

Personalized gamification to enhance implementation of eHealth therapy in youth mental healthcare

van Dooren, Marierose

DOI

[10.4233/uuid:9a8d3973-f5b5-4812-97ed-27e5c14afc34](https://doi.org/10.4233/uuid:9a8d3973-f5b5-4812-97ed-27e5c14afc34)

Publication date

2020

Document Version

Final published version

Citation (APA)

van Dooren, M. (2020). *Personalized gamification to enhance implementation of eHealth therapy in youth mental healthcare*. [Dissertation (TU Delft), Delft University of Technology].
<https://doi.org/10.4233/uuid:9a8d3973-f5b5-4812-97ed-27e5c14afc34>

Important note

To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

Personalized gamification to enhance implementation of eHealth therapy in youth mental healthcare

Proefschrift

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus, prof. dr. ir. Prof.dr.ir. T.H.J.J. van der Hagen
voorzitter van het College voor Promoties
in het openbaar te verdedigen op
vrijdag 3 april, 2020 om 10.00 uur

door

Marierose Margot Mabelle VAN DOOREN

Master of Science Universiteit Leiden, Nederland
geboren te Breda

Dit proefschrift is goedgekeurd door de promotoren en copromotor.

Samenstelling promotiecommissie bestaat uit:

Rector Magnificus	Voorzitter
Prof.dr.ir R.H.M. Goossens	Technische Universiteit Delft, promotor
Prof.dr. V.M. Hendriks	Parnassia Groep; Leids Universitair Medisch Centrum, promotor
Dr. V.T. Visch	Technische Universiteit Delft, copromotor

Onafhankelijke leden:

Prof. dr. H. de Ridder	Technische Universiteit Delft
Dr. M. van Orden	Parnassia Groep, Den Haag
Prof. dr. B.A.M. Schouten	Technische Universiteit Eindhoven
Prof. dr. ir. G.D.S. Ludden	Universiteit Twente
Prof. dr. ir. D.J. van Eijk	Technische Universiteit Delft, reservelid



Marierose M. M. van Dooren
mmmvdooren@gmail.com

Cover by: Margot M. M. de Beer
Printed by: ProefschriftMaken

© Marierose M. M. van Dooren, 2020
All rights reserved. No part of this book may be reproduced or transmitted in
any form or by any means without permission of the author.

CONTENTS

1.	7
INTRODUCTION	7
1.1. YOUTH MENTAL HEALTHCARE	8
1.2. DESIGN TO IMPROVE PSYCHOLOGICAL TREATMENT	9
1.2.1. <i>Blended eHealth</i>	9
1.2.2. <i>Personalization in design for mental healthcare</i>	11
1.2.3. <i>Gamification design in mental healthcare</i>	12
1.2.4. <i>Personalized gamification in eHealth for adolescents</i>	14
2.	17
PERSONALIZATION PROCESS IN GAME DESIGN FOR HEALTHCARE	17
2.1. INTRODUCTION	18
2.1.1. <i>Different definitions of personalization</i>	19
2.1.2. <i>Games for health</i>	22
2.2. METHODS	23
2.3. RESULTS OF THE LITERATURE REVIEW	24
2.3.1. <i>A general overview of papers involved in the Personalized Design Process</i>	25
2.3.2. <i>Overview healthcare effects</i>	30
2.3.3. <i>Combining the healthcare effects with the Personalized Design Process</i>	32
2.3.4. <i>Validating the influence of games involved in Personalized Design Process</i>	41
2.3.5. <i>Applied game-elements in reviewed papers</i>	43
2.4. DISCUSSION AND CONCLUSION	45
2.5. FUTURE WORK AND CONCLUSIONS	50
3.	53
THERAPY PROTOCOLS AND EHEALTH DESIGN: A FOCUS GROUP STUDY	53
3.1. INTRODUCTION	54
3.2. METHOD	55
3.3.1. <i>Therapy protocol</i>	55
3.3.2. <i>Procedure</i>	55
3.3.3. <i>Participants</i>	56
3.3.4. <i>Data analysis</i>	57
3.3. RESULTS	58
3.3.1. <i>Part 1: Focus group sessions with therapists</i>	58

3.3.2.	<i>Part 1: Focus group sessions with patients</i>	61
3.3.3.	<i>Part 2: Focus group sessions with both patients and therapists</i>	64
3.4.	DISCUSSION	67
3.5.	CONCLUSION	72
4A.		75
GAME DESIGN RELEVANCE OF PERSONALIZATION IN YOUTH MENTAL HEALTHCARE		75
4A.1.	INTRODUCTION	76
4A.2.	METHODS	76
4A.3.	RESULTS	77
4A.4.	DISCUSSION	79
4B.		81
THE DESIGN AND APPLICATION OF GAME REWARDS IN YOUTH ADDICTION CARE		81
4B.1.	INTRODUCTION	82
4B.2.	METHOD	85
4B.2.1.	<i>Ethics</i>	85
4B.2.2.	<i>Participants</i>	85
4B.2.3.	<i>Design</i>	86
4B.2.4.	<i>Variables and measures</i>	89
4B.2.5.	<i>Procedure</i>	89
4B.3.	RESULTS	89
4B.3.1.	<i>Strategy of analysis</i>	89
4B.3.2.	<i>Manipulation checks</i>	90
4B.3.3.	<i>Difference in playing time according to reward types between substance dependent and non-dependent adolescents</i>	90
4B.3.4.	<i>Difference in reward evaluation according to reward types between substance dependent and non-dependent adolescents</i>	91
4B.3.5.	<i>General results</i>	91
4B.4.	DISCUSSION	92
4B.5.	REWARDS IN PERSUASIVE GAME DESIGN: IMPLICATIONS	94
4B.6.	REWARDS IN PERSUASIVE GAME DESIGN: CASE STUDY	98
4B.7.	CONCLUSIONS AND FUTURE RESEARCH	99
5.		103
REFLECTIONS ON THE DESIGN, IMPLEMENTATION, AND ADOPTION OF A GAMIFIED EHEALTH APPLICATION IN YOUTH MENTAL HEALTHCARE		103
5.1.	INTRODUCTION	104

5.2.	RESEARCH THROUGH DESIGN: THE READYSETGOALS AS A DESIGN CASE STUDY FOR GAMIFICATION OF COGNITIVE BEHAVIORAL THERAPY	106
5.2.1.	<i>Define Transfer Effect</i>	108
5.2.2.	<i>Explore User Context</i>	109
5.2.3.	<i>Design Gamification</i>	110
5.2.4.	<i>Evaluation Gamification</i>	113
5.3.	PRELIMINARY TESTING WITH TARGET AUDIENCE	115
5.3.1.	<i>Results and suggestions for iterative improvement</i>	116
5.4.	FINAL ITERATION OF THE READYSETGOALS GAMIFICATION	118
5.4.3.	<i>The readysetgoals gamification</i>	118
5.5.	IMPLEMENTATION OF THE LUCA APP AND EVALUATION BY THERAPISTS	124
5.5.1.	<i>Qualitative mid-stage evaluation</i>	125
5.5.2.	<i>Ethical considerations</i>	125
5.5.3.	<i>Results</i>	126
5.7.	DISCUSSION: REFLECTION AND LEARNINGS FOR EHEALTH DESIGN	134
5.7.1.	<i>Managing stakeholder expectations through framing</i>	134
5.7.2.	<i>Integrating therapeutic aspects in a game world experience</i>	136
5.7.3.	<i>The value of personalization in youth mental healthcare gamification</i>	137
5.8.	CONCLUSION	138
6.		143
	GENERAL DISCUSSION AND IMPLICATIONS	143
6.1.	IMPLICATIONS	147
6.1.1.	<i>Implications of personalized gamification in eHealth</i>	147
6.1.2.	<i>Implications for the set-up of future eHealth evaluation methods within this field</i>	154
6.1.3.	<i>Implications and recommendations for future research and eHealth development</i>	156
	REFERENCES	161
	SUMMARY	189
	SAMENVATTING	195
	ABOUT THE AUTHOR	205
	LIST OF PUBLICATIONS	206

1.

INTRODUCTION

1.1. YOUTH MENTAL HEALTHCARE

Mental health disorders are the leading cause of disability in children and adolescents. Around 30% of children and adolescents suffer from a mental health disorder [1] and 70% of mental disorders have their onset prior to the age of 25 [2]. Adolescence is a period in life during which essential developments occur in biological, psychological, emotional, cognitive, and social domains [3-7]. Mental health disorders, including substance use disorders, in adolescence have a negative impact on these domains [8-12] during adolescence and adulthood. For example, mental health disorders during adolescence increase the risk of educational underachievement and later mental health disorders during adulthood [8, 9]. To reduce mental health problems and limit their negative effects, prevention, early recognition and effective treatment are needed.

With a few exceptions, the majority of evidence based therapies for adolescents with mental disorders include psychotherapy which can be defined as a treatment modality “in which the therapist and patient(s) work together to ameliorate psychopathologic conditions and functional impairment through focus on the therapeutic relationship” [13]. From these therapies, family-based treatment and cognitive behavioral therapy (CBT) are most often used and have shown to be effective in reducing mental health problems in children and adolescents for a range of disorders such as anxiety and depression [14-16].

Although psychosocial therapies are effective in reducing psychiatric symptoms in adolescents with mental disorders, there is still room for improvement. For example, a recent meta-analysis of more than 400 randomized controlled trials on children and adolescents receiving psychological therapies found a mean post-treatment effect-size of 0.46 (“medium effect”), and this mean effect-size dropped to 0.36 (“small effect”) at an average of one year follow-up. Highest effect-sizes were found in treating children and adolescents with an anxiety disorder (mean 0.61), and lowest effect-sizes were found among those with multiple disorders (mean 0.15) [17]. Hence, a considerable proportion of treatment-seeking children and

adolescents do not (sufficiently) benefit from treatment, and it is largely unknown which individual patients benefit most from which type(s) of treatment.

Factors that reduce the effect of mental health therapy include premature termination of treatment, poor attendance of treatment-sessions and a low or non-adherence to homework assignments (e.g. [18-22]). For example, about 28-75% of children and adolescents in mental healthcare drop out of treatment [23]. Drop-out and poor attendance can limit the amount of time that a patient actually spends “in therapy”, consequently decreasing the impact of the therapy on the patient’s functioning in everyday. Given the suboptimal effectiveness of psychological treatment, when focusing on the aforementioned examples of therapy adherence, there is probably room for improvement in the design of therapy. One area from which design modifications can be derived is the field of new Information and Communication Technologies. Apart from the patients themselves, two target groups of stakeholders can be distinguished which should be involved in improving the ‘design of therapy’, and which are likely to benefit from the work in this thesis: design researchers (i.e. healthcare design researchers and game design researchers) and mental healthcare professionals (i.e. therapy developers and therapists). How improvements can be achieved, will be discussed in the following paragraphs.

1.2. DESIGN TO IMPROVE PSYCHOLOGICAL TREATMENT

1.2.1. BLENDED EHEALTH

One great potential of improving psychological treatment is the use of Information and Communication Technologies in the delivery of mental healthcare [24-26]. Combining these technologies with current face-to-face psychological therapy with a therapist is also called “blended eHealth”. Blended eHealth can extend the reach of psychological therapy beyond the clinical setting, as technologies can be used anytime and anywhere (e.g. [27, 28] in adults). It is especially suitable for adolescents, as they are typically the

early adapters of new technologies and around 99 % of the youngsters and adolescents aged 12-25 years old own a smartphone [29].

