Compassionate Game Design: A Holistic Perspective for a Player-centric Game Design Paradigm for Games4health

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Abstract—**Despite the growing interest in using games for positive health outcomes such as alleviating disease symptoms, mental or physical therapies, or rehabilitation, finding suitable games or developing custom games fit for purpose is challenging for the researchers. Using commercial games for these purposes pose various usability challenges and health and safety pitfalls. When it comes to designing one, creating a compelling game is already challenging. This article presents a novel theory called compassionate game design that aims to encourage development of compassionate games with the help of a player-centric game design paradigm. The paradigm facilitates a closer exploration for affordances and limitations of games for players with (mental or physical) health conditions or with diverse physical and cognitive abilities. The main contribution of the paradigm is its ability to promote a closer focus on player resources and encourage a diverse inquiry towards creating games that are more compassionate.**

Keywords - game design; player-centric design; user-centered design; accessibility; games for health; compassionate design.

I. INTRODUCTION

The interest in game based interventions or game assisted treatments for greater health benefits has increased significantly over the last decade with a visible change towards a more positive perception of games. Games for health research hopes to leverage the compelling nature of games for positive health outcomes. For the games aiming to assist medical treatments or provide therapy or rehabilitation, the target player group is special as they are very different than a healthy player demographic. Despite the increase in the variation of player demographic playing all kinds of commercial games [63], the symptoms or the impacts of a disease such as (motor or non-motor symptoms) in Parkinson Disease (PD), or the effects of the conditions (such as mood or attention span in autism) are what makes a player demographic special. This means depending on the complexity of conditions, the ability to perform in a commercial game is limited, and the chance of frustration due to failures during the performance is high [4]. When the main purpose for using a game is increasing adherence to the therapy or treatment, the game needs to be engaging while also fulfilling its core purpose, i.e., therapy, rehabilitation, treatment, etc. [28]. Therefore, games that are designed for this purpose need to be favoring player's conditions while also establishing motivation and engagement. This means, a clear approach towards understanding the needs of the player and usability scope of the game is essential. Usability scope of the game is defined and shaped by its system-like properties that are curated through game design. Therefore, guidance to unite this understanding with game design would be beneficial for successful solutions.

Even though industry practice advices and attempts for early involvement of players by methods such as playtesting, focus group activities, interviews, questionnaires and usability analysis, participative practices in game development are not in the same form or shape as such in product design and development mainly due to the creative nature of intellectual property. Lack of player-centered approaches to game design in commercial contexts was also discussed by other researchers [30][35][54]. In the hindsight, common industry practices and priorities for commercial game development may not be relevant or efficient for developing games for special purposes such as learning or health and rehabilitation. Lack of a suitable game design methodology that explores designing for these demographics seems to be a result of lack of engagement with design research within games studies [21]. Therefore, creating player experiences for special purposes that are embedded in entertainment can seem overwhelmingly complex for a researcher who is not identifying as a game designer. Both for the use of commercial games and in order to develop new games, there is a need for further design research to inform suitability and purpose of the games for health outcomes [4][5][28]. A player-centered model that unfolds the layers of a game experience with respect to the player's perspective can help a designer (or a researcher-designer) cut through this complexity.

This work presents a player centric design paradigm for designing games for health and rehabilitation purposes. The paradigm is player-centric by prompting the designer to contemplate on player perceptions and player capacity. It encourages the designers to reinforce a closer relation across the layers of the game experience while promoting a discussion to understand the relation between players' conditions and the layers of the game. Therefore, it emphasizes compassion for the current state of the player in terms of their disease (especially if they have a chronic disease), mental and physical stamina, or their abilities in order to foster development of suitable game elements for positive health benefits. This means game design is influenced by a player model. In Merriam-Webster, compassion is defined as [a] "sympathetic consciousness of others' distress together with a desire to alleviate it". Thus, the model aims to support creation of a compassionate game.

To present the paradigm, its development and application, the paper is composed of the following sections. Section II presents the motivation and background work to explain why this paradigm is necessary and the plateau of literature to ground the work. Section III discusses the methodology. Section IV explains what compassionate design is and its challenges. Section V presents the player-centric design model with its layers and main elements while Section VI presents a discussion and conclusion.

II. MOTIVATION AND BACKGROUND

This design paradigm emerged during a research through design activity, and further developed into its current form with a synthesis of existing game design approaches and user experience research. A scoping review for player-centric (or player-centered) methods for game design revealed little in terms of an established methodology, techniques or model while the notion of player-centered design is commonly mentioned to be favored as user-centered equivalent of user experience design. Current game design methodologies are unhelpful to contemplate how to facilitate usability at the game level, how each design decision impacts the player's ability to play, and what to focus on during a design activity involving players with health issues [35]. Treadaway et al. [57] initiated a discussion on compassionate design for dementia care and developed guidelines on the use of compassion in activities of design for wellbeing. As much as these guidelines bring important concepts to the spotlight, i.e., dignity and personhood, application of these in game design can be more effective if adopted by a player-centric thinking. Towards synthesizing a player-centric design model for health purposes, this section presents the state of the art on game design, player-centric design, players, player experience, and games for health. The last subsection presents a case analysis to unite the background work towards strengthening the motivation.

A. On game design

Literature has a few well recognized, sometimes loosely defined, frameworks for game design and analysis. These are Schell's elemental tetrad [20], Fullerton's Formal-Dramatic-Dynamic (FDD) elements [19], Adams' interaction model [9] and mechanics-dynamics-aesthetics (MDA) [48]. All of these agree to see games as systems that resemble the characteristics of a closed system with the elements enclosed, their properties, and relations between those elements [13][66]. Among these, Fullerton's formal elements are a core set of elements granular enough to allow a micro-level thinking for the design or analysis of a game [19]. Formal elements allow studying the game grammar by dissecting a game into its smallest building blocks. These are listed in Table 1. with a brief explanation on how they relate to game grammar. Notice that all formal elements are somewhat interrelated in their definition, role and use in game design.

In Fullerton's FDD model [19], dramatic elements bring meaning to the formal elements and establish context while dynamic elements emerge when formal elements are put into motion.

TABLE 1. FORMAL ELEMENTS OF GAMES AND THEIR DESCRIPTION; REPHRASED FROM GAME DESIGN WORKSHOP BY FULLERTON [19].

Formal elements of games	*Description*	*Supporting questions*
players	The main agents of the game; define interrelations among players, the effects of rules on players, etc.	How many players, what are their roles, and how do they interact with one another?
procedures	Methods of play and actions towards achieving the game objectives	What exactly the players do, how do they do that?
resources	In-game assets that can be used to accomplish goals; they are a part of in-game economy; they must have utility and scarcity.	What can I afford? How is a resource useful to the player? When and how the player can access/lose resources?
objectives	Represent the purpose of the player within the rules of the game.	What are the players trying to achieve? What kind of impact do the objectives have on the game?
rules	Define game objects, actions that are allowed and restricted; rules govern the system.	What is the player allowed to do? How are the rules presented and enforced?
conflict	Emerges from the oscillation between goals and rules (accomplishing the goals within the given rules is a challenge).	What is the challenge? What makes it hard/challenging to accomplish the goals?
boundaries	Define the physical and virtual play-space by separating game elements from anything that does not belong to the game.	What are some physical limitations that define the play space? What are some conceptual limitations?
outcome	The result of the activity/session/game; this must be visible and measurable.	How does the game end? How does the player progress/advance? Is the objective reached?

However, the relation between those are rather loosely defined or are not presented in a form that would easily allow their use by un-trained game designers. Refraining from a detailed discussion on the set of formal elements, both the elemental tetrad and the MDA framework present a high-level model based on visibility of the layers or different perspective holders. Elemental tetrad and derivatives of this model [36] show a four-way relationship between mechanics, aesthetics, story and technology drawing attention to how visible these are from outside the system. Even though this four-way relationship is helpful for game analysis, it is too loosely defined to be helpful as a game design approach. On the other hand, MDA presents two separate viewpoints; one from designers' perspective, the other from players'. This makes MDA a useful model to discuss different perspectives even though it is not helpful for the design process. For a game designer, mechanics are designed to give rise to dynamics, and hence aesthetics are conveyed as a result of these dynamics. Therefore, they see mechanics, dynamic and aesthetics in this given order. Here, aesthetics represents all emotional aspects that stem from the game. Conversely, player's perception follows an inverse order: aesthetics-dynamics-mechanics. It is framed with their perception of the aesthetics; therefore, their

viewpoint is always under the influence of their perception of the aesthetics. As much as elemental tetrad and MDA are helpful for contemplation on perspectives, they do not facilitate a closer investigation towards dismantling a complete game experience into its thinner slices, explaining influences for experience design or designing a game for special purposes and/or special demographics such as people with chronic health issues. Such granularity is missing and would be very helpful for designing compassionate games that would keep emphasis on the capabilities of the player.

