On the Importance of Locations in Therapeutic Serious Games

Review on current health games and how they make use of the urban landscape

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Abstract - This article addresses the question of how different health games involve real world locations. A usage-based taxonomy is placed in relation to current research on "building blocks" for health games, on pervasive gaming and urban design theory. This provides a conceptual framework to guide a review on current practice, showing amongst other things, that mobile exergames use a wide range of gameplay activities. These activities span from developing physical skills, to immersive storytelling and social interaction. In contrast, diabetes management games seem to primarily involve simulating self-care, knowledge gain and "nurturing" of a virtual character. Both preventive and therapeutic health games – in this paper focusing on those promoting physical activity and dealing with disease management - increasingly use mobile technologies. It is shown that such games can interact with topographic and social context of the urban landscape in different ways. Therapeutic games have so far hardly involved any pervasive gaming strategies. The article concludes with an outline of further interdisciplinary research to address a broader range of gameplay activities and finally, various game sites are framed in the perspective of urban design research.

Keywords-mobile exergaming; diabetes games; locations; pervasive gaming, urban theory

I. INTRODUCTION

This workshop on *Therapeutic Serious Games and Pervasive Computing* sets out to advance the "seamless integration [of so called theragames] within medical services *regardless of space and time,* […][1]." The latter formulation highlights a certain independency of pervasive health care services from any restrictions that may occur for instance by opening hours or confined institutional spaces. Whereas greater accessibility and more seamless integration of health games in our daily lives seems appropriate, this emphasis poses an interesting question in the context of game design: To what extent are *pervasive* theragames *based on*, *aware of* or *sensitive to* real world locations? Or in turn: How may paying more attention to the role of space and spatiality while designing health games, improve their effectiveness and play experience? In the following, we review research in the field of health games, pervasive games as well as urban and architectural design theory in order to develop a conceptual framework for such location-sensitive health games. This working tool guides a review on recent health game practice analyzing their gameplay activities in general and their use of real world locations in particular.

II. USAGE-BASED HEALTH GAME TAXONOMY

Sawyer and Smith have criticized serious games in that they often consider only "the outcome" and therefore undermine "a larger possibility space of serious games [2]." According to them, the latter may precisely unfold from different "inputs" and may result from experimenting with various kinds of gameplay, technologies, or - as one could add - pervasive gaming or urban design strategies. Though very much in line with their claim to see "inputs" and "outcomes" closely related, for our purposes we suggest to derive a purely usage-based health game taxonomy initially. On that basis, we may go on comparing health games in the way they seek to achieve their purposes. In 2009, Sawyer suggested a "Games for Health Taxonomy" starting off with nine aspects on "*What is Games for Health*?":

- "Exertainment,
- Rehabilitainment,
- Learning-by-doing,
- Disease-management,
- Useable simulation,
- Health messaging,
- Pain distractions,
- Visualization and
- Information design [3]."

This list seems valuable to our discussion for various reasons. Firstly, it seems to provide a comprehensive overview on health games - distilled to a fairly operational amount of labels. We may therefore adopt some of these to construct a

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merely usage-based taxonomy. "Exertainment" turns into exertion games (*exergames*) as well as "rehabilitainment" into rehabilitation games (*rehab games)*. Labels such as *disease management*, *pain distraction* or *stress* [relief] *games* stay as they are, since they already indicate a primary usage. In this notion, "learning-by-doing", "useable simulation", "health messaging", "visualization", and "information design" may be subsumed according to their preliminary purpose of *learning.* The result may read as follows:

- Exergames,
- Stress relief games,
- Rehabilitation games,
- Disease management games,
- Pain distraction games,
- Learning games.