Patients often do not work on their therapy outside a therapy room, and thus do not practice that what they learn during face-to-face therapy sessions in their daily life (e.g. [18]). Blended eHealth has the potential to lower non-adherence, one of the main reasons for therapy failure and poor therapy outcomes in general mental healthcare [19, 30, 31]. For example, by enhancing the patients' motivation and engagement to go to therapy sessions and responsibility and possibility to do their homework (e.g. [32-34], with no specific focus on adult or youth mental healthcare). Besides, with blended care, therapists still have the opportunity to build up a collaborative relationship – also referred to as a 'therapeutic alliance' - with their patients [33]. According to previous findings, a strong therapeutic alliance has been associated with positive therapeutic outcomes (e.g. [35] for psychotherapy in general and [36] for adolescent and child psychotherapy).

Research focusing on the effect of eHealth in mental healthcare is limited, but existing meta-analyses suggest overall small to medium effect sizes in adults (e.g. [37-39] in reducing substance use or improvements in anxiety and depression symptoms) and adolescents and children (e.g. [40] in treating anxiety symptoms and [41] in treating depression and anxiety symptoms or disorders). Moreover, research suggests that blended eHealth is more effective regarding mental health symptoms compared with fully online eHealth without therapist contact (e.g. depression and anxiety in adults [42, 43]). However, research also suggests that blended eHealth is not more effective compared to standard face-to-face therapy [27]. Kenter et al. (2015) even suggested that blended eHealth in adult mental healthcare seemed to take more therapy sessions (face-to-face plus online sessions) compared to those who received only face-to-face sessions, resulting in higher costs [44]. Patients do not optimally use the online modules of blended eHealth and a majority does not complete the entire treatment program (e.g. [45] focusing on adherence of adults and [46] of children and adolescents). Even though eHealth adherence-rates have not often been compared with face-to-face

therapy (e.g. [27, 47]), systematic reviews indicate that non-adherence in eHealth is comparable to face-to-face therapy.

Therefore, the modules of current therapy should either be improved or patients should be motivated to start and continue to use the online modules for therapy-related activities [48], especially when they have to perform these online modules in their own environment and time. When the online modules of blended eHealth are aligned to the patient and his/her context of application, patients can be more motivated to start and continue to use the online modules, consequently improving the therapeutic effects.

1.2.2. PERSONALIZATION IN DESIGN FOR MENTAL HEALTHCARE

To enhance the motivation of an individual patient to start and continue to use a specific product or adhere to therapy, it can be “personalized” to accommodate the individual characteristics, needs and wishes of individuals or groups of individuals [49]. This can be done by involving stakeholders (e.g. the users of a product) in the design process [50], consequently enhancing the chance that the product is being used [51-54]. A lot of research involves “personalization”, but clear and shared concepts of what personalization entails are lacking. Stakeholders can be involved in different phases of a design process. At the start of a process, the problem and focus for the ‘to-be designed product’ is identified, established and analysed. This is followed by a phase where possible solutions are developed, tested, evaluated, and further improved. Lastly, the process ends in a personalisable product that can be tailored to the needs of individual users of the product, derived from the earlier design phases.

Current face-to-face psychological therapy is often protocolized to structure face-to-face therapy sessions. This is to ensure evidence-based practices, and consequently to increase the likelihood that the pursued treatment outcomes are attained [55]. Even though it is recommended to follow and apply therapy protocols as much as possible, as it plays a large role in the success of evidence-based therapies [56], both therapists and patients can have good reasons to change or partly apply a therapy protocol in therapeutic practice [57-61]. Generally, the therapy protocols that form the basis for the

implementation of evidence-based face-to-face therapies are also used for the design of eHealth [62]. A possible cause for the limited effect of eHealth in mental healthcare is a marginal level of engagement from users (e.g. therapists and patients) during the design process of eHealth. For example, by digitalizing the full therapy protocol that is actually only partially applied or used in therapeutic practice. EHealth should be personalized, as it is expected that personalization motivates them to continue to use eHealth [53, 63-69]. Consequently, this would positively influence the implementation process of the eHealth product in the individual's daily life and with that, the chance that the health related transfer effects are achieved [70, 71]. However, personalization practices are insufficiently described and there is a lack of systematic studies on the added value of personalization. Therefore, it is important to examine the conditions for a successful implementation of personalization in eHealth for clinical practice.

1.2.3. GAMIFICATION DESIGN IN MENTAL HEALTHCARE

Current eHealth interventions in mental health care are often focused on the therapeutic content and provide limited interaction motivation for the patient. A design technique that aims to enhance the motivation of patients to use eHealth by making it more appealing is the application of game-elements from entertainment games. Game-elements such as rewards, challenge and competition, generate engaging experiences such as pleasure, and surprise [72] or feelings of flow, a rewarding state of pleasure users can have when playing a game that matches their skills [73]. These experiences in turn directly fulfil basic motivational behavioral needs [74]: the need for competence, autonomy, and social relatedness [51, 75]. However, the experiences can be more and less preferred experiences by users, depending on the users' intrinsic needs, values and goals. Preferred experiences can improve their satisfaction [76] and increase usage frequency. If the gamification design is thus personalized to the users, this can enhance the engagement and motivation of the user to interact with the gamification design even more [68] and consequently improve the implementation of the gamified product.

The use of game-elements from entertainment games in non-game contexts is labelled as “gamification design”. Gamification design aims to change the behavior of a user in the real world by creating a game world experience [63] that is more engaging, free and enjoyable [63] compared to a real world experience (see Figure 1). Gamification design in healthcare and mental healthcare has shown potential [71, 77, 78], e.g. by improving healthy behavior, well-being, and/or positively influencing the knowledge and attitude of individuals towards healthy behavior [78-89]. Gamification design seems especially relevant for youth mental healthcare, as millions of adolescents play computer games as a leisure activity [90]. Therefore, one can assume that the motivating and rewarding experiences of games are more imbedded in the lives of adolescents compared to the lives of adults. A recent study of Deacon and O’Farrell (2016) focused on serious games and gamifications for adolescents with chronic diseases and found positive results, especially for behavioral interventions that promoted self-care behaviors [91]. However, more research is needed to study how gamification can be designed in the most effective way before implementing it in practice. For example, there are only a few independent trials and direct comparisons between gamified and non-gamified interventions are lacking [91, 92].

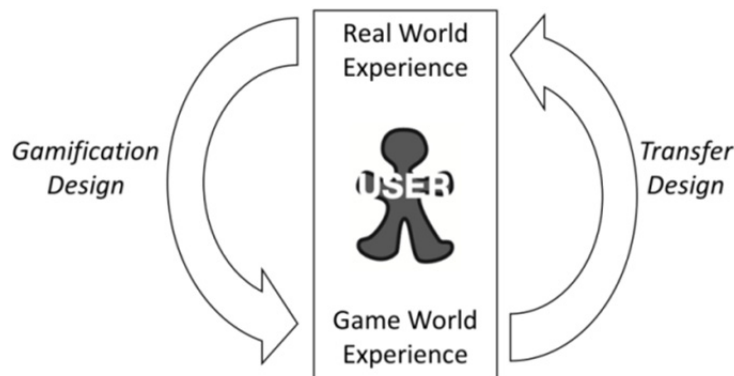


Figure 1. Persuasive Game Design (PGD) model of Visch et al. [63]

1.2.4. PERSONALIZED GAMIFICATION IN EHEALTH FOR ADOLESCENTS

Even though gamified eHealth seems successful in mental healthcare and youth mental healthcare contexts [71, 77, 78], there is a lack of validation research on the added effect of gamification and crucial aspects for a successful implementation of gamified eHealth interventions. Personalization has been suggested as a design technique for a successful implementation, but it is unclear how it has been applied and what the effects are on health related outcomes. Therefore, the aim of this dissertation is to study the added value of personalized gamification as a factor to enhance implementation potential of eHealth interventions in youth mental healthcare. As noted in the first section of this chapter, apart from the patients, the results of this thesis are relevant for two groups of primary stakeholders: design researchers and mental healthcare professionals.

Design researchers

Personalization is often applied by design researchers, since it has been suggested as a design technique for a successful implementation of the design. However, it is unclear how personalization has been applied and what the effects are on health-related outcomes. This dissertation can help design researchers to know how they can personalize a gamified eHealth application, which enhances the chance that the product matches the therapeutic practice. In this dissertation, we propose a uniform definition of personalization in game design to execute a literature study on how personalization has been applied in game design for health (Chapter 2). This uniform definition of personalization will help design researchers to structure the personalization processes of their designs. Other information that is important for design researchers is the alignment of a design to youth mental healthcare. We will study how a design can be aligned to youth mental healthcare by investigating the amount of and reasons for therapy protocol application (Chapter 3). In addition, we focus on the game design relevance of personalization in youth mental healthcare. Firstly, by describing a game design method using a specific personalization technique (Chapter 4A), followed by the potential

implementation of a game element (i.e. rewards as one of the most often applied game element) (Chapter 4B) in youth addiction care. This information is relevant for design researchers, since they need to know if this game design method is suitable to use within this context, or if there are other/multiple design methods needed in the design process. In addition, they need to know if the game element is suitable to apply in youth addiction care when they want to use game elements to motivate patients to engage and remain in treatment. This dissertation concludes with the description of an exemplary design implementation case, and describes our learnings for design researchers (Chapter 5).

Healthcare professionals

Next to design researchers, the studies described in this dissertation are also relevant for mental healthcare professionals. The amount of and reasons for therapy protocol application (Chapter 3) can be used by healthcare professionals to improve therapeutic practice, e.g. by updating therapy guidelines, providing training and/or more supervision to ensure evidence-based therapeutic practice. In addition, they can help design researchers to better align eHealth to both evidence-based therapy protocols and therapeutic application of these therapy protocols. Besides, we provide healthcare professionals with information regarding the potential usage of rewards as a motivational element in an addiction treatment context, since substance dependent youngsters may be less motivated by non-drug-related rewards due to differences in the motivational system (Chapter 4B). Lastly, this dissertation provides case-study driven learnings for the development and implementation of gamified eHealth within youth mental healthcare (Chapter 5).

2.

PERSONALIZATION PROCESS IN GAME DESIGN FOR HEALTHCARE

Stakeholders have increasingly been involved in game design, to enhance the alignment of a game to the end-user. In a healthcare context, this alignment is expected to enhance the end-user's motivation to interact with the game, thereby enhancing the games' health related transfer effect. However, the nature and effect of this involvement have never been systematically studied, making assumptions regarding the benefits of personalization ungrounded. In this literature study, we aim to provide 1) an overview of existing personalization design theory and description of our Personalized Design Process (PDP), consisting of the phases Problem Definition-, Product Design- and Tailoring Phase, and 2) a systematic review on the applications of the PDP phases in empirical studies and effects across these phases.

Based on: van Dooren, M. M. M., Visch, V. T., Spijkerman, R., Goossens, R. H. M., & Hendriks, V. M. (2016). Personalization in Game Design for Healthcare: a literature review on its definitions and effects. International Journal of Serious Games, 3(4), 3-28.

2.1. INTRODUCTION

Games are designed to motivate end-users to play. Especially in serious-games, that are typically a bit less entertaining than pure entertainment games, it is important for the game design to optimally engage the end-user. Research has suggested that involving stakeholders (like end-users and domain experts) in the design process enhances the engagement and motivation of the user to interact with the product [68] and consequently improves the game's implementation in the user's daily life. Such stakeholder involvement is often called co-design, where end-users are enabled to influence the design [50].