Almeida and Silva [41] reviewed a collection of game design methods and tools (as per 2013) drawing attention to the use of visual languages and design modelling despite favored varyingly across industry and academic fields. They argue that the immaturity of design research in game design field prevents the adoption of these by researchers or industry. Moreover, they note that the game design methods and tools under review lack representation of the player perspective, especially for aesthetic components. Indeed, these approaches seem to mostly favor the game over the player, therefore lacking methods to draw attention to the player and facilitate compassionate design. For this, a visual game design model can be helpful for communication across researchers, designers and other members of the development team while developing compassionate games.

B. Player-centric Design

It is commonly thought that the player-centric design is an extension of the user-centered design. On one hand, one can argue that game design is inherently player-centric since it always questions what the player is doing, what they are allowed to do, their objectives, rewards, the consequences for the player, and how the player is supposed to feel during the gameplay experience. Therefore, it would be unfair to suggest that game design is not player-centric. On the other hand, game design practice is a creative endeavor, meaning that it may carry a separate authorial intent due to its creative nature. In the virtual boundary of play-space, the game world is governed by the rules and dressed in the metaphors of the game. Besides, game design practice could also be perceived as play-centric, putting emphasis on gameplay over other elements of the game. Therefore, rather than the habits, requests or expectations of the player, the nature of play and how it manifests itself may take precedence. In response to all these arguments, player-centric design is centered with empathy to the player and aims to provide a positive experience to the player despite contradictions with creative pursuit [9]. Therefore, player-centric design puts the player before the creator.

Charles et al. also [27] acknowledge that most of the player-centered approaches to game design rely on the research on human factors and are adopted from user-centered approaches. Although these are useful for addressing usability issues at an application level, the additional qualities of games as a media (such as the level of challenge, player skills and gameplay, etc.) are not addressed. Adams presented another model that is based on the interaction between the player and the game, yet does not encourage explorations on sensory complexity of games more than perceiving them as user interfaces [9]. Although this could be seen as a much clearer approach that allows the use of existing HCI research for games, it creates further ambiguity on the potential needs of games on a visual and contextual level.

When game design literature is scanned for the role of player in game design, it becomes apparent that player-centric game design is not as common, but involvement of players in design process such as in participatory design is even less considered or troublesome [30][54]. A more often seen application of player-centric design is with early playtests and the use of player personas rather than participatory design sessions as seen in product design or service design. As much as iterative design practice is praised, most of the time studios prefer to involve as few people as possible and as late as possible due to secretive nature of creative production. Sometimes an audience model is created to enable intellectual assumptions for players' needs assuming that designers have a decent understanding of what players wants and needs. This notion has been strongly criticized for neglecting the real persona of the player and reducing them to simple unimportant actors disconnected from a larger socio-cultural context. Sotamaa suggests designers to focus on what they are good at while acknowledging the players as the specialists of their own "everyday gaming" [35].

On the other hand, player involvement in context of player-centeredness can also be considered continuous rather than finalized by the end of production period of a game. Player modelling [27] and automatic/dynamic difficulty adjustment based on biosensors [53] are some methods to create more player focus during gameplay. Industry practice ackowledges the use of personas rather than focus groups [66] since the involvement of individual tastes of potential players may be noisy rather than useful for the designer even though persona development or the personas themselves are rarely shared by the game designers within the industry [44].

Inspired from Norman's emotional design [12], Baharom et al. [33] suggest a conceptual framework that offers a valuable discussion about the relation between emotion, perception, reason and structural elements of games. The framework is encouraging for discussions on the cognitive, psychomotor and affective dimensions of games by placing player-centric design in the center although interrelations between these dimensions remain unclear. Hodent also argues that user experience (UX) should not be separated from the design cycle as it is the glue that ensures intended experience and players' perceptions work together to create an enjoyable gameplay experience [56].

C. Unpacking Play and Players

The concept of play and why people play have been a hot topic for decades in social and cultural studies, psychology, and philosophy. Sutton-Smith argued for the cultural significance of play stating that it takes many forms throughout the life of each individual [65], and Suits argued that games are central to human existence and that "everyone alive was really a grasshopper in disguise" [64]. Game studies as a relatively young research field also inherits this question, and further asks why people enjoy playing a game more than another, what it is that people find in the activity of gameplay,

what motivates them for this activity, how this enjoyment is governed, how it can be shaped, etc.

1) Aesthetics of play: Aesthetics, as adopted from MDA framework by [48], represents emotional aspects communicated by the game. Previous section on game design already mentioned that emotions emerge via the dynamics of the game experience, and mechanics of a game serve for the aesthetic goals. The aesthetics mentioned by [48] are (broadly) sensation, fantasy, challenge, narrative, fellowship, discovery, expression, and submission. On the other hand, Lazzaro argues that we play because it is fun despite the ambiguity in the definition of "fun". She suggested the Four Keys to Fun method to explain the phenomena of "fun" [49]. In 4Keys2Fun, fiero (hard fun), curiosity (easy fun), excitement (serious fun), and amusement (people fun) are chosen as four core emotions. Lazzaro presents groups of emotions as subset of these four and discusses how some actions (towards creating the game features) can resolve into these emotions. For example, actions of collection, rhythm and repetition create emotions of excitement, focus and relaxation. Therefore, they create "serious fun". The suggestion is building a play experience to evoke more than one emotion to prevent stagnation.

2) Meaningful play: Salen and Zimmerman [13] state that "the goal of successful game design is the creation of meaningful play." Meaningful play emerges from the relation between a player's action and the system outcome that is visible as immediate and long-term effect. If this relation is not clearly visible to the player, players lose interest in the gameplay. If the relation is discernable immediately and the result is integrated into the larger context of the game, the actions in the game become meaningful. With immediate feedback, the player receives a confirmation about their action; with long term effect, player sees that their choices matter and their actions carry meaning towards reaching their in-game goals. Hence, meaningful play motivates the player experience.

3) Motivation: Psychology studies on human behavior consider that factors that activate and sustain behavior towards a goal or that create propensity to learn and act are motivational factors, and are either intrinsic or extrinsic in nature. Intrinsic motivation comes from within such as enjoyment in the activity itself rather than for an external reason whereas extrinsic motivation originates from an external reward [45]. If extrinsic motivation is considered as controlled motivation, through practice this can be transformed into self-determined autonomous motivation (hence intrinsic). Self Determination Theory (SDT) suggests that human motivation is based on three basic psychological needs: competence, autonomy, and relatedness [37]. Competence refers to the universal will to perform better at something; autonomy refers to the desire to be in control of one's own path; relatedness refers to the desire to connect with other beings. Although SDT originates from the psychology field, Player Experience Needs Satisfaction (PENS) model [38] translates the dimensions of SDT into measurable domains for game development and analysis. According to PENS, when these three needs are fulfilled for a player within the context of the game world, players experience higher levels of satisfaction, and potentially continue playing the game.

4) Player personalities and preferences: The idea of player types and that some features are favoured by some types of players were first mentioned with the first Multi User Dungeon (MUD) [47]. Player types (sometimes referred as Bartle's player types)—killers, achievers, socializers, and explorers were representing players' interest in MUDs. Killers are interested in features that allow them to act on other players such as combat and direct interaction; achievers are interested in features that resolve with tangible acknowledgement of success such as badges, unique items, etc.; socializers are interested in features that encourage playing with other players, collaboration and social interaction; explorers are interested in adventure, discovering and mostly acting on the world. This is later adopted by other designers and researchers and expanded upon [51][52], still somewhat staying true to the first four types but developing interim types to suit the variety of game experiences present today.

As much as continuation of play is of interest, it is argued that there is a taste factor involved in a player's initial choice to start playing [39]. Correlations between motivation and taste may be possible although not supported by any research. Regardless, VandenBerghe argues that taste factor can be obtained by taste maps as presented in Engines of Play method [39].

Engines of Play is a method suggested by VandenBerghe [40], initially at a game developers conference. It relies on the Big Five psychological model (also known as Five Factor Model or OCEAN) and is suggested as a way to find out a correlation between game features and personality of players to enable a "more accurate empathy" towards different kinds of players. There is no empirical validation reported by the date of this writing; nonetheless, the idea is that people seek out experiences that align with their personality traits. Five personality traits are mapped to five discrete domains (OCEAN): openness, conscientiousness, extraversion, agreeableness, and neuroticism. This approach was further developed into taste maps to understand player motivations (domains of play) in relation to personality traits and game features by VandenBerghe [40]. Later, in his blog he noted that the Engines of Play method was employed by another game studio to analyze their existing franchise as an early exercise prior to adopting it in the future, and that the method was successful in terms of clarifying the reasons behind the success of the franchise and allowing all team members to effectively communicate intent and result at various stages of development by using the stereotypes created with the taste maps [55].

Stereotypes mostly take the form of personas and inform the design process while creating contextual layer and aesthetics. In a post about player profiles for *Magic: The Gathering* (Wizard of the Coast, 1993), Mark Rosewaters (head designer of *Magic: The Gathering*) explains that personas (he refers to them as psychographic profiles [44]) allow him to isolate different personality traits and behaviors so that what motivates a particular type of person to act in a certain way could become clear. He continues "[to] create an

emotional response, I had to understand what emotions I was trying to evoke". Therefore, personas can be used to guide the design strategy with empathy so that suitable gameplay features can be developed.