Sawyer goes on setting health games into a matrix between different target groups such as "personal" usage or "professional practices", "research & academia", and "public health" [3:17]. As will be discussed later in this article, we seek to advance participatory design processes of therapeutic health games. Our review will therefore focus on what Sawyer suggests as games for "personal usage." He lists in this category for instance exergaming, stress relief, rehabilitation as well as disease-management games [3:17]. Sawyer attributes exergames as well as stress relief games as "preventative", while rehabilitation games, disease management and pain distraction games are associated to "therapeutic" games [3:17]. In the following we will focus on disease management games dealing with diabetes as an example for *therapeutic* serious games. Demiris et al. observed an increasing use of mobile technology for diabetes management software in general [4]. Since this article seeks to advance the involvement of real world locations to such services, we will contrast diabetes games with a selection of exergames. As Mueller has pointed out, the latter have increasingly gained attention in the pervasive game domain, particularly since the sports market would consider this area of extensive potential [5].

"10 Building Blocks"	**Gameplay Check-List**
***"10 Ways to improve health through playing video games"*[9]**	***Gameplay activities emphasised in the reviewed health games.***
(1) Challenge	Distinctive Challenge set and constant feedback provided?
(2) Engagement and Immersion	Emphasis given to storytelling and "transport" to game world?
(3) Motivation	Game goal closely related to health outcome?
(4) Identification and Nurturing	Emphasis on care of a virtual character?
(5) Consequences of health behaviours	Consequences being portrayed through virtual character?
(6) Skill development and carrying out	Emphasis on learning and / or carrying out of physical skills?
(7) Knowledge gain	Emphasis on gaining health related knowledge?
(8) Rehearsing real life	Decision-making rehearsed in real life situation?
(9) Simulating self-care	Self-care simulated on an abstract basis?
(10) Social interaction	Social interaction motivates for health related behavior change?

Figure 1. Gameplay check-list retrieved from Lieberman's "10 Building blocks" for health games.

III. GAMEPLAY "BUILDING BLOCKS"

In a second step we can now relate single usage-based categories to whatever input – technology, game play activity or usage of space - we like to discuss. Lieberman has recently suggested a comprehensive list of "building blocks" for health games [6]. Drawing on the results of well-established and ongoing research in interactive media, behavioral science and game design, she advises to explore one or more of the following aspects when designing a health game as listed in figure 1.

It is worth specifying Lieberman's "building blocks" in more detail here, since they will guide our review on a general basis. Elsewhere Lieberman has pointed to the importance of goals as the central motivating feature in interactive games. It is precisely the loop of *challenges* and immediate feedback on progress that rewards players with a sense of control and self-efficacy [7]. Balancing challenges would contribute decisively to player's *engagement and immersion* to the game. Lieberman emphasizes the possibility to transport players "into new worlds" through an intriguing story [6]. In general, according to Lieberman, interactive games motivate players through the incentive of trying to win the game. This extrinsic *motivation* would start a learning activity that in turn stimulates a more intrinsic, internalized interest in the actual subject [7:380]. For health games, she suggests to relate the game's goal closely with the attempted health outcome [6]. For Lieberman, *identification and nurturing* of a virtual figure is a further crucial building block for health games. To take care for a virtual pet's health may well lead to the feeling "what could happen to them could happen to me [6]." Virtual characters may as well help to portray *consequences of health behaviors.* Lieberman states elsewhere that new behaviors would be foremost learned by observing the action of others as well as their outcomes and consequences [8:112]. The capability to give constant feedback on players' progress supports the *development of skills* within interactive media. Playing a video game allows players to train and fail in private and then go public when their skills have been developed well [6].

Lieberman directs our attention to an interesting point here as patients with chronic conditions may often feel stigmatized in this regard. This interplay between public and private gameplay will be revisited later in our discussion of the challenges of pervasive gaming in a health context. For Lieberman, well-designed health games offer plenty ways to *gain knowledge*. She highlights "procedural knowledge", which would support the complex decision-making required in disease management [6]. *Rehearsing real life* within a health game would put players into "real" situations asking them to make decisions that may lead to a good health outcome. Likewise, *simulating self-care* would allow players to make "lifestyle and self-care decisions and see the consequences" within the game. [6]. Lieberman concludes with the important role of *social interaction*, which may motivate for health related behavior by fostering "competition, collaboration, teamwork, talking about games, removing stigma and changing perceived norms [6]." As shown in figure 1, we derived a check-list for game play activities from Lieberman's "building blocks", which guided our review as will be presented in the following sections.