Currently, a lot of games for health are designed that involve "personalization", but clear and shared concepts of what personalization in game design entails are lacking. Besides, it is not sure if personalization contributes to the targeted health-effect of a game. Since theory on applying personalization in game design is lacking, we will use theory from personalized design methods and propose a theory on "Personalized Game Design". This "Personalized Game Design"(PDP)-model will be used to study if and how personalization in game design is effective in the context of health. Based on our PDP, we propose to define personalization as the involvement of stakeholders in at least one of the three PDP phases (Problem Definition-, Product Design- and Tailoring Phase). Stakeholders that can be involved across the phases of the PDP are: "designers", "domain experts" (therapist and care staff), "end-users" (typically patients), or "family/relatives" (of the patient). Some PDP phases are better suited to these four specific types of stakeholders than others. For example, designers and domain experts typically partake in the first Problem Definition Phase, by defining the problem and recommendations for focus of the design [93]. During the Product Design Phase, all stakeholders can contribute to provide design suggestions and feedback [94-96]. Finally, in the Tailoring Phase, the end-users are typically involved, for instance by selecting a personal avatar [97].

2.1.1. DIFFERENT DEFINITIONS OF PERSONALIZATION

Currently, many definitions are in use for the concept of personalization. In this section we first describe these concepts of personalization based on general design literature. This will be followed by our proposed PDP-model, consisting of three phases in the design process in which personalization can take place. These phases will be used to structure the literature results.

User-centered design process. Defined as: Any act during the design process where the user can be seen as a subject instead of a partner [53].

In user-centered design, the focus lies on designing for end-users [98] where these end-users have a passive role. Insights for designing a product are generated through interviews, observations and theory. An example of this is the design of an exercise game for older adults with help from focus groups and user testing [99]. A product is not created together with the user, but he or she only reflects on an idea, prototype, or is involved in the product's final user test [53]. Therefore, the user's influence on the product is limited.

Co-creation process. Defined as: Any act of collective creativity during [53].

Co-creation builds on the tradition of user-centered design. The term 'co-creation' is often used interchangeably with 'co-design', although they have different definitions. Co-creation refers to a temporary exchange of ideas and experiences, and consists of "specific parts within the design process" [50].

Co-design process. Defined as: Any act during design in which users are considered as expert of their experiences.

Co-creation takes place within a co-design process, where the end-user "is given the position of 'expert of his/her experience' and plays a large role in developing knowledge, ideas and concepts" [53]. The designer facilitates the end-users, so they participate in a way that is most suitable to their abilities [53]. We have adopted the co-design definition of Mattelmäki and Sleeswijk Visser (2011), who viewed it as "a process and tools of collaborative engagement" [50]. The design responsibility is kept to the designers, because they are experts in design. It should be noted that co-design is also often called

participatory design, as both concepts enable the end-users to influence the design [50]. However, with co-design a designer only wants to collaborate with end-users [50]. and in participatory design, more weight is placed on end-user empowerment.

Tailoring. Defined as: The adaptation of the designed product by itself, by the end-users or by others.

If a user explicitly changes aspects of a product design, such as its esthetics, we propose the term “User Controlled Customization” [54]. End-users can thus partly determine the appearance or functionality of a product [100]. If a system tailors itself to the user and the behavior of the user, we term this “Use-Dependent Adaptation” [54, 101]. In this case, the product changes while the user interacts with it, for example, by keeping the difficulty of the game aligned to the users’ (health) improvements.

Mugge, Schoormans and Schifferstein (2009) found seven options for tailoring. In one option, the Mental Effort, users are creatively involved, for example, a do-it-yourself lamp that has a metal sheet which can be scratched to customize it [100]. These dimensions can generate different tailoring options for the product’s design, of which some can be more or less favorable for specific target groups. Therefore, it is important to understand the target group and to know which of these dimensions are more or less favorable for the end-user.

Personalized Design Process. Defined as: Stakeholder involvement in Problem Definition, Product Design and Tailoring Phases of a product.

Common usage of “tailoring” and “personalization” is often non-consistent and can therefore be confusing. For example, some studies refer to individual characteristics (e.g., the name of the user) as personalization [102, 103] or as a tailoring variable [104] and some studies that saw personalization as a mechanism of tailoring [102, 105]. We aim to avoid this confusion, by referring to the involvement of stakeholders across the design process as “personalization”. We term this complete process, as the Personalized Design

Process (PDP). As will be shown, personalization can take place at different phases in the PDP.

The PDP consists of three phases: Problem Definition, Product Design and Tailoring. In the Problem Definition Phase, information is generated by consulting stakeholders, in order to identify, establish and analyze the problem and generate related ideas. This sets the focus for the ‘to-be designed’ product, and can be seen as the basis for the whole design process [106]. The next Product Design Phase includes both Ideation and Embodiment. In Ideation, the first possible solutions are produced, resulting in product ideas or design proposal(s). In Embodiment, these are tested and evaluated by users, and further improved through iterations [107]. In the last Tailoring Phase, the final product can be tailored to the needs of individual end-users. Tailoring a product can be done by an end-user, others or automatically (see Figure 1), for example, in the case of the game’s difficulty level automatically adapting to the user’s skill level. In this review we do not differentiate between Ideation and Embodiment of the Product Design Phases because both consider the actual physical design of a product. The PDP thus consists of different phases in which stakeholders can be involved. The last phase is the Tailoring Phase, which consists of two types of Tailoring: “User Controlled Customization” and “Use-Depended Adaptation”.

Although our model shows considerable overlap with earlier models that describe co-design processes and include stakeholder involvement in the Problem Definition- and Product Design Phase, it differs with regard to the Tailoring Phase, which is not present in these earlier models (e.g., [53, 108]). For example, comparing our PDP with the process previously conceived by Zebeko and Tan [108], there is a large overlap between our Problem Definition and their Diagnostic phase, where information about an organization or community is collected, in order to understand the situation and challenges [108]. There is also an overlap between our Product Design Phase and their Design and Develop and Test phases, where the most appropriate stakeholders develop and prototype together [108]. However, our PDP goes further, by including a Tailoring Phase, to ensure that products are aligned to individual end-users within a target group. This is important,

because, even in a coherent target group, there are always individual differences that need to be taken into account when designing a suitable product.

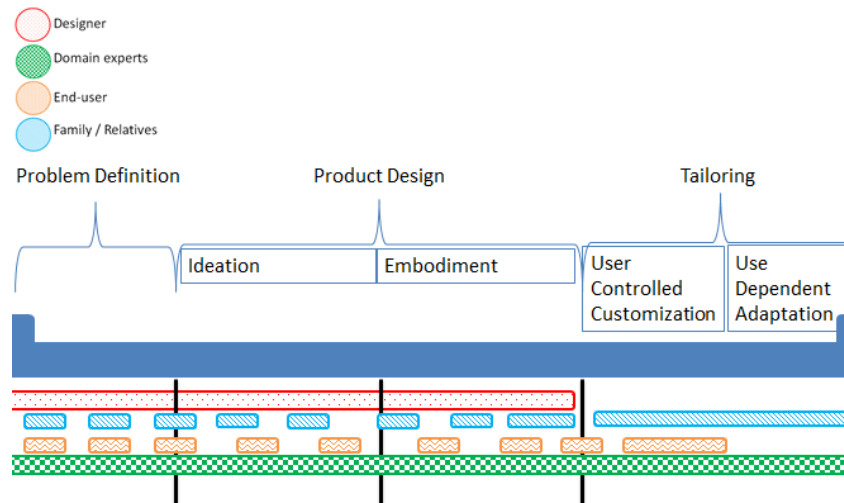


Figure 2. The Phases of the Personalized Design Process

2.1.2. GAMES FOR HEALTH

Games are designed to be enjoyable and immersive, and can help to motivate or persuade end-users to continuing playing the game [63]. Games can also be used to facilitate the realization of health-oriented goals of the user (e.g., [109]). A main advantage of these kinds of game-interventions is that they are always available, compared to face-to-face interventions, and often effective in supporting health related changes of behaviors [110-112].

When designing games with stakeholders, the alignment of the game with the end-user's preferences, needs and competences can increase [53, 64, 65], which in turn can motivate the end-user to interact with the product [68, 69], thereby enhancing the persuasive feature of a product [70]. This is because stakeholders with different expertise (e.g., in design, the health context, or in their own preferences) have different point of views and can provide more complete insights into what the product should consists of and focus on. Stakeholder involvement in the design process of games is more likely to

generate a health related transfer effect. Health related transfer effects are the effects a product is aiming to achieve, for example: effects on knowledge, mood, health, etc. Studies have focused on enhancing these transfer effects, by involving stakeholder in the design process [113, 114]. However, the effect of stakeholder involvement when designing games for health across the different phases of the PDP has not yet been studied in a systematic way. Therefore, this study aims to answer the following research question: How are Personalized Design Approaches applied in designing games for health, and how effective are they on health related outcomes?"

2.2. METHODS

In order to answer the research question, we conducted a literature study, with the aim of categorizing the design methods used in published empirical studies based on stakeholder involvement, as shown in Figure 1. We searched the following databases: IEE Inspec, ELSEVIER Scopus, Psychinfo, PubMed and Web of science. Keywords that served as basis for the search terms were divided into four groups: methodology, object, context of appliance and research method (see Table 1). Only empirical studies were included; the following types of articles were excluded: book reviews, technical studies, theoretical studies, reflections, reviews, withdrawn articles, editorials, studies with a focus on algorithms and articles not related to health. We first screened the abstracts and titles in order to deselect studies based on the exclusion criteria. The remaining articles were then scanned based on the inclusion/exclusion criteria in order to make a second selection. Lastly, we carefully analyzed the full texts of the remaining articles.

Table 1. Research keywords, divided in four groups.

A Methodology	B Object (Games)	C Context of appliance (health)		D Research method
Co-creat*	Game*	Therapy	Behavior	Experiment*
cocreat*	Gami*	Disease	Illness	Random*
Customi*	Persuasive	Health	Wellbeing	RCT
Co-design*		Care	Hospital	Evidence*
Participatory		Clinical	Training	Trial*

Codesign*		Disorder	Therapists	Empirical*
Collaborat*		Patient	Life	
Co-develop*		Medical	Health status	
Codevelop*		Psychology	Fitness	
Co-product*		Rehabilitation	Physical	
Coproduct*		Physiologic*	Disease course	
Personalize*		Lifestyle	Health attitudes	
Personalization		Health Knowledge	Psychological	
Personalise*		Medicine	(behavio*)	
Personalisation		Telemedicine		
self-creat*		Treatment		
Self-made		disease management		
Self-product*				

2.3. RESULTS OF THE LITERATURE REVIEW

We retrieved literature from the abovementioned databases using the search terms in Table 1 from the start of electronic records until April 2015. This resulted in a total of 2579 papers: 705 studies from Web of Science, 497 of INSPEC, 704 of SCOPUS, 326 of Psychinfo and 347 of PUBMED. Of the 2579 papers, 62 were selected to determine how personalization approaches were adopted in research on game interventions for changing health related behavior. To answer the research question (How are Personalized Design Approaches applied in designing games for health, and how effective are they on health related outcomes?), we investigated in what way the reviewed studies involved the four stakeholders (designers, domain experts, end-users, and family / relatives of the end-users) in their design process. Because their involvement occurred in different PDP phases in the design process, we present their combinations. We first describe stakeholder involvement in the Problem Definition-, Product Design-, and Tailoring Phase separately, followed by the cluster-combination of stakeholder involvement across the PDP phases. In 3.1 we discuss the stakeholder involvement, followed by the general healthcare and product effects in section 3.2. This is specified to stakeholder

involvement across the PDP in section 3.3, which ends in a conclusion regarding the quality of the validation papers in 3.3.7. The closing section 3.4 describes the involved game-elements across the PDP.

2.3.1. A GENERAL OVERVIEW OF PAPERS INVOLVED IN THE PERSONALIZED DESIGN PROCESS

In this section, we describe stakeholder involvement in the different phases of the PDP (Problem Definition, Product Design (both Ideation and Embodiment) and Tailoring).