D. Unpacking Game Experience

Game experience research shows interest in understanding the emotional experience of a player so that a better and more purposeful player experience can be created [62]. Towards this goal, user-centered design encourages the use of focus groups, participatory design, usability testing, and usability heuristics; however, the reception of these methods in games industry is mixed [59]. From a commercial angle, many studios seem to consider some of these methods less effective or time/resource consuming. It is hard to argue against business oriented decisions; however, this notion seems to be less effective when developing games for health and learning. Commercially, a common thought in game development is accepting that the product will not be appealing to all users within the target demographic, therefore should be selectively designed for the most profitable subset demographic. Nonetheless, in the context of games for health and learning, this notion can be challenged for the purpose of maximizing the reach of the product. Therefore, a closer look at the concepts of game experience is necessary. These are optimal experience, usability, playability, accessibility, and game feel.

1) Optimal experience: A balance between skill and challenge is often argued to create an optimal experience for a person in any kind of performance; flow [50]. Challenge depends on the fine balance between an individual's ability to perform up to the standard of a given objective. When they do not have the competence to fulfil the demands of the activity, they feel anxiety. Flow theory explains that there are seven core components to flow. They are categorized under conditions and characteristics. Conditions (clear tasks, feedback, concentration, attainable goal) are the prerequisites of flow while characteristics refer to the experience of the individual in the state of flow. They are control, diminished awareness of self, altered sense of time. According to Csikszentmihalyi, maintaining this balance is one of the most critical prerequisites for flow, and it is important for both motivation and learning [50]. In order to maintain engagement and promote flow, challenge should be matching player growth in skill, tasks and goals should be made clear, feedback should be timely and readable, and distractions should be minimized.

2) Usability: Usability in game development aligns with common usability guidelines developed for human computer interaction even though usability for games and game-like experiences encompass more than just the interface or the interaction modalities. Nielsen and Norman group defines usability as "a quality attribute that assesses how easy user interfaces are to use" [6]. A usable interface should be easy for a user to become familiar with and competent in; to achieve their objective; to discover previously less known attributes when need arises; to recover from an error; and to recall how to use the interface on subsequent visits. As much as these can be valid for a game interface, it is necessary to note here that player experience (game experience) is larger than the interface itself; therefore, an isolated perspective that only focuses on the experience based on interaction modality and the attributes of user interface would highly likely miss the bigger picture for evaluating the experience of a game. The bigger picture includes all facets of player experience including but not limited to interaction modalities, user interface, audio-visual design, in-game challenges and objectives, player attention, engagement, immersion, etc. As Juul and Norton [46] point out, distinguishing the difficulty in interaction/interface and the difficulty of gameplay as a challenge of the game is necessary to separate game usability from that of production software. Since games are by nature inefficient and lusory, the line between difficulty in interface versus the challenge of a game could be rather blurry while a gameplay challenge can also be located at the interface.

3) Playability: Extending from usability research, playability and player-game interaction has been gaining some speed to explore practical applications for game usability challenges [16][26][34][62], and there is further work on playability and the complexity of player involvement in player experience evaluation [25]. Sanchez et al. [25] define playability as "a set of properties that describe PX [Player eXperience]", and add that playability measures the effectiveness, efficiency, satisfaction and fun of performing to a specified performance as per the specific goals of the entertainment experience. Even though the same attributes of usability are applicable to playability, their meaning are different. Since the main goal of PX is entertainment, Sanchez et al. collated seven attributes to characterize playability: satisfaction, learnability, effectiveness, immersion, motivation, emotion, and socialisation. Among these, motivation and emotion are directly about the user and shaped by player preference. In addition, motivation is also said to be "a key factor in generating a positive experience for the player.

4) Accessibility: Despite the well-defined nature of accessibility within user experience domain, accessibility may differ for special demographics [33]. Accessibility of a game refers to the ability to enable the participation of people with disabilities to interact with the game and play without feeling any barriers during their interaction with the game or during overcoming the challenges presented by the game. Isbister states that "video games should be considered above all as complex IT systems, with which individuals wish to interact within the framework of a goal-directed activity" [34]. In fact, the complexity of each differs depending on pre-designed layers of gameplay experience, which may be open to emergence of more complex behaviours in some cases. On the other hand, accessibility seems to be simplified to interaction modalities without much consideration on cognitive load, emotional demand or context related issues. There is no disagreement on the importance of a suitable interaction modality and a satisfying user experience, and that they are integral to the creation of engaging and enjoyable game experiences. Furthermore, it is essential for a player to be able to see past the interaction modalities while playing a game so that they could fully engage with the activities and events in the game, hence be in the flow of the game. Juul

emphasizes that challenge of the gameplay should never be mixed with interface difficulty [46].

5) Game feel: Game feel, in Swink's definition, is "the tactile, kinesthetic sense of manipulating a virtual object" [10, pg.xiii], and it is essential to the game experience. Three building block of game feel—real-time control, simulated space, and polish, shapes the game feel towards resolving into five common experiences. They are (as taken from [10, pg.10]):

- The aesthetic sensation of control;
- The pleasure of learning;
- Practicing and mastering a skill;
- Extension of the senses;
- Extension of identity;
- Interaction with a unique physical reality within the game.

The pleasure of the game experience mostly maps to a combination of those. For example, with driving games, it is more about the aesthetic sensation of control; yet, while driving in an obstacle course, it is more about practicing and mastering a skill. When the car is damaged, and the player screams at that moment, it is about extension of the senses and identity. This is also how game feel connects to SDT. As a player gets better at performing in the game, their competence increases. As their competence increases, they will feel and demand more autonomy for their actions. The combination of balanced competence and autonomy (resembling optimal experience) makes them motivated. As they feel motivated and focused on the experience, they will feel connected to their avatar or their car that they are driving; hence, their avatar becomes a part of their identity.

E. Games for Health and Rehabilitation

Over the years, literature on games for health has grown with both the use of commercial games and the development of custom made games for health benefits including but not limited to improved balance and gait, muscle strength, reach, etc. [2]-[5]. Games are considered as a solution to non-adherence to therapy, the lack of motivation for therapy and/or rehabilitation, the service and delivery costs of therapy such as unbalanced patient-therapist ratio, reach to and distribution of services, lack of accuracy in tracking progress, etc. There are convincing arguments [28] about using commercial games for physical therapy since they are already products that are commercially developed to create and maintain engagement; however, clear contributions on re-appropriation of existing games for specific purposes and maturity of guidelines to adapt those for people with chronic diseases are limited. Similarly, researchers have mostly adopted or applied existing game design models [9][19], some extended from existing models [18][31], or developed on an ad-hoc basis in order to create a suitable product without much exploration on the design practice [4][5][14][15]. Lack of a design methodology to facilitate design exploration for a selected demographic with unusual limitations, such as motor, cognitive or mental difficulties that may be developed due to a chronic disease, seems to be a result of limited design research within games research [21]. This means, learnings and observations from these studies are fragmented and hard to reconcile for further studies. Both for the use of existing commercial games and with the purpose of developing custom games, there is a need for further design research to ensure suitability and accessibility of games for special demographics [4][5].

Potential recipients of game-based rehabilitation include a variety of age groups across a variety of diseases such as cerebral palsy, ADHD, autism, post-stroke, Parkinson's and parkinsonism, age-related deterioration, etc. Development initiatives for games for health in each of these seem to be discrete and isolated. Even though the requirements of each and every rehabilitation and limitations of each and every target user group are different, it is not unrealistic to expect a common design strategy or a framework that can accommodate common methods to develop games that augment rehabilitation during the treatment of these diseases.

Within games for health context, a set of guidelines was collated to inform developers on the special constraints for their design [11][14][17][18] while also pointing out the lack of further development in the game design discipline. Game design in its practice is agile and opportunistic, yet the design practice itself is under-researched. A study by Isbister and Mueller on variety of interaction modalities especially in the field of movement based games is one of the few that evaluates conditions of interaction and suggests strategies for a more successful design of movement-based systems, mainly games [17]. The guidelines provide insights for the design of interaction modalities, necessary feedback compatible with the interaction device and activity, extends from self-expression, challenge and fun. Among the few studies that attempt to develop games for PD patients, Assad et al. previously suggested design principles for designing games for PD, particularly for motion based games for rehabilitation purposes [11]. Although informative, the principles are prescriptive for a specific type of game (such as arm extension based exercise features or balance features) rather than allowing a wider applicability supported with a clear methodology for game design. Moreover, while each item in the guideline can be affecting various areas in the game, the interconnected nature of the game experience as per these affects is hard to perceive. Therefore, a model such as the one presented in this paper could have been useful to guide the designer towards realising these relations. For example, fostering wider and fluent movement is advised, but input modality is not discussed probably because the guidelines are aimed for movement based games. Gerling et al.'s "extended model" (seem to be extended from Fullerton's formal elements [19]) presents a useful basis for designing for older adults [18]; however, the analysis lacks a wider perspective on the interplay between the elements of the model in relation to a player-centric focus. As a game design paradigm, such perspective would encourage an exploration of player's perspective in this context especially for the needs/issues of special demographics with health issues. Nevertheless, the notes on the player's abilities (both cognitive and motor abilities, such as attention span, short-term memory, repetitive input, etc.) to be considered as resources resonates with the perspective of compassionate game design concept presented here. In line with the previous discussion here, Burke et al. [29] suggested three principles to game design for health and

rehabilitation: meaningful play, handling failure and setting a suitable level of challenge, and applied these to the development of games for the rehabilitation of stroke patients. Despite limited reflection on the development process or the design iterations, the note on adaptive aspects of the games and that they were well-received by the players is valuable.