IV. GAMEPLAY IN MOBILE EXERGAMES

Exergames have been described as "videogames that require or produce physical activity [9: 294]." The Health Game Research (HGR) database lists 46 games dealing with the *topic* of "physical activity" [10]. Nine games from the *genre* "exergames" run on mobile platforms including one for the iPhone, one purpose built handheld, two mobile, one Nintendo DS and four games developed for the web, which may potentially run on mobile devices as well [10]. Our selection includes two games of the HGR list: The "GPS word-spelling game" *Seek'n'Spell* [11] and a "ubiquitous activity-based gaming" series called *NEAT-o-games* [12]. Charles Rich's serious game course website at Worcester University provides us with a further comprehensive "Sample of playable serious games and interactive media". We discuss three examples from his category of "mobile exercise games" [13]: "*FastFoot Challenge* [14]*, FitQuest Lite* [15] and *Monumental* [16]. Conclusively, we discuss *CryptoZoo* [17], a mixed reality game seeking to promote physical activity. As shown in figure 2, we have searched articles referring to these games for keywords that may indicate the use of one or more gameplay activities in question. These references have been published in the form of commercial websites or scientific publications [18,19,20,21,22,23]. Most of their authors have been involved in designing and developing the games. It is important to note that the pattern of gameplays presented here represents the authors' emphasis and intentions rather than empirical data gained through actual play experiences.

As shown in figure 2, all mobile exergames specify clear challenges. These vary from "to gather letter tiles and create words to score the most points [18]", solve a Sudoku puzzle [19], guide a virtual character [21], "climbing the most stairs [22]" to "escape other runners [20]" or chase and spot fellow players [23]. All texts claim to combine these goals closely to expected health outcomes. Reference [22] for instance states: "The more you climb, the higher you go, and the more of the worlds great monuments you will explore." Four references [20,21,22,23] emphasize immersive storytelling. Reference [23] features fantasy characters, which players try to imitate while moving around in the real world: "There's just something about those mysterious cryptids... they unlock the creature in all of us." Three references touch upon the role of a virtual character within their game play as a play-other to identify with and get inspired by [19,21,23] Only one reference suggests players would take care of such a virtual character: "Your own natural movements, jogging in place, hopping and ducking will get baby squirrel safely to the tree house [21]."

All references for mobile exergames claim to support the development and carrying out of physical skills [18,19,20,21,22,23]. Whereas in [18,21,22] emphasis seems to be given to carrying out everyday physical activities in various intensities, others seek to challenge player's "parcour skills [20]". Mobile exergames attempt to engage "natural movements, jogging in place, hopping and ducking [21]" or even develop new "running styles [23]." Various kinds of social interaction are highlighted within all six references, from competition [18,19,20,22] or collaboration [23] to changing perceived norms of physical exercises [23]. As figure 2 indicates, none of the references seems to emphasize portraying health consequences with the help of a virtual character. To provide health related knowledge or to rehearse health related decisions is not mentioned. Likewise, none of the reviewed mobile exergames emphasizes any sort of simulation of self-care [18,19,20,21,22,23].

Gameplay Activities in Health Games	*1. Challenge*	*2. Engagement and Immersion*	*3. Motivation*	*4. Identification and Nurturing*	*5. Consequences of health behaviors*	*6. Skill development and carrying out*	*7. Knowledge gain*	*8. Rehearsing real life*	*9. Simulating self-care*	*10. Social interaction*
I. Mobile Exergames										
1. Seek'n'Spell [18]	✓		✓			✓				✓
2. Neat-o-Games [19]	✓		✓	✓		✓				✓
3. Fast Foot Challenge [20]	✓	✓	✓			✓				✓
4. Fit Quest Lite [21]	✓	✓	✓	✓		✓				✓
5. Monumental [22]	✓	✓	✓			✓				✓
6. CryptoZoo [23]	✓	✓	✓	✓		✓				✓
II. Diabetes Management										
1. dbaza's Diabetes Education [32]	✓		✓	✓		✓	✓			
2. Knock 'Em Downs [33]	✓	✓	✓	✓	✓				✓	
3. Glymetrix Diabetes Games [34]	✓		✓				✓			
4. GRIP [35]							✓			
5. Insulot [36]	✓		✓				✓		✓	
6. Packy & Marlon [40]	✓	✓	✓	✓	✓		✓		✓	✓

Figure 2. Gameplay activities in health games.