Problem Definition

Table 2. Stakeholder involvement in Problem Definition Phase

	Problem Definition		
	D	X	U
[115]	X		X
[116]	X		X
[93]	X	X	

Footnote: D = Designer; X = Domain experts; U = End-user

Three of the 62 studies involved stakeholders (designers, domain experts and end-users) only in the Problem Definition Phase, of which two studies involved both designers and end-users, but not domain experts [115, 116], and one involved designers and domain experts, but no end-users [93].

Product Design

Table 3. Stakeholder involvement in Product Design Phase

	Product Design						
	Ideation				Embodiment		
	D	X	U	F	D	X	U
[117]	X	X					
[118]			X				
[119]	X	X	X	X	X	X	FX

[120]	X	X		X			
[94]	X				X	X	X

Footnote: D = Designer; X = Domain experts; U = End-user; F = Family

Five studies involved stakeholders in the Product Design Phase. Three of them only involved stakeholders in Ideation of the Product Design Phase, where a product was generated based on their comments, suggestions or guidelines [117, 118, 120]. Two other studies involved stakeholders in both Ideation and Embodiment of the Product Design Phase [94, 119]. In the first study, designers were only involved in Ideation, where other stakeholders provided suggestions for improvement [119]. In the other study, components of a product were extensively pretested, and after the product was installed it was also previewed by others [94].

Combining Problem Definition and Product Design

Table 4. Stakeholder involvement in both Problem Definition- and Product Design Phase

	Problem Definition				Product Design						
					Ideation				Embodiment		
	D	X	U	F	D	X	U	F	D	X	U
[121]	X	X							X	X	X
[122]	X	X			X	X			X	X	X
[123]	X	X							X	X	X
[124]	X	X	X						X	X	X
[125]	X	X	X	X					X	X	
[95]	X	X			X	X					
[96]	X	X	X		X	X					
[126]	X	X	X	X	X	X	X		X	X	X

Footnote: D = Designer; X = Domain experts; U = End-user; F = Family

Of the 62 studies, eight studies involved domain experts during both the Problem Definition- and Product Design Phase. Four studies involved mainly designers and domain experts as stakeholders in the Problem Definition Phase and designers, domain experts and end-users in Embodiment of the Product Design Phase [121, 123-125], for example, by observing end-users and giving cultural probes (ambiguous stimuli and assignments that bring inspiration to design) to domain experts and relatives [125]. Two other studies included stakeholders, mainly designers and domain experts, in the Problem Definition Phase and Ideation of the Product Design Phase [95, 96], by letting end-users test game scenarios that were designed by domain experts and designers. Lastly, two studies involved stakeholders in Problem Definition Phase and Ideation and Embodiment of Product Design Phase [122, 126].

Tailoring

Table 5. Stakeholder involvement in Tailoring Phase

	Tailoring						
	User Controlled Customization					Use-Dependent Adaptation	
	Task		Virtual self			Task	Virtual /feedback / textual
	S	3	I	R	X		
[127]					X		
[128]		X					
[129]					X		
[130]		X					
[97]			X	X			
[131]		X					
[132]			X	X			
[133]		X					
[134]					X		
[135]						X	
[136]						X	

[137]						X	X
[138]						X	X
[139]							X
[140]							X
[141]							X
[142]							X
[143]							X
[144]						X	X
[145]	X					X	
[146]	X					X	
[147]	X					XX	
[148]	X					X	
[149]	X					X	
[150]	X					X	X
[151]	X					X	X
[152]		X					X
[153]		X					X
[154]		X				X	X
[155]		X					X

Footnote; I=ideal; R=real/realistic; x = ideal/real; S=self; 3= third person;

With “Use-Dependent Adaptation”, a Kinect device was often used to give visual tailored feedback about the performance or remaining time the end-user had [138-144] and/or by tailoring the difficulty of the tasks to end-user input, like performance [135-137]. In “User Controlled Customization”, end-users tailored avatars that could represent an idealized self or actual self [97, 127, 129, 132, 134] and others defined the objectives, difficulty level or specified the stimuli of a product [128, 130, 131, 133].

Eleven studies involved both Tailoring types, where the end-users provided input used in combination with giving Tailored visual performance feedback [150, 151], giving feedback based on the name of an end-user [145, 146], or by

adapting the difficulty level based on information provided by a user beforehand, e.g., through baseline measurements [147-149]. However, others (mostly domain experts) could also Tailor, by defining objectives and difficulty levels, which was combined with giving automatic feedback about performance [153-155].

Combinations of Problem Definition, Product Design and Tailoring

Table 6. Stakeholder involvement in Problem Definition, Product Design and Tailoring Phase

	Problem Definition			Product Design							Tailoring								
											User Controlled Customization						Use-Dependent Adaptation		
				Ideation				Embodiment			Task		Virtual self						
	D	U	F	D	X	U	F	D	X	U	X	S	3	I	R	X	T	F	
[156]	X				X							X	X				X		
[157]				X		X			X				X					X	
[158]				X		X	X		X							X			
[159]				X		X	X		X								X	X	
[160]				X		X						X						X	
[161]	X	X		X		X												X	
[162]	X	X			X			X		X			X					X	
[163]	X				X			X			X							X	
[164]								X		X							X	X	
[165]								X			X						3		
[166]				X		X		X	X		X		X						
[167]								X		X	X						X	X	
[168]								X		X							X		
[169]								X			X		X					X	
[170]								X		X	X	X	X					X	
[171]								X		X			X						

Footnote: D = Designer; X = Domain experts; U = End-user; F = Family; A=automatic; S=self; 3= third person; x=ideal/real; T=task, f=feedback

Of the 62 studies, seven involved stakeholders in the Embodiment of Product Design- and Tailoring Phase. The studies were mainly conducted in the domains of rehabilitation and physical health [164, 167, 168, 170, 171]. In one study, end-users with Autism Spectrum Disorders (ASD) played a therapy game with a robot, of which the behavioral and experience results were used to improve the next the experiment by domain and robotic experts [166]. Four studies involved stakeholders (mainly end-users and/or domain experts) in Ideation of the Product Design Phase and Tailoring Phase. One study used earlier guidelines that were combined with interviews and evaluations with end-users [160]. Involving stakeholders in both the Tailoring- and the Product Design Phase was thus quite common, however involving end-users in Ideation was least commonly combined with the Tailoring Phase. Only three studies involved stakeholders in all the phases; these focused on physical health [161], mental health care [162, 163], and/or where parents or domain experts could tailor the tool [161, 162].

2.3.2. OVERVIEW HEALTHCARE EFFECTS

Studies involving stakeholders in the PDP have mainly focused on teaching end-users about health related topics [96, 115-119, 122, 126], aiming at behavioral change or adherence [93, 95, 97, 121, 123-125, 128, 131, 132, 135, 137-141, 143-145, 147-157, 160, 161, 164-171], or at attitudinal change [94, 120, 127, 129, 130, 133, 134, 136, 142, 146, 158, 159, 162, 163]. Currently, researchers are optimistic that personalized games in a health context will generate a positive influence on interaction experience, interaction behavior and health related transfer effects. Interaction experience focusses on the subjective experience individuals have when interacting with a product [172, 173] and consists of experiences regarding aesthetics, meaning and emotions [173], for example, when the end-user likes the appearance of a product. The focus of interaction behavior lies on all forms of end-user behavior when the end-user interacts with the product, for example, on forming, altering or reinforcing self-initiated behavior [174]. For example, if and how easy it is to use the product. Lastly, health related transfer effects are the effects on “forming, altering, or reinforcing user-compliance, -behavior, or -attitude”, and can be regarded as a transfer effect of game-world related experiences to

a user's subsequent behavior in the real-world (c.f., [63] for a theoretical model of experience effects). Health related transfer effects thus reflects the intended behavioral change of the end-user in the daily life of the end-user, e.g., the compliance of an end-user to the medication schedule [175-177] or enhancing daily physical activity [63]. However, the optimism that these aspects are positively influenced, is not supported by a great deal of evidence.

The effects of the studies, combined with stakeholder involvement across the PDP are described below in more detail where we evaluate the effects on interaction experience, interaction behavior and health related transfer effects. Studies in this literature review focus on either one, a combination of, or all three of these outcome variables and of the 62 reviewed studies, a majority (N = 46) focused on interaction experiences. The following five aspects were used to rate the methodological quality of the studies: pre-post measurement, comparison or control group, (blind) randomization, number of participants and valid and reliable measurements. A higher methodological quality means that at least a comparison or control group was present in the study. Most studies included small samples (25 or less participants), and, hence, had insufficient statistical power to draw firm conclusions about the effects of involving stakeholders in the PDP. A majority of the studies generated information about interaction experiences, by using questionnaires (N = 24), interviews (N = 17) or observations (e.g., to see the end-users' facial expressions while interacting with the product) (N = 13). A total of 28 studies focused on interaction behavior, often measured by observations (N = 15) or by using hardware data derived from the tool itself (N = 14). A total of 40 studies focused on health related transfer effects, which was often assessed by questionnaires and tests (N = 26) and sometimes by physiological measures (e.g., heart rate) (N = 7). In general, data was obtained at pre-post [119, 123, 135, 145, 162] or during and after interaction with the product [127, 136]. Because the duration of the studies were heterogeneous [128, 137, 156, 166], it is hard to compare these results. A minority of the studies used a control group (N = 17), of which eight had small to average study samples, ranging from 8 to 57 participants, and five had large study samples, ranging from 95 to 121 participants. A total of 9 studies randomly assigned their participants to

either the control or experimental group group [97, 132, 140, 144, 146, 148, 157, 162, 169]. When measuring the effect of a product, experimental groups are compared with control groups. Ideally, both groups are equal except for the independent variable (e.g., when comparing a product with a tailored product, and the only difference is the tailoring). This would make it possible to draw conclusions on the effect of the independent variable [178]. Because validation research in the context of games for health is limited, we not only took into account the control groups that received a non-personalized game, but also treatment as usual (e.g., no game-intervention), or control groups that consisted of other user-groups (e.g., healthy end-users [121, 125]).

There are many different methods for measuring study quality. As game research is a young and developing domain, we did not use these, since applying a strict index is not appropriate. A minority of the studies in this review involved a randomized controlled design, and a majority of the studies used qualitative measurements including a small sample size. In addition, the results were mostly founded on outcomes of questionnaires that were not validated. This means that if a questionnaire is not validated, it is unclear if it measures what it claims to measure. Both qualitative measures and small sample size indicate a 'low quality' ranking of the studies included in this review.

2.3.3. COMBINING THE HEALTHCARE EFFECTS WITH THE PERSONALIZED DESIGN PROCESS

This section focusses on the healthcare effects of studies that involved stakeholders in the PDP. The tables consist of a) Problem Definition- or Product Design Phase only, followed by b) both Problem Definition- and Product Design Phase, c) either User Controlled Customization or Use-Dependent Adaptation of the Tailoring Phase, d) both types of the Tailoring Phase, e) combining Product Design and Tailoring Phases, and lastly f) other combination of phases. No study reported a power-analysis.

Studies which involved stakeholders only in either the Problem Definition or Product Design Phase

Table 7. Characteristics to analyze the quality of studies involved in Problem Definition Phase

	Pre-post measurement		Number of participants	Valid and reliable measurements	
	Yes	No		Yes	No
[115]	X		807		X
[116]	X		23	X	X
[93]		X	5		X

Studies that involved stakeholders in the Problem Definition Phase were of low methodological quality. Results suggested improvements regarding knowledge and awareness about health, more specifically regarding (raw) milk and HIV, which could lead to behavioral changes [115, 116]. A gradual need to collaborate and enhanced social interaction was found in end-users involved in collaboration sessions with a multi-touch game [93], beneficial to the health problem in question.