F. Case analysis: On Design Challenges for Players with Impairments due to Parkinson Disease

In light of state of the art presented above, this subsection presents a case analysis to unite the background work towards strengthening the motivation. In this example, the case analysis looks into the difficulties that people with PD may be facing in their daily life. In the context of compassionate design, these difficulties help addressing the design challenges. A similar analysis would be useful, in fact necessary, while attempting to design for a special demographic. Later, in the presentation of the paradigm, the notes from this analysis is used to show how challenges are addressed within the holistic nature of the paradigm.

Research shows that quality of life for PD patients drops over time meaning that activities of daily living, such as dressing, grooming, bathing, self-feeding and functional mobility are jeopardized as disease develops [23]. Even at earlier stages various disturbances and impairments limit the ability of the users while performing tasks that are considered simple; rendering many games inaccessible for this player base. The disturbances and impairments that are commonly observed across PD patients are sensory sensitivities, motor impairments, cognitive impairments and emotional sensitivities. Many of these impairments, especially in early stages of PD, show close similarities to age related changes that are commonly observed among older adults or other health related situations, such as stroke patients [14].

1) Sensory sensitivities: Sensory difficulties include not only hearing or vision problems as mostly seen with elders [18], but also sensitivities for sensory overload due to visual and sound stimuli. Occupational therapy for PD advise reducing visual stimuli by reducing confusing patterns (striped-checker), strong colours and hues, and simplifying the load by preventing contrasting visuals and clutter [22]. Visio-spatial disturbances and strong contrasts cause freezing while clutter overloads cognitive processes with a need of strategising and replanning. There are no specific sensitivities reported about audio; however, the use of metronome and inducing percievable rhythm into daily life are presented to be useful to enhance motor abilities [22].

2) Motor impairments: Main motor impairments observed in PD are trembling fingers and hands (tremor), rigidity, slowness in movement (bradykinesia), and gait problems [22]. Subtle slowness in movement, postural change and gait problems are also seen in elders even though the scale of these differ from PD. Trembling fingers and hands, especially depending on the scale of movement can make it very hard to use an input device or perform button presses while the slowness in movement can increase the response time.

3) Cognitive impairments: Cognitive impairments that are commonly seen with PD are learning and retaining information (working memory), concentration and attention, and executive functions. Executive functions are a set of inter-related cognitive processes that are essential for goal-directed behaviours [24]. Even though they are heavily related to cognitive domains, motor skills and connection between cognitive and motor skills are the main reason why they are absolutely necessary for activities of daily living [24][23]. In order to preserve gait, a person needs to evaluate their surroundings, strategically decide a path of movement, shift their weight and meanwhile check their balance. If they come across an obstacle, they should be able to stop executing their plan and rework a new plan similar to the correction cycle mentioned before. This means all six executive functions are actively used during a simple walking task: attention, inhibition, planning, reasoning, shifting (flexibility), and working memory. Gait disorders share similar issues originating from deficiencies in executive functions and also observed among older adults. This means impairments in executive functions also develop among older adults, perhaps milder than PD. In addition to a previously identified need for task creation frameworks to facilitate purposeful use of games for special demographics [4], it has become appearant that there is a need for a design paradigm that draws attention to the abilities and limitations of the players, thereby clearly mapping the position of the player in relation to the game experience. Therefore, the player-centric design model is developed to support and inform designing games for rehabilitative and preventative therapies for PD.

III. METHOD

The method of this study is design science research (DSR) while the presented work aligns closer with the idea of developing a nascent theory through the means of DSR [42]. Despite the emergence of new frameworks or design principles towards facilitating purposeful use of games for serious means such as creating positive change, alleviating disease symptoms, chronic disease rehabilitation, etc. [28], there is a clear fragmentation in the design field, separating other more flourished design fields and game design. The compassionate design philosophy and the player-centric game design paradigm are developed through grounding strategies [42], and the synthesis draws from human computer interaction, user-centered design practices, and game design. As per the activities of DSR compiled by [43], the activities of this research are below.

- *Activity 1*: Problem identification and motivation is discussed in Motivation and Background section (Section II) while conceptual grounding is also presented. Existing approaches for the intersection of game development, user-centered design and the state of the art for design approaches for games for health are presented. Core issues of research projects utilizing games for therapy/rehabilitation of special demographics including chronic diseases and elders

are (1) researchers' potential lack of knowledge and understanding for game design and development towards creating a compelling game experience or selecting a suitable game, (2) the complexity of a game experience that would fulfill the requirements of a therapy (or rehabilitation), and (3) the ability to identify the necessities and expectations of the chosen demographic within the context of game design. Hence, the conceptual grounding not only provides a motivation for the problem but also synthesizes theory from the material sources in order to build grounding material for the suggested paradigm.

- *Activity 2*: In relation to the problems identified in the previous section, objectives for a solution are discussed in the Compassionate Game Design section (Section IV). The core objective is drawing attention to three areas about the player: (1) player-game relation, (2) player resources, (3) player perception and game content. The objectives of the compassionate design are explained starting from these three areas while value grounding for these are also enclosed. Following from the core problems identified with the activity 1, the activity 2 reinforces the development of the compassionate game design concept. Hence, a leading philosophy for the design paradigm is developed via an inquiry on purpose and action.
- *Activity 3*: In response to the objectives identified during activity 2, the player-centric design paradigm is developed to present an easy to apply model for development and selection of games for a special purpose. The paradigm presents a clear account for the layers of a game experience, how these layers are interconnected, and the role of the player in relation to these. The details of the concepts across the model, their nature and their relations are explained in the Section V.
- *Activity 4*: The purpose of the paradigm is enabling the development or selection of a game fit for purpose. This activity is dispersed across the explanation of the model in Section V. A detailed discussion for the application of the model as per the holistic capacity of the paradigm is presented. The application of the model, design examples and validation fall out of the scope of this paper and are planned for future work.

The work stands as a theory building DRS activity to create synthesis across diverse fields while providing an easy to follow perspective for researchers, who may be new to games for health or who may have limited knowledge about game design. The artefacts of the activities are the compassionate game design concept (presented in Section IV) and the player-centric game design paradigm (presented in Section V). Strengths, limitations and future steps are discussed in the last section.

IV. COMPASSIONATE GAME DESIGN

What is meant with *compassionate game* may seem fluffy and idealistic. However, the idea of a compassionate game originates from the comfortable and embracing feeling of compassion. Compassion has been actively practiced within the context of healthcare and made its way into public healthcare policies despite the ambiguity of its application as compassionate care [61]. In healthcare context, the meaning of compassion sometimes gets mixed with dignity, identity, and self-worth. Regardless, it is suggested that caring conversations and building relationships with the patients can help to effectively practice compassionate care [61]. If we are considering games as platforms to deliver or support healthcare, we need to start practicing ways of integrating compassion into game design.

A compassionate game would tolerate the failures of a player with kindness rather than confrontation so that the failures are perceived as opportunities of development rather than unsuccessful attempts; therefore, the remaining feeling is not frustration. A compassionate game would allow for a grace time that suits a player's capabilities rather than confronting the player with a challenge that they cannot improve upon; therefore, the remaining feeling is not a decline in self-esteem. Compassionate games would not compete with the player on a layer that the players cannot improve; they rather encourage the player for participation by providing a harmonious and suggestive environment of support and care. Therefore, they strive for accessibility, inclusivity, care, tolerance and adaptation. Compassion in this sense may seem to conflict with the notion of challenge and conflict in game design. On the contrary, it is about finding the right area in the game design where challenge should be planted so that it is possible for the players to fairly overcome the challenge rather than facing an unsolvable/impassable problem due to their limitations; thus, feel incompetent. Therefore, compassion does not suggest removing the challenge but planting it in an area where player progression is not limited by the disease. Hence, it is about care and tolerance with an understanding of what a player is going through so that their competence develops.

Applying compassionate game design means seeking further inquiry in the design process in relation to three areas about the player: (1) player-game relation (at a one-to-one level), (2) player resources (skills and abilities), (3) player perception and game content (what is going on in player's mind versus what the game is offering). By doing so, the player model, as the central element of compassionate game design will be integrated into the process of developing a game that is compassionate towards its players. The following subsections present the compassionate design concept as per these three areas while the last subsection discusses the challenges of compassionate design.

A. Player-game Relation: Interactivity

Crawford [66] defines interactivity as "a cyclical process in which two actors alternately listen, think, and speak. The quality of interaction depends on the quality of each of the subtasks (listening, thinking, and speaking)." This points to the relational prospect of interactivity and its iterative nature.