V. GAMEPLAY IN DIABETES GAMES

The health games research database lists six games dealing with "diabetes management" [10]: *Dbaza's Diabetes Education for Children* [24], *Glucoboy* [25], *Glymetrix Diabetes Game* [26], *GRIP* [27], *Insulot* [28] and *Packy & Marlon* [29]. Two are developed for mobile devices [25,28], one runs on a console [29], one has been developed for PCs [24] and two are web based [26,27]. Since both websites referring to *Glucoboy* were disabled at the time of writing we substituted [25] by the glucose meter system *Bayer Didget* [30]. It can be attached to the Nintendo DS and is distributed with the game *Knock 'Em Downs* [31]. References have been taken from product websites [32,33,34,35] or – if available - from scientific publications [36,37]. As can be seen in figure 2, one of the most prevalent building blocks claimed for diabetes management games is "knowledge gain". Most references claim to teach players procedural knowledge required in diabetes management [32,34,35,36,37]. Reference [32] for instance claims "to cover the interrelationship among insulin, diet, exercise, and blood

glucose levels." Challenges set within diabetes management games seem to be foremost diabetes related quests and puzzles [32,33,34,37]. Reference [36] highlights "calculating the carbohydrate grams in each food" that would partly "determine the final score for each time the game is played". Four references claim to combine the extrinsic motivation of winning a game [32,33,37] or "winning free prizes [34]" with the more intrinsic interest in diabetes management. It is stated for instance "keeping their character's blood glucose within the normal range, through appropriate insulin and food, helps players win the game [37]." Two references give particular emphasis to storytelling where for instance a "character tries to save a diabetes summer camp from marauding rats and mice [37]."

Three references highlight the use of virtual characters [32,33,37]. Two texts point to portraying consequences of health behaviors with the help of its virtual characters [33,37]. Reference [33] states that due to low energy levels play characters "will become tired and move at a slow pace until given food." For only one game the development of a "physical" skill is mentioned. Reference [32] claims to "show to do home blood glucose monitoring and illustrates how to do a finger stick." Three references mention simulating self-care on the basis of an algorithm underlying diabetes management [33,36,37]. Social interaction is mentioned only in one text, which highlights the experience of "social support when interacting with other players [37]". It is important to note that social interaction here is seen as a result of the gameplay rather than a distinctive part of it. In this view, games act as a springboard to stimulate more communication about diabetes management through talking about the game with doctors, friends and family members [37].

As figure 2 indicates, comparing the different patterns gives us a mixed result. On the one hand, both categories seem to employ slightly different gameplay activities. Whereas none of the mobile exergames highlights knowledge gain, simulation of self-care or rehearsing real life situations, diabetes games give particular emphasis to teaching health related knowledge. While social interaction and the developing and carrying out of physical skills seem to be crucial to mobile exergames, diabetes games do hardly cover any of these activities. On the other hand, both categories explore immersive storytelling and the role of virtual characters. Moreover, both set distinctive challenges, which they seek to combine with their specific health outcomes. Discussing gameplay activities in general has only touched upon the question of how space and real world locations are involved in health games. In the next section, we will relate the observed gameplay patterns to recent research on pervasive gaming and architectural theory.

VI. PERVASIVE GAMING AND URBAN DESIGN THEORY

Walther points to various pervasive gaming *formats,* which would involve real world locations and physical space in different ways and to different degrees [38]. On the one hand, *mobile embedded games* use portable devices and take absolute or relative changes in position of the player into account [38: 62]. Walther likes to exclude what he calls "*mobile interfaced games"* from pervasive gaming formats. For him, these would use mobile devices simply as "a delivery channel where key features of mobility are not relevant to the game mechanics [38: 62]." In contrast, *ubiquitous games* would use existing computing and communications infrastructures of our everyday lives. *Mixed reality games* would seek to integrate virtual and physical elements, while *adaptronic games* would oscillate between virtual and real space. *Location-based games* would "include relative or absolute but static position / location in the game rules [38:62]." As Walther concludes: "Truly Pervasive Games - excluding, for instance, traditional computer games intended for mobile phones - evolve around specific sites or locations [38: 75]."