Table 8. Characteristics to analyze the quality of studies involved in Product Design Phase

	Pre-post measurement		Number of participants	Valid and reliable measurements	
	Yes	No		Yes	No
[117]	X		33		X
[118]	X		41		X
[119]	X		3829		X
[120]	X		1	X	
[94]		X	45		X

Studies that involved stakeholders in the Product Design Phase were of low methodological quality. Results suggested enhanced knowledge about health (e.g., about AIDS) [118, 119]. A study that focused on discussions regarding obesity suggested a doubled discussion time between domain experts, end-

users and family, and improved self-efficacy of domain experts in doing this [117]. Other enhancements were found in social interaction and communication, combined with less stereotype behavior in a child with an ASD [120]. Lastly, feedback from end-users suggested that a product was feasible and acceptable with regard to what it aimed to achieve [94].

Studies which involved stakeholders in both the Problem Definition and Product Design Phases

Table 9. Characteristics to analyse the quality of studies involved in Problem Definition- and Product Design Phase

	Pre-post measurement		Comparison or control group		Number of participants	Valid and reliable measurements	
	Yes	No	Yes	No		Yes	No
[121]		X	X		?		X
[122]		X	X		53 & 36		X
[123]	X			X	5	X	X
[124]	X			X	5	X	X
[125]		X		X	10	X	X
[96]		X		X	4		X
[126]	X			X	165		X
[95]	X	X		X	14	X	X

Most studies that involved stakeholders in both the Problem Definition- and Product Design Phase had methodological limitations. For example, only two studies had a control group [121, 122], most studies had a general low number of participants (5 studies involved between 4 and 14) and a minority of the studies applied validated and reliable measurements, e.g., used observational data. Results of the studies showed that due to the games, end-users improved in various outcomes measurements, like their physical health. Examples regarding the improvements that were found on physical health, were some improvements in shoulder muscle activity [124] and in motivated participants that played the game often, of which one even improved movements and use of the impaired limb [123]. Other results showed that end-users improved their knowledge regarding diabetes [96],

cardiopulmonary resuscitation [122], and obesity and nutrition [126]. Significant correlations were found between physiological responses to stressful experiences and subjective evaluations on stress in PTSS (Post-Traumatic Stress Syndrome) patients, and a clear correlation between diagnostic PTSD severity and skin conductance responses [95], which could be important for stress inoculation training. End-users with ASD and healthy controls matched on IQ, gender and age, showed difficulties in respecting the personal space of virtual others, but acknowledged that behaving in a virtual environment was different from daily life [121]. Lastly, in a study where end-users participated with both a game and a traditional leisure activity product, results suggested that some participants improved social behavior during sessions with the game, but that the control product made the user answer more questions in sentences and handle the object more [125].

Studies which involved stakeholders in either User Controlled Customization or Use-Dependent Adaptation of the Tailoring Phase

Table 10. Characteristics to analyse the quality of studies involved in User Controlled Customization

	Pre-post measurement		Comparison or control group		(blind) randomization		Number of participants	Valid and reliable measurement	
	Yes	No	Yes	No	Yes	No	N	Yes	No
[127]		X		X		X	30	X	X
[128]	X	X		X		X	12	X	
[129]		X		X		X	??		X
[130]	X		X			X	40	X	
[97]		X	X		X		130	X	X
[131]	X		X			X	8		X
[132]	X		X		X		95	X	X
[133]		X		X		X	>200		X
[134]		X		X		X	2		X

Studies that involved stakeholders in User Controlled Customization had limited methodological weaknesses. The studies were effective with regard to

various outcomes measurements. One study indicated that end-users showed physiological indicators (by levels of skin conductance) of emotions during gameplay, and that they had the feeling they were part of the game [127]. Besides, end-users were more motivated to play, and experienced feelings of competition and understandability of the product [133], [50], and showed behaviors and experiences on cooperation and playability [129]. Feelings of togetherness and mental stimulation were enhanced in a virtual environment [134], as well as a reduced agitation and improved mood during an intervention with Alzheimer patients compared to controls [130]. End-users that participated in all conditions had more social behaviors in “enforced collaboration” than in “free play” [128]. Studies with control conditions reported end-users being more “aggressive” after playing a violent game with a customized avatar compared to a non-violent game and generic avatar [97]; they also found that an ideal-self avatar significantly influenced prevention-focused behavior to keep this ideal appearance in real life, but an “actual self” was related to promotion- focused behavior [132]. Lastly, results suggested that controls had significantly higher progression on cognitive functions compared to the experimental group [131].

Table 11. Characteristics to analyse the quality of studies involved in Use-Dependent Adaptation

	Pre-post measurement		Comparison or control group		(blind) randomization		Number of participants	Valid and reliable measurement	
	Yes	No	Yes	No	Yes	No		Yes	No
[135]	X			X		X	2	X	X
[136]		X		X		X	6 & 5		X
[137]	X	X	X			X	21 & 20	X	X
[138]	X	X		X	X		19	X	X
[139]	X			X		X	6	X	
[140]		X	X		X		8		X
[141]	X			X		X	6		X
[142]		X		X		X	14		X
[143]	X			X		X	16	X	X

[144]	X		X		X		37 & 34	X	
-------	---	--	---	--	---	--	---------	---	--

Studies that involved stakeholders in Use-Dependent Adaptation also had some methodological flaws and were effective with regard to various outcomes measurements. For example, two studies suggested that the users had positive subjective experiences while playing the game (e.g., enjoyment and a sense of accomplishment) and that they were motivated by the tailoring aspect of the activity [136, 142]. Regarding physical health, the physical performance improved significantly [143], [60], which was a significant [135] or a percentage improvement in motor and sensory impairments [139]. End-users that participated in both conditions rated the experimental game as more enjoyable [138], and after playing an imitative collaborative game with a robot, children with ASD played more with each other [141]. Studies with a control group found significant improvements in symptoms and balance functions, with longer in-patient stay in the control condition [144] and that a product was usable, acceptable and it offered personalized arm-training [137]. A study that only focused on the experimental group, found that a majority increased their health awareness, connection with the nurse, but also experienced use frustration [140].

Studies which involved stakeholders in both Use-Dependent Adaptation and User Controlled Customization of the Tailoring Phase

Table 12. Characteristics to analyse the quality of studies in both types of the Tailoring Phase

	Pre-post measurement		Comparison or control group		(blind) randomization		Number of participants	Valid and reliable measurement	
	Yes	No	Yes	No	Yes	No		Yes	No
[145]	X			X		X	23	X	X
[146]	X		X		X		57 & 15	X	
[147]		X		X		X	10		X
[148]	X		X		X		155	X	
[149]		X		X		X	30		X
[150]	X	X		X		X	17	X	

[151]	X		X			X	19 & 17	X	X
[152]	X			X		X	9	X	X
[153]		X		X		X	9 or 8		X
[154]	X			X		X	15	X	
[155]	X			X		X	3	X	X

Studies that involved stakeholders in both types of the Tailoring Phase had some methodological flaws. Results suggested positive results with regard to various outcome measures, like positive experiences while interacting with the product, sometimes with suggestions for improvement (e.g., worries of falling while using the product) [149, 150, 153]. Physical health was positively influenced (e.g., postural stability) [154, 155]. A study that focused on smoking cessation, showed that at follow-up only 14.3% of the end-users had not smoked in the past 7 days, and that product use declined over time [145]. Two studies let end-users participate in all conditions, which resulted in a longer playing-time than allocated, higher than expected speech improvements compared to natural conversation [152], and that healthy end-users significantly increased successful pointing tasks and challenged experiences in the tailored session, compared to random adaptation but without differences in experiences (difficulty, frustration and fatigue) in a post-stroke therapy game [147]. Studies with a control group found significant effects in the intervention group regarding a decrease in fat mass, weight and BMI (Body Mass Index)[151], better arithmetic skills, higher intrinsic motivation, feelings of self-competency and attention [146], and enhancement in all 8 domains of cognitive performances compared to 4 in adherence only, or 6 in intent-to-treat of the control group [148].

Combining the Product Design and Tailoring Phase

Table 13. Characteristics to analyse the quality of studies in Product Design and Tailoring Phase

	Pre-post measurement		Comparison or control group		(blind) randomization		Number of participant	Valid and reliable measurement	
	Yes	No	Yes	No	Yes	No		Yes	No
[157]	X		X2	X1	X2	X1	X1=7 X2=16	X	X
[158]		X		X		X	19 & 7		X
[159]	X	X		X		X	1	X	X
[160]	X			X		X	19	X	
[164]	X		X			X	115	X	X
[165]		X		X		X	1		X
[166]	X	X		X		X	6		X
[167]	X	X		X		X	8	X	X
[168]		X		X		X	7	X	X
[169]	X		X		X		18	X	X
[171]	X			X		X	7 & 1	X	
[170]	X			X		X	3 & 1	X	X

Note: X1 is study 1, X2 is study 2.

Studies that involved stakeholders in Product Design- and Tailoring Phase had some methodological limitations. The studies were effective with regard to various outcomes measurements. For example, end-users had positive experiences while interacting with the prototype game, e.g., that the prototype was appealing but also had some improvements for the design [158], or that the product was easy to use by the end-users, who also experienced a higher perceived wellbeing [159]. Studies with a control condition, showed improvements in physical health in the experimental condition on physical health, for example, a significant increase in steps per week, but also an increase in weight, BMI and percentage body fat in both experimental and control condition [164], and an improved medication adherence accuracy from 43% to 56% in end-users interested in games [169]. A paper that

involved two studies reported significant improvements in the upper limb motor function in both studies, as well as improvements in global function in the first study [157]. A study where end-users participated in all study conditions, with different tailoring algorithms, reported that seven of the eight participants could interact with the product, of which six reached the recommended energy expenditure levels, and that the algorithms influenced scores and experiences [167]. Other studies found that the BMI decreased for overweight/obese participants, increased in an underweight participant, and was maintained in healthy participants [160] and that tailoring game-levels to the abilities and performance positively affected body movements during therapy [168]. End-users connected with their avatar (it represented them in performance), and this had (in)significant positive effects on upper-limb stroke rehabilitation [170]. Studies that involved participants with ASD found some engagement with a robot through interaction flow and self-initiation behavior, but with room for improvement [165], and more social engagement and less playing alone, but only when interacting with a robot [166]. Lastly, five out of seven active duty soldiers and one veteran with PTSS were successfully treated by the use of a tailored Virtual Reality, but one did not benefit and two other participants discontinued the therapy [171].

Other combinations of involving stakeholders in the design Phases

Table 14. Characteristics to analyse the quality of studies involved in different combination of the Personalized Design process Phases

	Pre-post measurement		Comparison or control group		(blind) randomization		Number of participants	Valid and reliable measurement	
	Yes	No	Yes	No	Yes	No		Yes	No
[161]	X	X	X			X	18	X	X
[162]	X		X		X		10	X	X
[163]		X		X		X	8		X
[156]	X			X		X	6		X

Studies that involved stakeholders in different combination of the PDP phases had some methodological limitations. Studies noted that a product could be

more than an icebreaker as it could improve client-patient relationship, but there were also some engagement concerns, according to therapists [163]. Additionally, studies with a control group resulted in enhancements in selective and sustained attention and in overall visual motor abilities, combined with future design requirements [162], but also in design requirements for a product to motivate physical activity in adolescents [161]. Lastly, involving stakeholders in Problem Definition- and Tailoring Phase resulted in effects on playability, where only one user improved control of gestures [156].