The *micro level* (the smallest interactive cycle, i.e., moment-to-moment) and the *macro level* interactions (a larger trajectory of interactions) are intertwined to create a meaningful player experience [13]. Within compassionate design context, a compassionate game would show competence in listening more attentively, finesse in speaking with care, and less complexity in the combination of interactions and interaction modalities. Therefore, the design paradigm needs to draw attention to the flow of interaction.

Citing from Sutton-Smith, Salen and Zimmermann [13] refer to game experience as a combination of five dimensions: visual scanning, auditory discriminations, motor responses, concentration and perceptual patterns of learning. Players scan the entire scene based on the visual and auditory signs while concentrating on events and signals provided by the game. They perform actions based on the demands of the game and proceed whilst scanning for visual and auditory cues. This cycle continues as the player carries on playing the game. As they do so, players learn more about the patterns of play and improve their understanding of the game from familiarity to higher expertise. At its core, the cycle of play is an implicit micro game loop that stands on the perceptual understanding of the game world, the processing time of the perceptions, and the response from the player. Norman suggests that the ideal interaction cycle is present when no psychological effort is necessary to use a system (bridge the gulf of execution) [58]. This resembles the correct game feel notion in which the performance of interaction with the system becomes a compelling spatial presence [10].

Swink explains the interaction cycle as an action-correction cycle where player perceives an interim goal towards completing an action and slowly reaches their target, except this happens so fast that we do not necessarily notice the process [10]. The trouble arises for people with neurodegenerative diseases. Due to motor or/and cognitive impairments, a part or some parts of the action-correction cycle show delays; therefore, the action becomes harder to perform. When there is delay at system's end, we see that as a usability problem due to the lack of timely feedback. When delay happens at player's end (Fig. 1), system needs to be gracefully waiting and in fact supporting at times by additional supportive feedback. Since our main concern is reducing frustration and increasing compassion in our design, we need to consider this cycle both for the player and the game.

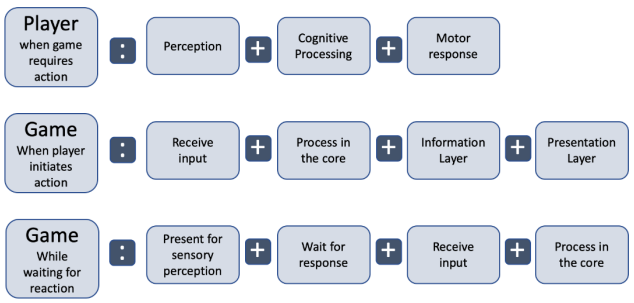

Figure 1. Interaction between player and the game when an action is initiated by a player or a game

The figure above (Fig. 1) presents the stages of the interaction between player and the game (action correction cycles from top to bottom):

- (1) When it is player's turn, what happens at player's end: Player perceives the situation, it goes through their cognitive process, then player creates a motor response; meanwhile, the game waits.
- (2) When it is game's turn after player initiates an action, what happens at game's end: Game receives input, processes the information in its structural core (games as a closed formal system), then contextualizes the outcome with information layer, then feeds the information to the presentation layer via relevant metaphors.
- (3) When game responds for player's turn while waiting for a reaction from the player, what happens at game's end while waiting for player's reaction: Game presents the current state of the game and waits for an input (response of the player); then receives the input and passes it to its core to process as response again. From the moment an input is received, the rest of the cycle is the same as the second cycle. When the game reaches to the second step here—waiting for response, this step is where the first action cycle takes place.

Each of these interaction cycles requires well-tuned graceful delay for player action (the moments that the game receives input), and player perception (the moments that the game presents output). Intended player actions or player reflexes should be considered to be potentially affected by their condition, so should player perception—as it includes vision, hearing, and cognitive processing that may also be affected by their condition. This means response from the game should be perceivable by the player with longer and lingering feedback to support the moment-to-moment gameplay within an action-correction cycle and ensure a continuity of perception. More about the response of the game and forms of the response are discussed as the paradigm explained in Section V (Subsection D).

B. Player Resources (Skills and Abilities): Game Difficulty, Challenge and Accomplishment

Starting questions for identifying the right challenge for a compassionate game experience goes through identifying the areas impacted by a disease or condition. A thorough analysis for the underpinnings of impairments, disease symptoms, physical or emotional difficulties enhances the start of a better-informed game design process. This is exemplified in the case analysis presented before. Previous discussion on formal elements (Section II.A) already mentioned the holistic nature of these elements. While the conflict between the in-game game objectives and the rules form the challenges in the game, difficulty sits in a sliding scale based on what kind of skills are necessary and the complexity of the procedure to perform in-game actions. Player skills, abilities, and capacity shape the player performance, therefore player experience. This means the paradigm needs to draw attention to these for a true player-centered approach.

Skill, as per the definition we use from the dictionary[1], is "dexterity or coordination especially in the execution of learned physical tasks"; ability[2] is "the quality or state of being able"; and a resource loosely refers to the capacity. In this context, the players suffering from a condition such as motor impairments may have the skill (originally) to perform fine motor tasks such as buttoning a shirt; however, their ability may not be allowing to do so any more. This is most of the time true for all patients as they go through different stages of a chronic disease [60]. For diseases such as PD, Alzheimer's, Dementia, etc., cognitive skills, motor skills, emotional and physical stamina deplete over time as they progress.

Player resources pose a larger problem depending on patient demographics. For example, Parkinson's patients develop cognitive impairments such as working-memory issues, or reduced flexibility and inhibition, which may hinder their strategic planning ability. Even when they are able to perform a level of strategic planning, how fast they get tired in the process of re-strategizing restricts their capacity in this task, therefore their resource for strategic planning. They also develop motor-skill impairments such as precision control, bradykinesia, freezing, etc. As disease develops, the scale of these hindrances grows demanding more support and compassion from the system. Since these impairments limit their cognitive and motor ability to perform precise, repetitive or complex tasks, this means their cognitive and motor resources to perform in this system is limited. In addition, their physical resources such as endurance, agility and stamina are limited along with their emotional resources such as resilience, self-efficacy, and self-esteem. Hence, it is important to identify the resource intensity of the skills (type and scale of resources—motor, cognitive, emotional, physical) necessary to perform to a level of completion.

1) Motor resources: These refer to the capacity in performing activities with fine and/or motor skills such as quick-response, timed-response, precision, repetition, reach, etc. If the ability of a player is already restricted in any of these domains, interaction modality needs to accommodate the restriction. For example, people with tremor may not be able to use a control scheme that requires timed-response and precision simultaneously. What is and is not achievable by the player needs to be identified in the process.

2) Cognitive resources: These refer to the capacity in performing activities that demand cognitive abilities such as remembering a number of items for a certain amount of time (working memory, short-term and long-term memory), attention (selective attention, sustaining and retargetting attention), anticipation (pattern recognition and prediction), decision making, problem solving, planning (sequencing, prioritization, reordering), etc. People with conditions that affect cognitive resources, executive functions are also affected [24]; hence, quality of life is under threat. For example, people with attention deficit hyperactivivity disorder (ADHD) will find it hard to sustain their attention; therefore, a game designed for this target demographic needs to reclaim their attention repetitively and be ready to gently remind without drawing attention to the reality that they did not pay attention in the frst place.

3) Emotional resources: In playability context, Sanchez et al. [25] refer to the emotion as players' involuntary response. In the context of compassionate game design, emotional resources refer to the capacity in perseverance while feeling those emotions evoked by the game. It is less likely that a player would find it hard to deal with too much fun; however, it is more likely that they will have a limit for frustration before they give up playing the game. Thus, the emotional resources are resilience, self-esteem, self-efficacy, trust, etc. The capacity of the emotional resources can be influenced if not directly affected by a disease or a condition. The response of a game at moments of success and failure may drain or refill this resource.

4) Physical resources: These refer to the capacity in physical performance including the ability to perform throughout the gameplay session (endurance), ability in combined tasks such as movement and button press (dexterity), speed, muscular strength, power, etc. This may sometimes overlap with motor resources especially when precision and reach are required as in interactive dexterity by Sanchez et al. [25].

Overall, failing forward and a positive reinforcement throughout the challenge as per the previous discussions on motivation and optimal experience, should be the driving force of a compassionate game. According to dopaminergic studies [28], it is noted that uncertainty of result (win or lose) and almost succeeding or narrowly avoiding failure increase not only motivation but also dopamine release.

C. Player Perception and Game Content: Motivations and Reservations

Playing a game is rewarding; it rewards the player with an experience of "fun" as long as they wanted to play it. Swink suggests a challenge for a game designer is to create a game mechanic that is worth learning for players [10]. In fact, the difficulty of learning a procedure for gameplay only becomes worthwhile by the return of that action and how integral that action for the continuum of gameplay. Therefore, rewards of mastery, how difficulty of a procedure scales for the variety of individuals with diverse skills and abilities, and the relation of the mechanic to the contextual layer of the game (its art, theme and story) shapes the motivation. Meanwhile, pre-judgement, previous experience or fear shapes reservations. If the reservation grows larger than what motivations has to offer, it causes non-adherence. For a compassionate game, the challenge is creating pathways to overcome the reservations. This goes through positively changing the player perceptions. Games have the unique ability to invite people in and persuade them for participation. Their ability to shape perception and fight reservations of the participants should be explored further towards creating compassionate games.