However, location specificity may not be essential to interesting and useful gameplay. Smartphones and PDA's tend to use a combination of GPS and WiFi data to determine geographic location. Due to the limitations of these technologies, activities that seek to use this data are limited (mainly) to the outdoors. A further distinction needs to be made here between different two modes of utilizing data relating to geographic location. Firstly, location specific applications can locate and integrate known geographic features. Whereas this can make for a rich 'embedded' experience in gameplay for example, it does limit applications to specific locations. In order to enable a location sensitive game to be played anywhere, properties such as stored visits, speed, orientation and relative movements need to be incorporated. Such use of 'translocational' media has been used, for example, by Parry, Bendon, Boyd Davis and Moar to deliver a locative sensitive, but not location specific, drama [39].

Stenros and Montola have observed established and developing pervasive gaming *genres* [40]:

- Treasure Hunts
- Assassination Games
- Pervasive Larps
- Alternate Reality Games
- Smart Street Sports
- Playful Public Performances
- Urban Adventure Games
- Reality Games

As they put it: "These genres are not discovered, but *constructed*; we classify existing games into groups according to their properties, historical developments and gameplay activity they create [40:31]." In contrast to Walther's *formats* [38], Stenros and Montola's *genres* seem to reflect a broader cultural context of designing pervasive games.

Walz has tried to open up the discussion about video games to a broader perspective of architectural design and urban planning theory [41]. He sets out to frame players' individual experience of different spatial and cultural configurations while playing digital games. After considering the "modalities" of game sites, he discusses "how play has its roots in movement

between player and play-other" as "kinetic" play dimension [41:88]. Walz deals with the stimulation of emotions by different game sites before conclusively addressing the wider "context and culture" of potential playgrounds [41:88]. For him, research on the role of space in digital games from the perspective of game and architectural design has unfold in dimensions such as "locative, representational, programmatic, dramaturgical, typological, perspectivistic, form-functional & form-evotive, technological to phenomenological [41:118]." He combines these two matrixes and organizes a set of questions that may be asked about space when designing and analyzing games. As we are concerned with the role of locations here, we may list his "locative dimensions" of digital games [41:130-131]:

- Player: Where in the game is the player and where is the game for the player?
- Modality: In what modalities of location, when, and for how long does the game take place?
- Kinesis: How does the location affect kinesis and rhythms between player and play-other?
- Enjoyment: What is the play pleasure set of the game's locale? What emotions does the site inspire?
- Context and Culture: How do the context and culture of the play site affect the play site?

Though Walz likes to exclude the field of serious and persuasive games from his discussion [41:129], his set of questions may well help to orient our analysis. In the following section we will revisit our references with these conceptual frameworks in mind.

VII. MOBILE EXERGAMES AND LOCATIONS

As figure 3 indicates, mobile exergames correspond to a wide range of pervasive gaming formats. There are four mobile embedded games tracking players' absolute or relative changes in position. [11,12,14,16]. The "GPS word spelling game" *Seek'n'Spell* [11] for instance tracks players' positions and movement using the iPhone's 3G and GPS. The "stair climbing game" *Monumental* [16], on the other hand, being played foremost indoors, uses primarily the iPhone's on board accelerometer to count players' steps. Two examples seem to fit in Walther's definition of a Mixed Reality Game, integrating virtual and physical elements. In *Fit Quest Lite*, players navigate a virtual character by their own "natural movements, jogging in place, hopping and ducking [21]." Rather than relative or absolute change in position, *Fit Quest Lite* seems to be using the iPhone as a "pedometer" tracking players' small-scale exercises. In the Mixed Reality Game *CryptoZoo* [17], players mimic various "running styles" shown on its website and chase fellow Cryptids for instance by following chalk signs on the pavement. The urban topography is crucial for CryptoZoo's gameplay. Much like free runners, players interact with certain "spots" such as long stairs or rails, or a series of benches on the sidewalk or in the park. Players are asked to design own running styles in response to paths and obstacles "discovered" in their everyday environment [23]. Yet, the system does not track players' movement, positions or locations by any embedded positioning. Players capture their runs in small clips and post them on the CryptoZoo website, where they locate corresponding spots on the map [23].