2.3.4. VALIDATING THE INFLUENCE OF GAMES INVOLVED IN PERSONALIZED DESIGN PROCESS

Normally, effects are quantitatively measured by studies that compare an experimental condition with a control group. However, most studies in this literature review were of low methodological quality due to the low number of participants, absence of control group(s) or use of qualitative measurements (e.g., [96]) or non-validated questionnaires. Validated questionnaires that are often used to quantitatively measure the usability or experience of games, are the User Experience Questionnaire [179] and the System Usability Scale [180]. Other validated questionnaires that can measure the health related transfer effect also exist (e.g., Child Depression Rating Scale Revised (CDRS-R) [181], when measuring depression). A minority of 17 studies did include a control group, where end-users only participated in either an experimental or control condition. All found positive results in health related transfer effect, interaction experience and behavior. Of these studies, a majority of 9 studies randomly assigned their participants to either the control or to the experimental group [[97, 132, 140, 144, 146, 148, 157, 162, 169].

Generally, the reviewed studies compared experimental groups who received a serious game, that was designed via stakeholder involvement in phases or a phase of the PDP, with groups that received Treatment As Usual without such a game. Other studies compared groups of patients with groups of healthy end-users. Such a comparison can clearly show the health effect of the serious game, but makes it impossible to show the effect of personalization. In order to test the effect of personalization, a comparison should have been made

between a product that was developed with stakeholder involvement in the PDP and a product that was developed without stakeholder involvement in the PDP. A majority of the studies with a control group involved stakeholders in the Tailoring Phase [97, 130-132, 137, 140, 144, 146, 148, 151], of which some studied the effect of personalization by comparing tailored vs. non-tailored interventions [97, 132], or a personalized intervention with a likewise non-personalized intervention [130]. Other studies that involved stakeholders in the Tailoring Phase, compared activities with a personalized game product to a standard activity that used a paper and pen method [131], a motivational and tailored learning method with the same learning method but without the motivational and tailored variables [146], and patients with healthy controls [137]. Studies also compared a personalized game with two elected exercises [144], a tailored training with a computer game [148], a training with additional a tailored diet game [151], or did not study or further describe the control group in the paper [140]. Involving stakeholders in the Tailoring Phase seems to have positive effects on the end-users regarding the interaction experiences (e.g., that a product was usable and acceptable [137]), interaction behavior (e.g. reduced agitation and improved mood during an intervention with Alzheimer patients [130]), and health related transfer effects (e.g. significant effects in the intervention group regarding a decrease in fat mass, weight and Body Mass Index, [151]). For a more detailed description of the effects, see the result section 3.3. Because some studies that involved stakeholders in the Tailoring Phase used an experimental set-up, that compared a tailored with a non-tailored group, we can only draw conclusions regarding the additional effect of stakeholder involvement in the last phase of the PDP and recommend game designers to involve stakeholders in this phase.

Studies that focused on the health related effect of stakeholder involvement in the Problem Definition- and Product Design Phase of the PDP did not focus on the effect of this personalization. Therefore, it is difficult to conclude that the reported outcomes of the studies were due to stakeholder involvement in these phases. However, some studies did attempt to study the effects of a personalized game. For instance, the two studies that involved stakeholders in both Problem Definition- and Product Design Phase [121, 122], compared

participants with autism spectrum disorders (ASD) to participants without ASD or two experiments to see if there was improvement on the outcome measures between the two. These studies found mixed results regarding interaction behavior [121] and positive self-assessed health related transfer outcomes regarding learning about a health aspect [122]. Three studies that involved stakeholders in both Product Design- and Tailoring Phase [157, 164, 169], compared an exercising game with exercises in laboratory sessions [164], two groups that had the same app of which one also consisted of a game [169], and therapy alone with the same therapy that also consisted of a personalized game [157]. The games that were designed by stakeholder involvement in both the Product Design- and Tailoring Phase seemed to result in positive [157, 169] and mixed results regarding interaction experience positive [164], positive results regarding interaction behavior (e.g., how the end-user used the product [169]), and health related transfer effects (e.g., regarding physical functioning and improvement in medication adherence [157, 169]) that were not always fully positive [164]. Only two studies involved stakeholders in all the PDP phases [161, 162], and compared a treatment group (that received extra sessions with games) with a control group (who did not receive these), or let groups use different kind of likewise tools. This seemed to result in different but mostly positive interaction experiences [161], and in interaction behavior and health related transfer effects [162]. For a more detailed description of the effects of studies that focused on the effect of these combinations of phases, see the result section 3.3. To study the additional effect of stakeholder involvement across the (other) phases of the PDP, future studies need robust experimental designs that compare personalized versus non-personalized games.

2.3.5. APPLIED GAME-ELEMENTS IN REVIEWED PAPERS

Table 15. Game-elements in the Personalized Design Phases.

Game-element	Personalized Design Phases		
	Problem Definition	Product Design	Tailoring
Avatar	[96, 115, 121, 162]	[95, 121, 157, 158, 160, 162,	[97, 127, 129, 131, 132, 134-137, 143, 144, 154, 155, 157, 158, 160, 162, 167,

		167, 170]	170]
Reward points	[123, 156, 161, 162]	[118, 119, 123, 160-162, 164, 167-170]	[137-139, 143, 144, 149, 153-156, 160-162, 164, 167-170]
Progression / level	[93, 96, 115, 123, 124, 156, 161, 162]	[118, 123, 124, 157, 158, 160-162, 164, 168, 170]	[130, 131, 133, 135-142, 144-149, 151, 153, 155-158, 160-162, 164, 168, 170]
Social (e.g., leader boards)	[96, 116, 121, 124, 125, 161]	[118, 121, 124, 125, 159-161, 164, 169]	[128-130, 132, 141, 143, 159-161, 164-166, 169, 170]
Puzzle, cards, quiz	[96, 115, 116, 122, 123, 125, 126]	[94, 117-119, 122, 123, 125, 126, 158, 159, 164-166]	[128, 130, 150, 151, 158, 159, 164-166]
User assignments in real life	[93, 96, 116, 122, 125, 161]	[118, 120, 122, 125, 161, 164]	[133, 135, 137, 140, 142, 143, 145, 161, 164]
Others	[163]	[95, 121, 157, 159, 163, 164, 168, 169, 171]	[133, 135, 137, 138, 141, 143, 144, 146, 147, 149, 150, 152-155, 157, 159, 163, 164, 168, 169]

The games that were described in the reviewed papers contained specific game-elements. Game-elements are the elements that are found in games [182], that motivate the player for specific behavior [183]. In papers that focus on personalization, the game-elements have a more abstract role when stakeholders are involved in the Problem Definition Phase, compared to the Product Design- and Tailoring Phase. Generally, game-elements are shaped in the Product Design Phase, of which some studies test these game-elements in the Tailoring Phase. Therefore, game-elements were more “visible”, because they are better described and tested in the Product Design- and Tailoring Phase (Table 15).

When stakeholders were involved in the Tailoring Phase, games were used that mostly contained game-elements like “progression”, “levels”, “reward points” and “avatars”. Especially an avatar was often present, since they could be tweaked to the preference or behavior of the user (e.g., let end-users tailor an avatar by giving them freedom to do so [97]). “Points” and “progression” were often combined, because progression or levels can make the points more meaningful: by receiving points, the end-users can see how they progress and eventually reach higher levels. When stakeholders were involved in the Product Design Phase, “progression” and “points” were also often present, but mostly combined with social game-elements, puzzles, and quizzes. In one study, end-users could tweak a game-element themselves, e.g., by adjusting the difficulty level of the game [146]. The type of tailoring (e.g., tailoring avatars) was studied in isolation. However, if more game-elements were present in a product, the effects of these game-elements were not measured in isolation, but as a “black box”.

2.4. DISCUSSION AND CONCLUSION

To our knowledge, this is the first systematic literature review on personalization in games for health. Existing literature from personalized design methods were applied to propose the Personalized Design Process model and to investigate if and how personalization in game design is effective in the context of health. The aim of the PDP-model, which consists of three different design phases in which personalization can be applied, is to provide insights in when personalization can be applied in the design process. The effect of this personalization is aligning a product to the needs and preferences of the end-users [53, 184]. This can increase the satisfaction with and the value of the product [66, 67], the interaction time with the product, and consequently it can positively influence the health related transfer effect. It can be concluded that stakeholders (mostly end-users and domain experts) were often involved in the Tailoring- and Product Design Phase only, and not in the Problem Definition Phase of the PDP. The problem was often pre-defined, for example, by the government or principal, without any check whether it was the correct problem to target [66]. However, it would be preferable to also involve stakeholders in Problem Definition Phase, because

this can serve as the basis of the whole design process and provide a more holistic picture of problems and aspects to focus on [185].

If the problem that the game will tackle is not checked with the stakeholders (especially the end-users and domain experts), it is possible that the game is designed for a problem that does not exist or is not possible to improve. This would make it difficult or even impossible to obtain positive results, especially regarding health related transfer effects.

Within the Product Design Phase, we observed different stakeholder involvement, where stakeholders were most often only involved in Embodiment. They could provide comments, suggestions or guidelines, but they could also design products, help designers, and give feedback. It is probable that it would have taken too much time, been too expensive, or not found necessary to also involve stakeholders in short passive tests in Ideation (for example, about the usability) [186]. A majority of the studies only involved stakeholders in the Tailoring Phase. Possibly, this phase is the most important phase for stakeholder feedback in the design process, or perhaps stakeholders can be involved more easily in this phase. Studies often used a Kinect device to give tailored visual feedback to the user about their performance or remaining time, or to tailor the difficulty of the tasks to the end-user input (e.g., in-game performance). The end-user's name was also often used when feedback was given, in order to make the feedback or content more personally relevant and thus more motivating and persuasive for the end-user. End-users actively tailored avatars, which gave them the opportunity to connect to the avatar, as if it was a representation of themselves. Unexpectedly, the objectives, difficulty level or the stimuli of a product were often tailored by others (mostly domain experts). There was an expectation that both a domain expert and end-user would be involved in tailoring these assignments together, e.g., by letting domain experts tailor assignments of which an end-user could choose from, because this would optimally combine the expertise of both the end-users (about preferences and needs) and the domain experts (about theoretical proven assignments or

therapy aspects). In addition, it would also give the end-users a sense of choice, which could promote engagement [187].

The studies generally found positive effects on interaction experience, interaction behavior and health related transfer effects. However, because the duration (in time) of the studies was heterogeneous [128, 137, 156, 166] and a majority of the validation methods were not methodologically sound (i.e. a low number of participants or use of measurements that were not valid or reliable), it is hard to compare the results of these studies and to warrant conclusions on the effects of stakeholder involvement across the PDP. Of the 62 studies included in our literature review, a majority (50) had a small study sample ($N < 50$). Only 17 studies used a control group, of which nine randomly assigned their participants to either the control or the experimental group [97, 132, 140, 144, 146, 148, 157, 162, 169]. Taking these limitations and results into account, it can only be suggested that it is important to involve stakeholders across the Product Design- and Tailoring Phase for a more effective design of games for health. It should be mentioned that involving stakeholders in the PDP can also have some disadvantages. It takes time, money, and effort to let stakeholders participate in the design process [186]. However, if involving stakeholders in the PDP results in better outcomes regarding the experience, behavior and health related transfer effects, this can be seen as more important compared to the disadvantages. Balancing the amount of personalization to the expected outcome enhancement should be performed in advance of each game design process.

It is possible that our review strategy did not result in retrieving all available studies on the effects of stakeholder' involvement in the Personalized Design phases, because of the different definitions of personalization that currently exist [188]. We attempted to minimize this, by brainstorming the search strategy and selection of keywords with expert researchers from the field of co-design and personalization, and from psychology and game design. We also proposed a PDP model, which would make it possible to extend the potential of personalization towards a better design in the context of health, and limit the confusion within this field. It should be noted that we did not systematically take user-centered design into account, because according to

our definition, it can be part of co-design. It is standard to at least (iteratively) test a product once with possible end-users, and to check whether they understand and can use the product [53, 66].

