Zagal et al. [57] in their discussion of dark game design patterns. The idea is that the instant gratification of, e.g., not doing a daily exercise outweighs objective interest and long-term goals of players. Dark game design patterns described above can be used, carefully, to provide motivation for neglected health goals. Game design here has to weigh potential benefits against ethical drawbacks.

Social connectedness, collaboration and competition all provide additional value to a game. Both the impression of not being alone in a recovery or treatment process and the possibility to connect with others inside (e.g., by showing off progress in Mirror) and outside of the game (e.g., by using Lebensnetz to tell stories) can help sustain engagement. Social competition can help add challenges and ease lack of game content (see below). Comparison of progress can also not be advisable due to individually different healing processes, which was the reason social features were excluded from INTERACCT.

One of the bigger logistic challenges of sustaining interest in games for health is to stay relevant content-wise. Content production for games is expensive, especially for serious games, long-term content strategies are rarely financially viable. In the presented case studies we used procedural content generation (the islands in INTERACCT) and a form of user-generated content (the uploaded personal pictures that constitute the core of Lebensnetz).
5.3 Research Design

In games for health, there ideally is an overlap of core gameplay with health-beneficial behaviour. In contrast to gamification techniques, where game elements are used to provide feedback, rewards or incentives for behavior, games for health can use game mechanics that are aligned with the behavior they are meant to support. In our case studies autobiographical play in Lebensnetz and the aligned schedules in INTERACT are examples of this. The use of metaphors can also help with linking gameplay and health-related behavior. It eases the transfer of an idea from theory to something graspable, e.g., fighting mechanics in cancer treatment in INTERACT or the use of balloons or building to represent rehabilitation progress in Mirror.

From a design perspective we can assert that the use of formative research, in particular qualitative user-centred approaches, tremendously helped in grasping the complexity of problems and eased finding directions for ideation and subsequent designs. This is in line with the emphasis Baranowski et al. ([2]) and Desmet et al. ([13]) put on formative research in games for health design. We also document the use of proxies in user-centred design for sick children from an a priori perspective [29]. Ruland et al. [45] discuss the particular ethics around this as well: sick children might already be under a lot of stress and it often can be a burden to add participation in user research methods.

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<th>Application Context</th>
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Figure 4: Overview of design considerations.

6 CONCLUSION

This paper presents design insights from three games for health projects with different target audiences and application areas including knee, hip and shoulder rehabilitation, prevention of cognitive decline and medical diaries in cancer treatment. The result is intermediate-level knowledge in the form of a series of design considerations that future games for health in the areas of rehabilitation, disease prevention and chronic disease can build on. The considerations can be broadly structured into those relevant to context of application, gameplay and research design. Gameplay related design considerations discuss feedback and representation of progress, using rewards to increase player attachment, procedural and user-generated content, as well as social connectedness, collaboration and competition. Considerations for research design confirm the usefulness of the application of formative research methods and recommend an overlap of core gameplay with health-beneficial behaviour. Design considerations related to the application context of games for health discuss personalised and individual experiences, how to relate to everyday habits and daily routines, how to provide additional value and increase perceived value, and the use of mobile platforms.

Ensuring long-term engagement with and evaluating the long-term implications of serious games in general and games for health in particular is one of the big future challenges of these fields. Future work can build on the design considerations presented here from both practical and theoretical perspectives. First and foremost, they provide tangible starting points for designing games for health. Second, a more directed approach towards evaluating and validating the use of specific game design features in a long-term context can be taken with games designed based on these considerations. Future publications could provide finer-grained considerations and descriptions of game features. Combined with evaluations over longer time frames these can then lead to a taxonomy of validated features for long-term engagement with games for health.

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