Locations in Health Games	Pervasive Game Formats [41]	Pervasive Gaming Genres [43]	*Where?* [44]	*Modalities* [44]	*Kinesis* [44]	*Emotions?* [44]	*Context and culture?* [44]
I. Mobile Exergames							
1. Seek'n'Spell [18]	Mobile embedded	Treasure Hunts	✓	✓	✓		✓
2. Neat-o-Games [19]	Mobile ebedded / ubiquitous	Smart Street Sport		✓	✓		
3. Fast Foot Challenge [20]	Mobile embedded / ubiquitous	Assassination	✓	✓	✓	✓	✓
4. Fit Quest Lite [21]	Mixed Reality	Mixed Reality	✓	✓	✓	✓	✓
5. Monumental [22]	Mobile embedded / augmented	Urban Adventure	✓	✓	✓	✓	
6. CryptoZoo [23]	Mixed Reality	Mixed Reality	✓	✓	✓	✓	✓
II. Diabetes Management							
1. dbaza's Diabetes Education [32]				✓			
2. Knock 'Em Downs [33]	Mobile Interfaced			✓			
3. Glymetrix Diabetes Games [34]							
4. GRIP [35]				✓			
5. Insulot [36]	Mobile Interfaced		✓				
6. Packy & Marlon [37]			✓	✓			

Figure 3. Locations in Health Games.

All mobile exergames show overlaps to Stenros and Montola's pervasive gaming genres. *Seek'n'Spell* [11] reads like a modern Treasure Hunt game. Players may "gather with […] friends in an outdoor space (like a park)" and shall "use the map to find letters. Move quickly to beat other players to the letters you need [18]." According to Stenros and Montola, the emerging genre of *Smart Street Sports* requires "both physical exercise and cold tactical thinking [40:40]" often combining physical with virtual gameplay. Most Smart Street Sports may be seen as "updated, technology-enhanced versions of sporty neighborhood games of youth or physical variants of popular digital games [40:40]." In this light, the *NEAT-o-games series* appears as a physical variation of a Sudoku puzzle. Exercising gains players "activity points" and provides them with hints to solve the on screen puzzle [19]. *FastFoot Challenge* [14] seems to build upon a few characteristics of Assassination Games, claiming the mobile phone becomes "radar showing the GPS positions of other players". Therefore the game "unexpectedly inspires your hunting instinct [20]." As described above, *Monumental* augments stair-climbing with virtual storytelling in which players explore the "world's greatest monuments" and "check out views and souvenirs [22]". At the same time, *Monumental* addresses a certain typology of architectural space its seeks to augment, namely

staircases. Likewise, Urban Adventure Games, according to Stenros and Montola would "combine stories and puzzle with city spaces [40:42]." *Fit Quest Lite* describes itself as "exercise adventure game" [21]. Conclusively, CryptoZoo seems to employ several characteristics of an Alternate / Mixed Reality Game. For Stenros and Montola such games typically feature "collaboration rather than competition, large self-organized player communities, Internet-based gameplay, and secretive production styles [40: 38]."

Conclusively, Mobile exergames seem to address a large variety of "locative dimensions" [41]. The literal game localities span from outdoor spaces such as parks, public places and streets [18,23], any chosen "arena" [20]," hotel room, home or an airport waiting hall [21] to "the stairs" in [22]. The Modalities would vary from being played on special occasions [18,20] to being played next to everyday activities such as "while watching TV" or before "boarding a plane [21]". Most game play would last for relatively short periods such as a "10-minute whirlwind tour [23]," which designers hope to be repeated for days and weeks [22]. All references would address the urban landscape and how it may hinder or foster the game's play rhythm. Players for instance are advised "to pick a space with a good cellular signal and a good view of the sky" as well as to "watch out for traffic, trees and other players when you are chasing tiles [18]." Direct response to the urban topography is encouraged: "Pick your own running styles, and design your own fast and furious one-block races [23]."