D. On Challenges of Compasionate Game Design

Within the context of compassionate game design, a game that is not able to accommodate a player's health or learning

[1] https://www.merriam-webster.com/dictionary/skill

[2] https://www.merriam-webster.com/dictionary/ability

related difficulties is considered to be impaired. Therefore, the main challenge of compassionate game design is removing the impairment of the game so that it is playable by special demographics. This starts with identifying areas that players are struggling due to their conditions. As a starting point, these areas can be categorized in three domains: sensory challenges, physical challenges and cognitive challenges. For example, a core challenge of game design for special demographics with health issues is the restrictions on the physical and cognitive abilities of the player group. When this merges with the perceptions of the players about the nature of the activities, it becomes hard to create motivation to play the game. Therefore, it is important to notice that when players are not able to fulfil the expectations of the moment-to-moment gameplay simply because it is not possible due to their current condition, they will lose interest in the game as the game is only another reminder of their inability; hence, the experience is not enjoyable. Then, the challenge is introducing tolerance and support for these moments of need.

According to Swink [10], any delay that breaks the continuity of an experience creates poor game feel. Therefore, a game needs to be responsive for the player inputs. Similarly, any player action in response to the events presented by the game needs to be timely; otherwise, deemed unsuccessful by the game. Hence, the game acknowledges successful behavior and rewards it while also clearly communicating the consequences upon failure. From a purely game design point of view, facing consequences helps to reinforce meaning in choices. However, from a player-centric design point of view, especially for players with motor and/or cognitive impairments as in Parkinson's or stroke patients, how much time should be evaluated as the time-frame for "timely response" is unclear. The procedures of the game should be forgiving with a suitable error margin and compensating for delays as motor-cognitive processes in player's mind may take longer than an ordinary player. This may mean shifting the challenge to another aspect of game rather than using input-timeliness, input-combinations, or input-related challenges as a central element of core gameplay. Especially for anxiety prone demographics, removing time-constraint related design elements such as time-trials (obvious time constraint), falling platforms (hidden time constraint), traversal challenges (time constraint imposed by combination of other elements such as enemies, moving platforms, etc.) all together could even be a more suitable approach. In consideration of mental barriers, such compassion would reduce anxiety and stress, while replacing those with confidence, self-assurance and trust.

Game accessibility requests compassion from the system to bridge the gap between the player and the game in order to reduce the impact of impairment. For example, similar to how a poor visual design of an interface would reduce the usability significantly, a poorly developed game world with low quality art assets and poor choice of color palette would also reduce the quality of game experience. For a user interface (UI), chosen color palette, negative space, density/scarcity of visual elements, placement and alignment of UI elements such as button, text boxes etc., consistency of all UI elements in and across the pages including font, size and color, and the feeling and readability of transitions are extremely important. All these elements come together to create the right feeling for the interface with its content and suitability to the context. Similar but more intense, contextual content of games requires far more depth compared to a user interface. The player perceptions of the game world not only stem from the narrative elements that are telling a story of the game world but also the familiarity of the player with the game and game world. Therefore, the player needs a high processing power in order to evaluate all the information they could gather from the game in real time while playing the game. Thus, complex visual stimuli may become paralyzing if the system does not show enough compassion when a player's impairment is getting in the way of their play activity. Without a model that helps breaking down areas that demand processing power and areas to hide delay, it is uneasy to contemplate on how this need could be resolved without frustration.

V. A Holistic Model for Player-centric Game Design

The model seen in Fig. 2 attempts to draw attention to the identified core areas of compassionate design as per the discussion in Section IV. It aims to encourage a designer to take a player's perspective in relation to the formal structure of games and aims to enable a deeper discussion on game design challenges for special demographics. In doing so, the purpose is presenting a holistic map laying down the building blocks of the compassionate game design concept. This concept becomes readable with a game model and a player model that interacts with one another. With a player-centric focus, the model (Fig. 2) is extended from [1], and combines layers of player experience—as inspired from Garret on the planes of user experience [7][8]—with Adam's game design model [9] and Fullerton's formal elements [19]. In addition, Mayra's [67] core and shell dialectic informed the work for explaining the relation between formal elements of a game and a game's context. In a simplistic fashion, the dialectic captures the actors of player experience to start a conversation about their relation even though it lacks details to explain the potential elements of player experience or player's role in this dialectic.

The rationale for compassionate design is discussed in the previous section including a perspective for potential challenges it may entail. Here, player-centric game design model is explained with its layers.

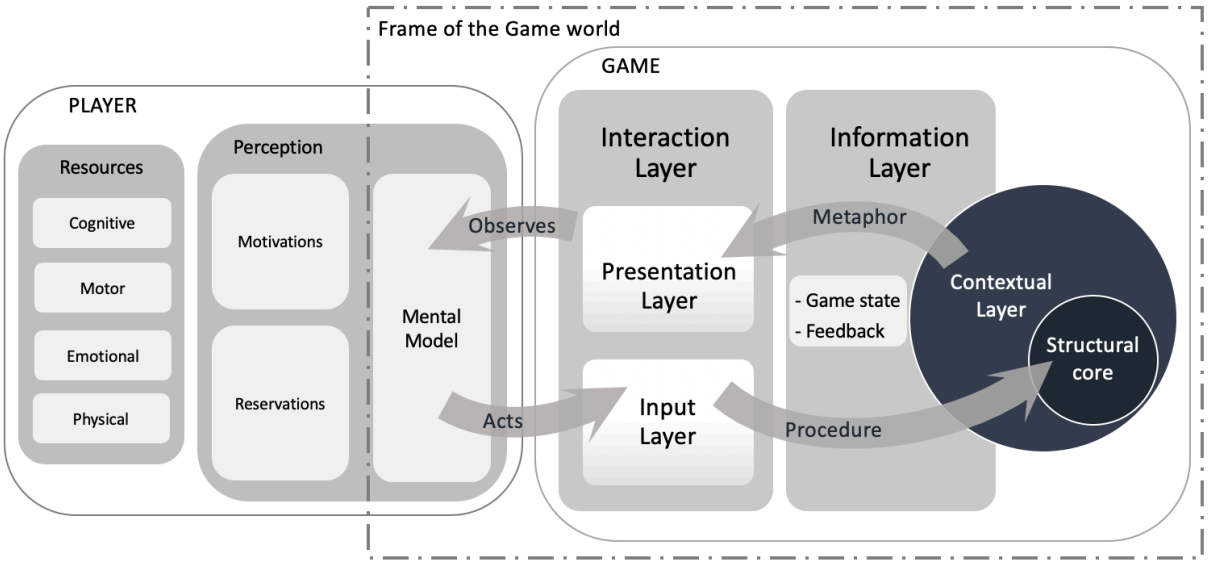

Figure 2. The player-centric game design model aims to encourage the development of compassionate games (extended from [1]). Therefore, it favours a player model by bringing transparency to the capabilities of the player and helps a designer to perceive the system from players' point of view.

With this model, a designer (i.e., researcher as a designer) can map the systematic flow of player experience and the mechanisms carried out in the game without losing focus on the player end of the game world. When the interaction cycle starts with a presentation of a game scene to the player, player observes it through their perception. As they act via pressing the buttons on the controller, moving the joystick or somewhat invoking the input layer as per the interaction modality available to them, the game receives this input and carries it to the structural core of the game to be resolved as per the predefined rules (as per the formal elements of the game). When this is resolved, the response will be dressed up by the contextual layer (in order to fit with the theme and style of the game) and shaped into the form of necessary information as per the game, its genre and style; hence, a responsive feedback will be passed to the presentation layer for the player to observe and start the interaction cycle again. Compassion is a necessity to be practiced at all stages of this cycle in order for a game to become compassionate.

A. *Frame of the Game World*

Frame of the game world acknowledges that the player model overlaps with the game model in creation of the gameplay experience similar to the discussions on experience of play in Salen and Zimmermann's schemas [13]. Schemas explain how the experiential layer of a game emerges when players play it. The game is governed by the rules that are formal elements of the game grammar and stays same for each player, yet the experience of each player is unique as per their session filtered by their perception. Each player engages with the game world through their perceptions that are mainly based on their mental model [12]. In this context, the relation between the game and the player is initiated and maintained by the player. Therefore, the frame of the game world encloses the player as it is activated with the presence and interaction of the player.

B. *Player Model*

Player model is composed of player perception and player resources. It considers the player perception as a combination of motivations, reservations and a mental model through which players engage with the game world. Swink refers the player perception as "perceptual field" [10] that is a combination of all previous experience including ideas, thoughts, memories, etc. From a player's point of view, game is only the interface since they do not need to know about (or perhaps are not interested in) any inner workings of the system (Fig. 3).