Within the PDP model, we used the general term ‘Tailoring’ for both User Controlled Customization and Use-Dependent Adaptation. Some studies focused on the technical challenges regarding tailoring, and not on the effects of tailoring. This made it difficult to study the effects of the design outcomes in terms of personalization. It should be noted that in addition to our two tailoring types, we also found another type of tailoring that we termed “Context Dependent Adaptation”, where a product is tailored based on the specific context of the end-user. However, with this type, the end-user has no active role in tailoring. Therefore, we did not focus on Context Dependent Adaptation in this review. Examples of this kind of tailoring are studies that personalized a game to the context of end-user (treatment of burn wounds) [189], that let designers make suitable levels for end-user context without influence of end-users or other stakeholders [190], or where tailoring was done based on gamer types, aiming to motivate behavior for each gamer type [191].

In addition to the definition of personalization, the involvement of stakeholders in at least one of the three design phases of the PDP, there may have been confusion regarding the definition of games and gamification and thus some studies could have mistakenly been excluded. Generally, gamification is defined as “the use of game design elements in non-game contexts” [192] and games with a serious aim can be considered as games that do not primarily have an entertainment purpose, but aim towards something “serious”, like influencing knowledge [182]. It is interesting that in only one study, end-users could actively tweak the game-elements, e.g., the difficulty level [146]. Some game-elements were commonly involved across the reviewed studies. Points and progression were often combined, e.g., by designing a threshold of a number of points before the user could proceed to the next level, and avatars were often applied to represent the user within the game. However, the effects of these game-elements were not measured in

isolation, but as a “black box”, making it impossible to measure the influence of separate game-elements. Only the ‘way of tailoring’, e.g., tailoring the difficulty level to the user or an avatar in different ways, was studied in isolation. It would be preferable to study the separate influence of specific game-elements, to know which specific game-element influences motivation and effect, and how this occurs.

Regarding the different stakeholder involvement when designing games for health, Baranowski et al. (2016) [193] divided the stakeholders into “those who (a) are interested in using games for health to advance their or their organization’s agenda, (b) may benefit from playing the games, (c) create games for health for profit, and (d) conduct research on games for health.” [193]. The PDP stakeholders can be divided according to these roles. Domain experts are those “interested in using games for health to advance their or their organization’s agenda”, end-users, family and domain experts are those that “may benefit from playing the games” and designers and experts are those that “create games for health for profit”, as well as those who “conduct research on games for health.”. We thus agree that involving stakeholders across the creation of a game in the context of health is important, in order to ensure that the game meets their needs, expectations and preferences [193]. However, we recognize a difference between Baranowski’s stakeholders. The main difference is that our PDP model also explicitly takes the Problem Definition- and Tailoring Phase into account, and that stakeholders should be involved across all the PDP phases when designing games that aim to positively influence health aspects of end-users.

According to a meta-analysis by DeSmet and colleagues (2014), games should be dynamically tailored to both behavior change needs and socio-demographic information (e.g., tailor the difficulty level to what the user can master). This is already present in our PDP, by involving stakeholders that know about theories of games and behavior change (domain experts and designers) in the whole PDP [83]. We defined ‘tailoring based on the performance of the user’ as “Use-Dependent Adaptation”, and ‘tailoring to socio-demographic aspects of the end-user’ as “Context Dependent Adaptation”.

In a meta-analysis of 61 studies focusing on stakeholder involvement (more specifically end-users) in serious digital games for healthy lifestyle promotion, DeSmet and colleagues (2016) found other results when end-users were involved in designing games for healthy lifestyle promotion. If they were involved in “participatory design”, where end-users were involved as informants, behavior was changed significantly less effectively than when they were involved in pilot-testing [52]. Participatory design was also related to lower effects on self-efficacy than when end-users were not involved in game design or in pilot-testing. When involved in co-design, stronger health effects were noted when involved in game challenges, but weaker health effects when involved in character and game world creation. This suggests that how stakeholders are involved in personalization can influence the health effects, and that a specific type of stakeholder (end-users) should be equal partners in design instead of being only informants. However, it should be noted that their- and our definition differs: according to DeSmet and colleagues (2016), participatory design represents stakeholder involvement as informants (where they give input and feedback) or as co-designers (where they are equal partners). Co-design thus has a specific role that end-users can have within participatory design. However, according to our definition, participatory design and co-design differ from each other, since co-design puts less weight on the emphasis of user empowerment, as is the case in participatory design [50]. In addition, DeSmet and colleagues (2016) state that users are equal partners in the design process when co-designing. We believe that it is important to give the user the position of ‘expert of his/her experience’, but that the design responsibility belongs to the design team, since that is their field of expertise. Besides, we also take into account other stakeholder, instead of only end-users as is the case in the study of DeSmet and colleagues (2016).

2.5. FUTURE WORK AND CONCLUSIONS

To conclude, the results of our literature review do not yet allow definite conclusions about whether and when involving stakeholders in the PDP (Problem Definition-, Product Design- and Tailoring Phase) has added value in terms of effect. Therefore, the current motivation to involve stakeholders can be seen as a theoretically driven concept rather than an empirically driven

concept. Our findings suggest that stakeholders should be involved in the Tailoring and Product Design Phases. However, a majority of the reviewed studies were hampered by small sample size, lack of control conditions, and other methodological weaknesses. Future studies thus warrant solid evaluation and design strategies for personalization, which may lead to empirically founded conclusions that personalization really enhances behavior, experiences or the health related transfer effect in the context of games for health. However, these future studies should choose their research method with care, because the “golden standard” for experimental validation, a placebo-controlled double-blind study, is complicated using serious games for health as intervention instead of a medical pill you can swallow. Designing products with stakeholder involvement takes a lot of time, and designing control groups in this context is difficult. This is because almost all serious games mix the serious content with the game content and because it is almost impossible create a ‘placebo’- or ‘control’-game by removing one component without changing the other. Besides, end-users may have different experiences and be differently affected by a game, and participants cannot be blinded [193]. In addition, the ‘black-box’ of game-elements should be made more visible, by studying the effects of separate and combined game-elements within this context.

In this literature study, we have defined personalization and how it can be applied within the games for health design process. We recommend that future studies not only focus on involving stakeholders in the Product Design- and Tailoring Phase of a PDP, but also to methodologically test whether this stakeholder involvement in the PDP results in better outcomes on experience, behavior and health related transfer effect, by the use of suitable control groups [178].

3.

THErapy PROTOCOLS AND EHealth DESIGN: A FOCUS GROUP STUDY

Personalization is not only often applied in game design for healthcare, to enhance positive effects on interaction experience, interaction behavior and health related transfer effects, but also in a therapeutic process. When aiming to redesign a therapy with personalized gamification, to facilitate efficiency, access and quality of therapy, it is important to know how a therapy protocol is personalized. If eHealth designers do not take this into account, the redesigned therapy might not optimally fit the therapeutic practice and impede implementation. Therefore, we wanted to generate information about the proportion, type and reasons for personalization of a given therapy protocol by therapists and patients. We conducted two rounds of focus-group discussions on how a Cognitive Behavioral Therapy protocol in youth addiction care was applied in practice by patients and therapists.

Based on: van Dooren, M. M. M., Visch, V. T., Spijkerman, R., Goossens, R. H. M., & Hendriks, V.M. (2020), Therapy Protocols and EHealth Design: a Focus Group Study, JMIR Formative Research (forthcoming)

3.1. INTRODUCTION

To reduce the adolescents' risk of developing adverse consequences due to mental diseases (e.g. [9, 194]), adequate treatment is needed. Therapy protocols contribute to the implementation of evidence-based therapeutic practice and help therapists to structure their face-to-face therapy sessions [55]. Although psychosocial therapies are effective in reducing psychiatric symptoms in adolescents with mental disorders, the available therapies show modest effects and not all adolescents benefit [23, 195]. Including eHealth, the use of information and communication technologies in the delivery of (mental) healthcare [26], in the therapeutic practice is a promising mean to improve the patient engagement and therapeutic effectiveness (e.g. [38, 39, 43]).

The therapy protocols that form the basis for face-to-face therapies are typically used as a basis for the design of eHealth as well [62]. Therapy protocols play a large role in the success of evidence-based therapies [56] and it is recommended to apply therapy protocols as much as possible. However, both therapists and patients can personalize or only partly apply a therapy protocol in therapeutic practice (e.g. [57, 59-61, 196, 197]). For example, therapists can believe that following therapy protocols goes at the expense of a strong therapeutic alliance [198], the trust between a patient and therapist that allows them to work together in an effective way and an indicator for positive therapy outcomes [35].

The difference between therapy protocols and therapeutic practice has serious consequences for eHealth design. If personalization possibilities in therapeutic practices are not taken into account in the design of eHealth, eHealth may not suit current therapy practice which limits its' implementation. For example, when eHealth does not suit how therapists use the therapy protocol or if therapists have negative expectations about the benefits of eHealth compared to face-to-face therapy [199-201]. Many eHealth interventions have failed to integrate personalization to the individual user in the design [202]

To align eHealth to therapeutic practice, it is important to know the content of the existing therapy protocols and how these protocols are applied in therapeutic practice by therapists and patients. Designers of eHealth can use this information to ensure that eHealth matches the therapeutic practice, consequently improving the quality and enhancing the implementation potential of eHealth. Therefore, this explorative study aims to gain insight into personalization practices in a mental healthcare context and concludes with recommendations to eHealth designers on how they can access and involve the need for protocol personalisation in eHealth design. To achieve this, we examined therapists' and clients' perceptions of protocol application in a youth addiction treatment facility as a case study by generating both quantitative and qualitative data. Firstly, we wanted to know how much therapists and patients personalized and applied. We generated this information by asking them to estimate the amount of therapy application and personalization in therapeutic practice. Secondly, we wanted to know how and why they applied and personalized the therapy and generated this information by using the quantitative data as input for discussion.

3.2. METHOD

3.3.1. THERAPY PROTOCOL

The commonly applied protocol for Cognitive Behavioral Therapy in adolescent addiction care was used as a case protocol [203]. The protocol consists of nine sessions, followed by four "sessions of choice" (selected from seven optional sessions in consensus with patients). In each session, patients set specific short-term goals with regard to the therapeutic homework. Part of the therapy protocol is a therapy workbook, that patients can bring home and to therapy sessions. The activities that are described in the workbook correspond to the content therapy sessions.

3.3.2. PROCEDURE

We conducted semi-structured focus group sessions in two phases at two locations of one large out-patient treatment facility centre for adolescent addiction care in the Netherlands (see Table 1). The aim of the first phase was

to investigate therapists' and clients' estimations of the amount and type of protocol personalization.

Therapists estimated how much of their therapy consisted of a strictly followed and adapted therapy protocol and patients indicated how much of the provided therapy by their therapist they strictly followed and adapted. Important to note here is that clients thus could receive a personalized therapy protocol in practice. Both therapists and patients also indicated how much other (non-protocol) therapeutic parts they added. These amounts were represented by percentages that added up to a total of 100%, i.e. the whole therapy. The second part evaluated, with other therapists and patients than those who partook in the first part, the results of the first part and aimed to gain insight into the reasons for personalization. Participants were brought together with a moderator (the first author) for a discussion lasting one hour. Before starting the group discussions, we received informed consent from the participants and explained the concept of personalization, i.e. changing a designed end-product, like a therapy protocol, to match the needs and capacities of the end-user and enhance the effectivity of the product [204].

3.3.3. PARTICIPANTS

We invited experienced therapists, who received training in the CBT protocol, to participate in focus group sessions. Patients, who were at least 18 years old, received CBT, were recruited by their therapists to participate in the study. Therapists received an information leaflet to inform their patients about the study. A therapist informed us if a patient wanted to participate. In turn, we contacted the patient to schedule an appointment for the focus group discussion. In the first part, six therapists ($N = 3$ female, $N = 3$ male) and five patients ($N = 1$ female, $N = 4$ male) participated. In the second part, three therapists ($N = 1$ male, $N = 2$ female) and four patients ($N = 1$ female, $N = 3$ male) participated. All interviews took place at the youth mental healthcare facility.