As noted above, one reference directs players to a certain typology of space - "seek out real stairs [22]" – from which certain effects to the game play can be expected. As noted in [21], *Fit Quest Lite* produces physical activity independently from the wider cityscape. It seeks to encourage "natural movements" such as jogging in place, and merely makes sure there is enough space provided around the player [21]. Some references seem to dwell on emotions stimulated by certain locations. They emphasize descriptions for game sites such as "*urban* neighborhood" and "*forgotten* forests" [20]. Conclusively, our references touch upon a wide range of cultural and spatial context of potential game sites. The spectrum spans from technical aspects such as having a "good cellular signal" and "safety first" appeals [18] to social and cultural aspects [20,21,23]. Whereas [20] would suggest to "check into the community to meet new people in your arena", a *Fit Quest Lite* player points to the role of witnessing bystanders in pervasive gaming: "It's fun to play and even more fun to watch other people playing [21]!"

As shown above, there is already a close connection between pervasive gaming strategies and mobile exergames. The latter seem to experiment with a broad range of "locative dimensions", which enables and affects users' play experience. Some mobile exergames use locations to distinguish its play sessions from everyday life, for instance by choosing game sites that stimulate positive emotions or serve as a "safe" playground [18,20]. Others use certain types of spaces such as staircases or obstacles, which are pervasive features to the urban landscapes, in order to further integrate mobile exergaming to players' everyday routines [22,23].

VIII. DIABETES GAMES AND LOCATIONS

Two of the discussed diabetes management games run on mobile devices [28,30]. According to Walther, they may be considered as mobile interfaced games, since they do not involve position or movement to their gameplay. Indeed, none of the references would make any hints towards pervasive gaming genres whatsoever. Four references would suggest any locations [32,33,34,35]. Since they have been developed for PCs or the web, their authors seem to assume that they are played at home. Reference [37] would clarify: "Each participant received a video game system at an initial clinic visit [and] could play their video game at home as much or as little as they wished [37]." Referring to the mobile interfaced game *Insulot,* it is indicated that the "advantages of cellular phone-based games are their […] portability [36]." Yet, neither [33] nor [38], would make any suggestions where - thanks to a greater portability – users may play such mobile games. Regarding the game modalities, reference [32] would estimate "approximately one and a half hours to complete" the game, while reference [35] would hope "to monitor patients' condition" and presumably their game play activities "on a daily basis." None of the reviewed references seems to mention any of the other "locative dimensions" discussed above [32,33,34,35,36,37].

Diabetes management games seem to hardly explore any pervasive gaming strategies yet. Even though there are first attempts to run on mobile platforms, their game play is neither aware, sensitive, nor based on particular locations. In fact, it seems just taken for granted that diabetes games are played in the domestic home. Various explanations for this approach diverging from exergames have occurred through out this article. First of all, mobile exergames are considered as "preventive", while diabetes management games have been associated to "therapeutic" games [3]. Lieberman has pointed to the advantage of health games to train certain skills on your own in private places and then being able to "go public", when these skills have been developed well [6]. We may speculate that especially in a therapeutic context with further emotional implications, the balance between "safe" learning environments like the domestic home and pervasive gaming in public has to be thorough fully addressed. Knöll has pointed to users' comments on potential locations for both - diabetes management *routines* and imagined *game* situations. Favors and disfavors for certain locations – for instance where to test your blood sugar levels - seem to be closely related to practical reasons as well as social urban context [42]. Furthermore, we may speculate that certain gameplay activities entail the possibility for pervasive gaming more than others. The two categories may as well target different age groups, which have a diverging access to mobile devices. Technically, there is an obvious difference: Whereas plenty of mobile games on the market deal with physical activity, for diabetes management, we have been able to discuss only two. However, bearing in mind that there is a trend being observed towards more mobile devices in diabetes management [4], we may ask how to apply experiences from mobile exergames to diabetes management games in particular and therapeutic serious games in general?