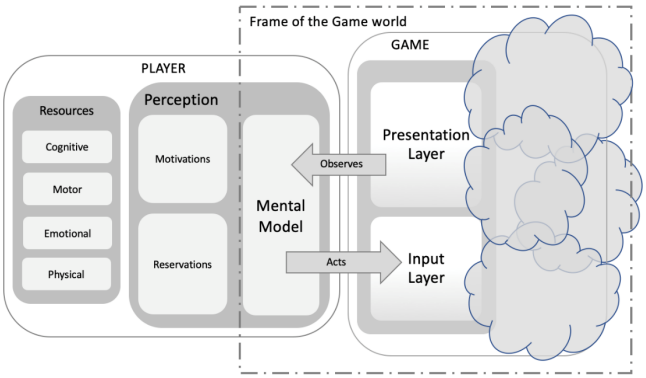

Figure 3. When we truly think in a player-centered fashion, it becomes apparent that players are very likely not aware of the interconnected system that makes the game function.

Game presents the current state of the system to the player, this is observed and filtered through the mental model to be judged against motivations and reservations by player's perception. Once there is a decision or a resolution at player's end, an action is performed by the player via the input scheme of the game. The game receives this input and magically

processes it. Both decision making process and performing the action are taxing on player's resources.

1) Mental model: Mental models refer to thought processes about how something works in the real world. They are formed via observations, or assumptions based on prior knowledge. Each person's mental model is clouded with their pre-judgements and their interpretation of the system [58].

There are three models of the system (as adopted from [58]): (1) how the player thinks the game works; (2) how the game is presented to the player as; (3) what the game really is. Mental model maps to the first model, even before player starts any interaction with the system. This resembles the user image and the system image concepts of Norman [58]. After the first interaction, mental model is reinforced with their continuous interaction. The further the gap between the first model and the last—what player thinks for how the game works versus what it really is and how it works—, the lower is playability—hence the higher is frustration.

A well developed game interface either resembles an already known system to leverage familarity or helps the players to develop a clear mental model of what they can do in this game. Tutorials are generally used as a bandate when game is not able to intuitively help players to build a good mental model of the system. The ability of the game to suggest a clear mental model reduces the complexity of interaction during stages of the action cycle [12]. Unlike HCI's common approach of mainly relying on user interface for evaluation of usability, for games human action cycle is dispersed over gameplay. Therefore, mental model is influenced by three contextual elements at perception level: (1) the contextualisation of actions at goal formation stage of the human action cycle, (2) the procedures and their contextual presentation at execution stage of the human action cycle, and (2) audio-visual feedback and game state presentation within user interface (or heads-up display—HUD) at evaluation stage of human action cycle. These are directly related to the presentation aspect of the interaction layer and indirectly related to the information layer as the contextual metaphor is fed from the core of the game.

2) Motivations: Elaborating on the aforementioned research on player motivation, the purpose of this in the framework is to draw designer's (researacher's) attention to the motivations of the player and how they influence their participation. This should align with not only the purpose of the game but also the intentions of the player to motivate participation. With meaning and purpose built in the game, the idea is leveraging the players' motivation for working towards their in-game goals to fulfill the health and rehabilitation goals. This is why *PokemonGo* (Niantic, 2016) has been praised by health practicioners. For a patient who needs to do a descent amount of walking every day, the in-game goal of hunting pokemons serves the purpose of the therapy by motivating the patient to walk since hunting requires finding the pokemons in the first place. In order to find them, a player needs to physically walk around until pokemons appaear in the location based augmented world. Hence, daily walking activity is fulfilled with the help of the mobile game.

3) Reservations: Any reason that prevents a player from participation is referred within reservations. It may be based on previous experience or can be formed at the first instance of interaction. Barriers to physical activity such as fear of injury, poor self-image, low self-esteem or lack of confidence to join group exercise activities are commonly reported among reasons for lack of motivation for therapies or rehabilitation [28][60][63]. Another set of barriers may also originate from unfamiliarity with technology, lack of clarity and ease of use (accessibility) of a system, perceptions on the usefulness of technology, self-image, and fear of failure. Therefore, the player model draws attention to the relation between reservations and motivations, and how they may influence the mental model of a target user group. As much as motivations act as a driving force, reservations act as the hand brake. Nevertheless, the game experience needs to be fluid and effortless.

C. Player Resources

In this context, player resources are considered as the currency that a player spends during the play session. Each individual has finite physical, emotional and cognitive capacity. Player resources represent this capacity and its availability during gameplay. Rather than the resources commonly discussed as a formal element of a game, the resources referred in this model are intrinsic to a player. Intrinsic player resources are cognitive skills, motor skills, physical abilities and emotional abilities (physical and emotional stamina). These are within the power of the player and do not belong to the in-game economy. They are not generated by the game or in the game; however, they are brought in and used by the player, yet consumed by the game. They are limited, and refresh time for these vary from person to person. For a suitable design targeting players with physical or mental health related difficulties, designers need to study how these resources are effected by the disease and how they will be used in the game in order to prevent frustration during the game.

For example, after long hours of play, the physical stamina of a player may drop, and they may not be able to function as prompt as they were at the beginning of the play session. This is an example of a player spending their physical stamina (their physical ability resource); hence, getting tired after a long period of playing. If the player is suffering from anxiety and the game is designed to alleviate this, the decision-making process in the game needs to accommodate that and should not rely on dilemmas as a challenge, dynamics such as time trials or quick-time events should be avoided, and visual stimuli should be organised to prevent clutter and overloading.

D. Interaction Layer

Interaction layer represents the overlapping space of game world and player's world. Via this layer, player sends input to the game world, observes the results of their input and receives a response from the game world. Interaction takes place between the player and the game world. It is either started by the player via an input, or by the game world via an event presented with the presentation layer. When it is initiated by the player, the game responds; when it is initiated

by the game via presentation layer, the player responds via input layer. In both cases, information layer feeds the presentation layer with necessary data. Interaction layer is composed of presentation layer and input layer.

1) Presentation Layer: Presentation layer can also be thought as sensory layer encompassing audio, visual and haptic presentation of the current status of the game. This includes continuous presentation of the game world and the game's response to the player inputs. Any feedback generated in response to the player inputs is presented by the presentation layer. Clarity of presentation and a suitable composition of audio-visual elements are essential for readability. The presentation of this layer is either (1) active or (2) reactive:

a) Active presentation (1) is initiated and conciously generated by the game with respect to or regardless of player positions or existance. It is important to notice that in any moment that the player is not interacting with the game, this presentation would still be actively present; hence, active presentation. It is an audio-visual presentation for the theme and of the game world, and would include any audio-visual element to inform the player about the current active or passive status of the game including but not limited to telegraphing for potential actions/events or signalling for awareness of moment-to-moment development of events in the game, score, etc.

b) Reactive presentation (2) is developed in response to or because of an action initiated by a player, therefore can be considered as system's (game's) response to the player; commonly referred as feedback. Necessary to note that this presentation would only be executed if an action that would trigger a reaction was performed by the player. Reactive presentation can take forms of audio-visual and/or haptic feedback directly in response to a player input or to draw attention to a change that was a result of the player action/input. Audio-visual effects in user interface that inform the player for the moment of change are also examples of this category. For example, a falling platform would only fall (or destructed into pieces with an appealing vfx and sfx) if the player character walks/jumps onto it. Therefore, audio-visual presentation (vfx and sfx for distruction) is a reaction to player's interaction with a game element (falling platform in this case). If player health changes during this action, an audio-visual effect on user interface (one of the hearts blinking prior to disappearing) would also be used to draw attention to this change in addition to the update of player health on screen. Any of the reactionary feedback is time sensitive and loses its value at the end of the perceivable window (i.e., 240ms for a full correction cycle). Swink [10] suggests, if a computer's response takes equal or longer than half of the correction cycle (i.e., 120ms), the systems feels laggy.

The response of the game world could be:

- in the form of visual effects that shows the moment and result of interaction (mostly referred as visual feedback);
- in the form of sound that acknowledges the moment and result of interaction (mostly referred as audio feedback);
- haptic such as vibration of the controller;
- in UI including sound and visual effects.

The response fulfills the expectations of gulf of evaluation. The longer it takes the game to respond or the more disconnected the response is to the current perceivable context of the game, the larger is the gulf of evaluation. Hence, the game usability is lower.

2) Input Layer: Input layer is responsible for the interaction device, input techniques, clarity of input mapping, directness, sensitivity and consistency of input. A common goal for a game controller is effortless use with which the input device feels like the extension of the body [10]. This motto becomes challenging for special demographics with impariments or difficulties related to motor skills. For example, PD has some symptoms, such as tremor, bradykinesia or hypokinesia that may cause difficulty in using an input device or perform an input action within a required time-frame or precision. Therefore, additional research into input devices and interaction modalities would be useful. Moreover, further research on familiarity of the player group, mental model, and restrictions of disease stages for input modality is expected to improve the design.

In addition to the input device or interaction paradigm, the complexity of input is also important. The complexity of input refers to the combination of buttons for an input and the characteristics of the combination such as time-specific input, simultaneous or ordered button presses, etc.

To reconcile, an effective interaction layer for a compassionate game needs to be: 1) immediate; therefore, presentation layer needs to present the feedback immediately, and show the change in game-state if there is; 2) responsive; therefore, the presentation layer always presents a response to any input and the player is never left in dark in terms of what is happening with the system; 3) informative; the presentation is readable and clearly presenting all necessary information such as game-state or contextual clues, feedback is clear and adequate; 4) forgiving; the input scheme allows for a feasible input window, error recovery has necessary feedback and is motivational.

E. Information Layer

Information layer sits in the middle of presentation layer and structural core of the game, and interprets outputs of the core system in a readable format for the player. Cues for meaning making (semantics), affordances and limitations for the player [12], contextual visual material, data organization, response of the game (feedback for the player), and any information, such as score, status, outcomes, etc., belongs to this layer. Even though the information is generated by the structural core of the game, its interpretation is handled in information layer and passed to the presentation layer for the player to see. Therefore, the collaboration between information layer and presentation layer carries high importance.

1) Contextual Layer: Contextual content works with the formal elements and supports meaning making. Objectives,

rules, procedures, affordances and limitations become meaningful with the help of contextual content. While being important for engaging the audience, contextual content is also important for maintaining attention and motivation. In order to develop content based on the interests of the target audience (elders, kids, young adults, etc.), a participatory approach or persona studies would be preferable. Salen and Zimmermann [13] emphasize that without context, there is no meaning; hence, contextual meaning helps to develop meaningful play. For example, *Pokemon Go* creates a context around training a special creature called pokemons and battling to defend your dojo; therefore, one needs to capture the pokemons prior to training them. This means the activities of walking around to find the pokemons, performing the moves, and using the means to capture them serve within this context. The rarity of the creatures, what kind of environment they prefer, and how they respond the moves of the player feed into the lore of the game. Swink suggests that the visual content and the context need to work together with the help of the right metaphor for a fuilfilling experience [10]. The metaphor represents the connection between context and mental model.

2) Game State: Game state presents any necessary trackable data that influences players' decision making while they are playing. Game state includes but not limited to score, item count, health, current or remaining time, active or planned tasks/quests, current progress, success/failure, win/lose, etc. Transparency of game state is necessary to ensure competence and autonomy in gameplay.

3) Feedback: Feedback refers to a compassionate reaction that is both contextually suitable and positively perceivable by the player. The positive nature of feedback is emphasized in games for health circles [28][11]. Feedback needs to be focusing on the successes rather than failures. Encouraging continuation of participation and reinforcing flow are within the role of feedback. Necessary to note that feedback can take many forms within a game including but not limited to audio effects, audio-visual changes to the entities in the game (sound, color changes, color flashes, outlining, scaling, etc.), animation of entities in the game or animation at user interface level, visual effects, narration, or any change in the game world, etc. Some important things to consider for the attributes of feedback are; how often to show, how amplified it needs to be, how long it should be shown, and in which form (audio and visual) it needs to be. These attributes should also take into account the capability of the player (as per the player resources dsicussed before) for a compassionate feedback. For example, for a player who can be disturbed by the nature of visual stimuli (i.e., colour, shape, light or change in those), visual feeback should be carefully catered not to breach the acceptable visual qualities.

F. Structural Core

Structural core of a game comprises formal elements [19]. Both the information layer and the presentation layer are dependent on the core structure of the game while also creating meaning for it. From player's point of view, the core of the game may be completely invisible (Fig. 3) as their perception is shaped by the presented information (based on how it is interpreted by the information layer). Therefore, discoverability, learnability and consistency of the system need to be resolved at this layer so that relevant data could be fed to the information layer.

1) Procedures: Procedures are the first point of interaction with the input from the player. They are integral to moment-to-moment gameplay, and they define the chain of moves necessary for performance in the game. Reiterating the previous discussion on correction cycle, a delay in any stage of player performance will make the time-frame of user input longer. For example, double jump could require hitting the jump button twice within a second in order to perform double jump. This seemingly simple action could be unexpectedly challenging for a person with rigidity or sloweness of movement, who might find hitting the same button twice hard to repeat within a second's window. Another example is the number of steps necessary to do something, such as the steps to be performed to bake a cake. For a person with memory issues such as in Alzheimers, remembering those would be really hard, therefore frustrating to perform. Thus, procedures should be catered for a suitable grace time, simple recovery (this does not mean game needs to be easy), shorter and less complex chain of actions for ability to learn and retain information. On top of these, additional consideration for impairments would make a big difference. When done right, the core game demands less player resources and/or compensates for lack of those when necessary.

2) Resources: Management of in-game resources may prove challenging if learning, managing and controlling the resource features of the game are challenging for the players' resources as per discussion in Section IV.B. Additionally, depending on the way in-game resources are used in the game, an interface complexity may also occur creating additional sensory and cognitive challenges at a level of presentation layer. For example, games of real-time strategy genre are more resource heavy than single screen puzzle games even though their cognitive complexity may resemble one another.

3) Objectives: The role of objectives in game design has already been discussed throughout the article. An additional note here is on how in-game objectives of the game need to somewhat serve the targeted health and rehabilitation benefits of the overall experience. Previously discussed motivation example on *Pokemon Go* shows how in-game objectives motivate gameplay, and partially serve for the therapy objectives (walking daily). If the therapy objective was doing some moves in addition to walking, the game would have needed these moves performed towards catching a pokemon. Besides, objectives should be discernable and achievable by the player considering limited cognitive and emotional resources may make an objective unreachable.

4) Rules: Since the system is governed by the rules, transparency and consistency of these were already mentioned as necessity. It is important to note that if the complexity of the rules prevent the players from understanding the moment-to-moment gameplay, game fails to be compassionate. The limitations emposed by the

cognitive and emotional resources also shape the player's ability to understand the rules.

5) Conflict: Conflict in context of compassionate design requires additional care. By definition, conflict represents the challenge that attempts to prevent a player from reaching their in-game goals and objectives. This is also what separates digital games and game usability from other interactive digital experiences. While challenging a player, a game presents the player with a problem to be solved and to be overcome. Referring back to motivation and the experience of flow, the design of the challenge directly affects the playability of the game. Therefore, developing a suitable challenge and scaling the difficulty for sensitive demographics is absolutely necessary to motivate play and induce flow. Designing the challenge is essentially designing the game.

VI. Discussion and Conclusion

This section shares a discussion and a closing note on the theory and application of the model presented in the paper.

A. On Compassionate Game Design

The idea of compassionate game design emerged during the analysis of potentially suitable commercial games for rehabilitation of PD, followed with an attempt to identify the sources of the issues found with them [4]. During the prototyping stage of an exercise game for PD, the building blocks of the player-centric design paradigm surfaced as a nascent theory. Compassionate game design concept is novel and brave although naïve. The concept has a novel perspective to carry the idea of empathy towards a more applicable format that is much clear for inquiry and contemplation for game design process. It draws attention to the player's position in the game experience, and encourages the researcher/designer to examine the design in relation to three areas about the player. These are player perception, player resources, and player-game relation (discussed in Section IV in detail). Player-centric game design paradigm is the artefact of the design research activity that is grounded with the compassionate game design concept. The model aims to be easy to read and apply by anyone without prior game design knowledge. As any novel idea, the way to see whether it is useful for the larger community is by putting it into use and letting it evolve with the findings.

B. Strengths, Limitations, and Future Work

The purpose of the model is to promote further discussion on the elements of game design with a player-centric focus; therefore, the main strength of the work originates from the incorporation of the user experience model and "game feel" to ensure this. The paradigm welcomes exploration in those layers, and encourages analytical thinking towards a player-centric design. Currently, there is no other work that brings a player model and a game perspective together as a game design model. The details of the player model with the never-ending dance between motivations, reservations, and mental model contributes to the understanding of what players think when they start playing a game. Furthermore, the resources in the player model allows the researcher/designer to keep an eye on the internal challenges only apparent to the player that are of a sensitive nature affected by a condition or a disease.

As much as the compassionate game design concept and the paradigm were developed with a synthesis of current work, the player-centric design model should not be considered to carry any predictive abilities for a best possible system of game based rehabilitation. The development of a compassionate game with the help of the model do not ensure an effective rehabilitation, nor a single design that is useful for all kinds of rehabilitation. A planned improvement is expanding the model with the addition of a set of questions on what to do for each layer, and exemplar design snippets to further help the researchers. Since the bulk of the theory is presented through synthesis now, there is room to develop a user map or a guide for holistic thinking in future work. In addition, a report for the application of the paradigm with a development journal, the resulting product and a postmortem is planned for the future. Finally, despite some mentions of playability, an additional angle with a more detailed playability concept following from existing playability literature, and a discussion on how playability relates to this model are in the pipeline of future work.

C. Conclusion

In this paper, a player-centric design paradigm is presented to improve game design practice for health-related purposes. The paradigm is holistic as it draws attention to the interconnected nature of a game experience, the layers of the game experience to allow a closer understanding of players' perception of these layers, and some approaches to enhance empathy for player resources. The paper encloses an analysis of the current literature for similar game design pursuits, presents a discourse for compassionate game design, and explains the player-centric design paradigm in detail with grounding strategies. The main contributions of the work are the compassionate game design concept and the player-centric design model. They are developed to provide an easy to follow perspective for researchers, who may be new to games for health or who may have limited knowledge about game design despite a vision on using games for health and rehabilitation purposes. The hope is more effectively leveraging the potential of games for this vision with the creation of more compassionate games.

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