IX. FURTHER RESEARCH DIRECTIONS

As Sawyer and Smith have pointed out, experimenting with different kind of inputs such as gameplay activities is crucial to enhance the possibility space of serious games [2]. We may therefore argue that to explore a broader range of gameplay activities may well contribute to design new and effective health games in general and therapeutic games in particular. Therefore more detailed analyses of what seems to have worked for other health games and how these practices may be used in a therapy context seems to be required. As shown above, especially when dealing with space, the field of exergaming becomes of particular interest, since it seems to have pioneered involving pervasive and urban design strategies. Yet other fields of health games and their involvement of real world locations need to be investigated.

More inputs may be sought after from related and probably unexpectedly related disciplines such as the fine arts and urban design. For a start, this process may help to argue that there is more to the concept of health games than measurable medical and economic benefits. The cultural and political implications of seem to be as challenging. It may be claimed that the design of hybrid environments – digital and spatial – promises to set a sign against a health climate, which shifts the responsibility for bad health outcomes increasingly on to the shoulders of individuals. As Blaxter has shown, especially the most vulnerable in our societies seem to have "learned" to emphasize self inflicted health behavior over social and environmental circumstances [43].

The concept of Persuasive Games seeks to frame how a broader understanding of procedural rhetoric can reveal cultural and social messages in video games [9]. According to Bogost, there is still need to define whether this concept shown in fields of politic, marketing and education may be advanced to further subtopics such as health [9:64]. One underlying idea of this article is that especially in therapeutic serious games concerned with daily behavior such as physical activity or nutrition, to involve the urban environment is crucial. Denis Gosgrove has pointed to the important relation of city landscape, city life and its virtual representation in maps [44]. He appeals for a creative update in the use of advanced technology, which had been started by artistic practices such urban geography or urban drifting by 1960s Situationists. It may be the artist Christian Nold's work on "Emotional Cartography" seeking to connect our subjective reception of city landscapes with rather objective measurements such as a stress levels and positioning data [45] that points to an important track here. Picking up this tradition, persuasive health games may become a tool to express and criticize public health policies from the perspective of users. Boyd Davis argues that interactive maps in particular bear huge potentials for a subjective way to experience the city [46]. To which extend these playful and artistic approaches to mapping personal (health related) behavior can contribute to health related behavior change must be addressed and evaluated by future research & design projects.

We may conclude this outlook on further research with an on going research project at Middlesex University, London and University of Stuttgart. It seeks to contribute to the discussion presented above from a very distinctive perspective: How may a location sensitive and playful digital service motivate users to document their daily diabetes management? In various play testing sessions with patients, ideas and technologies are being developed to map daily diabetes management in users' subjective city landscape. Digital and paper prototypes are being produced and discussed with patients in diabetes centers in London and Stuttgart in order to explore and evaluate ideas of location sensitive health gaming. The latter may unfold between the already established gameplay activities for diabetes games presented in this article and for instance the emotional cartography inspired by Chris Nold's work [45].

X. CONCLUSION

This article has reviewed research in the fields of health games, pervasive games, and architectural & urban design theory. A usage-based health game taxonomy has been constructed. The discussion of various "building blocks" has led to a check-list of gameplay activities that guides a review on current design practice. A sample of mobile exergames has been contrasted to a selection of diabetes management games as an example for therapeutic health games. It has been shown that for both groups different patterns of gameplay activities seem to prevail. A brief introduction to pervasive gaming formats and genres and the role of space and spatiality in digital games has informed the discussion on health games and their involvement of real world locations. Mobile exergames have been shown to use a wide range of gameplay activities, as well as pervasive gaming strategies. They involve a great variety of "locative dimensions", which enables them to distinguish or further integrate mobile exergaming to players' everyday lives. In contrast, diabetes management games have been shown to use a more distinctive selection of gameplay activities. Though increasingly running on mobile devices, they don't explore any pervasive gaming formats and genres yet. Indeed, diabetes games do not specify any game sites at all apart from the domestic home. It has been argued that paying more attention to the urban landscape and different locations when designing therapeutic health games may well contribute to improve impact and play experience for users. Further research needs to be undertaken to advance this topic for which an outline has been presented in the perspective of urban design and research.

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