Table 1. Set-up of the focus group sessions with therapists and patients on protocol application and personalization

Goal	Part	Location	Participants	N
Generate information with separate groups of either therapists or patients about how much of their therapy consisted of a strictly followed therapy protocol, adapted therapy protocol, and added therapeutic parts.	P1	A	One group discussion with therapists	3
		A	One group discussion with patients	2
		B	One group discussion with therapists	3
		B	One group discussion with patients	2
		B	One interview with a patient	1
Joint evaluation of the results from P1 with combined groups of both patients and therapists.	P2	A	One mixed group discussion with a therapist and two patients	3
		B	One mixed group discussion with two therapists and two patients	4

3.3.4. DATA ANALYSIS

The data are presented accordingly to the standards of reporting qualitative research by O'Brien et al, 2014 [205]. We used thematic analysis instead of grounded theory to analyse the data. With grounded theory, one wants to generate an exploratory and overarching framework or theory [206], which we were not interested in. With thematic analysis, themes are derived from the data [207-209] in which we were interested since these could directly go to the guidelines for eHealth designers. We focused on the phases that were described in the paper of Braun and Clarke (2006), when analysing the data [207]. The researcher, also the first author of this paper, was a PhD candidate and had two masters in clinical and health psychology. She was qualified in doing qualitative interviews, had neither assumptions about nor a relationship with the participants prior to the discussions. All interviews took place at the youth mental healthcare facilities of the therapists and patients. Experienced therapists were invited to participate in the study. They had to be trained in the new CBT protocol the study was focusing on. Patients, who had to receive

CBT, were informed about and invited to participate in the focus group discussions by their therapists. In this way, more patients were informed about the study which enhanced the chance that more patients would be willing to participate. After the patients' consent to participate, the researcher would contact the patient by phone to ensure everything was clear to the patient and to make an appointment for the focus group discussion.

We received formal ethics approval from the Human Research Ethics Committee of the Delft University of Technology in the Netherlands. All discussions were recorded with an audio recording device, after receiving verbal consent from participants. Quantitative data was saved with only a link to the type of participant (i.e. being either a therapist or patient). All focus group sessions took one hour each and were audio taped and transcribed by the first author. Interview guides were used during the discussions and during and after the discussions, field notes were made.

After transcribing the data, the first author went through all recordings again to check the accuracy of the transcripts in line with [205]. Next, the first author went through all the transcripts multiple times before coding the data. This ensured that the themes generated from the codes were not based on only a few examples. Similar themes were grouped together into higher level themes. When analyzing the data, themes were linked to each other, ensuring a coherent story. Enough time was allocated to analyze the data adequately.

The fourth topic of O'Brien et al (2014) focusses on the results (topic 16 and 17) that are described in the following section [205]. Supportive quotes were chosen to substantiate analytic findings. This is followed by the fifth topic that describes the discussion section (topic 18 and 19) and last "other" topic, where conflicts of interests and funding are mentioned (topic 20 and 21).

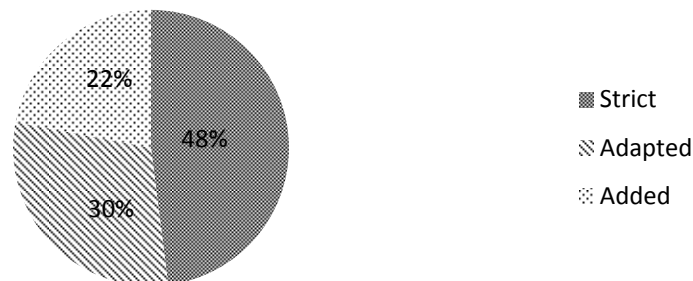
3.3. RESULTS

3.3.1. PART 1: FOCUS GROUP SESSIONS WITH THERAPISTS

Therapists indicated that they strictly applied 30 – 75 % (mean 48 %) of the therapy protocol and adapted between 10 – 50 % (mean 30 %) of the therapy protocol. They further reported to add 10 – 33 % (mean 22 %) of non-

protocol therapeutic parts. The percentages of one therapist were excluded, because the percentages of strict application and personalization overlapped (see Figure 1).

Figure 1. Therapists' mean estimated percentages of CBT protocol usage.



Note: The percentages of one therapist were excluded, because the percentages of strict application and personalization overlapped. This is impossible according to our definition, because the categories of protocol application are exclusive components.

We first went through the quotes several times and generated codes from the quotes that focused on reasons for therapists to personalize the therapy protocol. These codes referred to therapists who personalized the protocol based on what the patient needed *"Corking works the best, adapting [the therapy] to where the patient is"* (Therapist 1A), what they thought would be more beneficial for the patient *"It is related to if they have stopped [with using substances], than focusing on cravings. Also if they already went into therapy before, than removing elements of which you think are a repetition"* (Therapist 2A), and because therapists knew other therapy protocols that could help patients with different problems at the same time *"I also give group therapy and some elements of which I notice that work [during group therapy] I also use during individual therapy"* (Therapist 1B). Besides, codes mentioned that therapists personalized to enhance the therapeutic alliance. *"Much is related to the connection, the therapeutic alliance is important so I invest a lot of time in building one"* (Therapist 1B). We went through the codes again which resulted in higher-level themes.

The main theme that we derived from the codes of the therapists was that they used the protocol as a “toolbox”, a bundle of therapy tools that they could choose from. The code that did not fit this main theme, focused on adding elements from other therapy protocols. However, all therapists mentioned that they did not apply the order of the therapy protocol in a strict way. The protocol was not seen as a step-by-step manual but a manual that consisted of all the possible interventions. *“Toolbox CBT, I do not use it as a step-by-step manual but I can choose interventions from the toolbox that I find relevant.”* (Therapist 1B). Three sub-themes were derived: therapists who personalized based on what they thought their patient needed, on their own therapy-giving experiences, or because they thought it enhanced the therapeutic alliance.

The first subtheme to the grand Toolbox theme consisted of therapists who personalized the therapy protocol based on what they thought their patient needed. They thought that by adapting the therapy, their patients would be better prepared to specific situations. This was influenced by the (possible difficult) situations that patients experienced prior to the therapy session (e.g. had an argument with their parents), how the motivation of patients was to change their behaviour and if patients understood all elements of the therapy protocol. For example, therapists tried to enhance the trust of patients that they could achieve the goals they set or by mainly focussing on the homework that a patient did well instead of focusing on the homework that a patient did not do well. *“What is important for patients, such as dealing with social pressure. In general, I follow the therapy protocol but if you notice that patients have difficulties with it [social pressure] you focus on that”* (Therapist 3A).

The second subtheme to the grand Toolbox theme consisted of therapists who personalized the therapy protocol based on their own therapy-giving experiences. During the discussions they commented to not apply or only partly apply the workbook to prevent their patients from experiencing feelings of failure, since patients generally forgot to bring it to therapy and/or fill in the homework assignments. Therapists thought that not applying the workbook prevented their patients from experiencing feelings of failure. *“I always estimate if it [the patient] is the type of person that can do homework at*

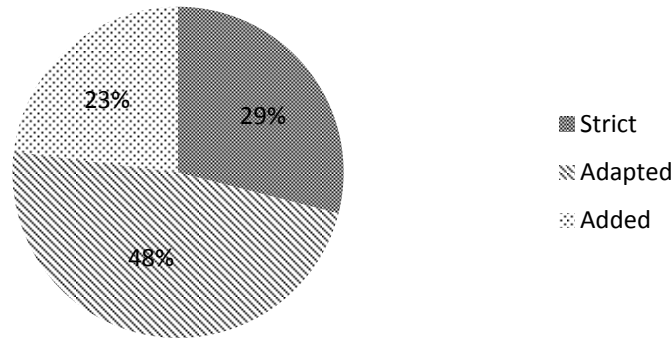
home, if it [the patient] is someone who will really do it [the homework, you want to prevent experiences of failure] (Therapist 3B). In addition, more experienced therapists have more knowledge of and experience with other different therapy protocols. Therefore, more experienced therapists tend to apply elements from other therapy protocols during therapy more often compared to less experienced therapists.

The third subtheme to the grand Toolbox theme consisted of therapists who personalized the therapy protocol because they thought it would enhance the therapeutic alliance. *"It depends on the connection [between me and the patient]. The therapeutic alliance is important, on which I spend a lot of time"* (Therapist 1B). They would try to work on the bond they had with a patient by focussing more on the positive steps a patient made, compared to what a patient did not do. In addition, this would also enhance the motivation of patients to continue with therapy and try to achieve the tasks they agreed on.

3.3.2. PART 1: FOCUS GROUP SESSIONS WITH PATIENTS

Patients indicated that they strictly applied 12 – 65 % (mean 29 %) of the provided therapy by their therapist, adapted between 9 – 64 % (mean 48%) and added between 18 – 26 % (mean 23 %). The percentages of one patient were excluded, because the percentages of strict application and personalization overlapped (see Figure 2).

Figure 2. Patients' mean estimated percentages of therapy application.



Note: The percentages of one patient were excluded, because the percentages of strict application and personalization overlapped. This is impossible according to our definition, because the categories of protocol application are exclusive components.

We first went through the quotes several times and generated codes that focused on reasons for patients to personalize their therapy. These codes referred to patients who personalized how they achieved their homework, because they preferred to personalize *“Actually I try to think of some rules for myself”* (Patient 1B), and because they were somewhat carelessness and forgot their homework *“It is quite hard to keep up with it and it is not really in my routine, like brushing my teeth”* (Patient 2A). In addition, the personalization of patients was influenced by the connection they had with their therapist *“The connection you have with your therapist influences how well therapy works”* (Patient 2A). We went through the codes again which resulted in higher-level themes.

The main theme that was derived from the codes of the patients was that they personalized the therapy based on their own situation. The code that did not match the main theme, focused on personalization of therapy by the therapists. Even though therapists and patients decided on the homework the patient would work on together, all patients mentioned that they personalized their homework. Two sub-themes were derived: personalization to better

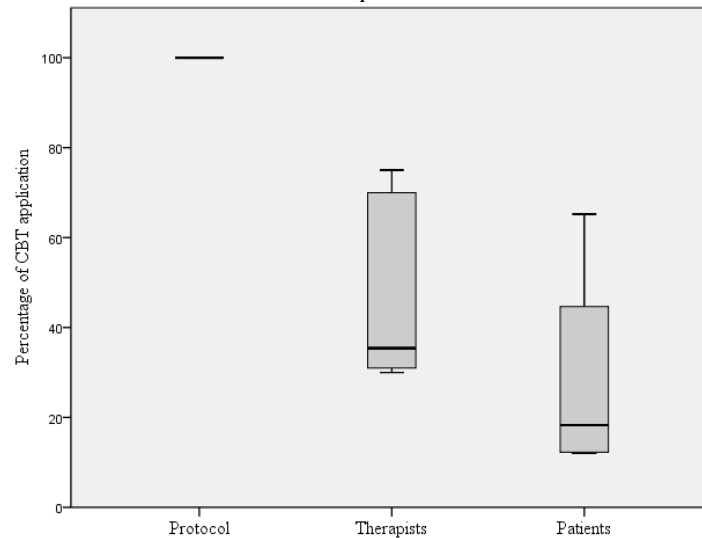
match therapy with the daily life of the patient and personalization that was influenced by the varying motivation of patients.

The first subtheme to the grand own situation theme focused on patients who mentioned that they personalized their therapy to better match the therapy with their daily life. They personalized to match the therapy to their own situation, personality and preferences. This lowered their feelings of stress and worry. *"I always change it [doing the homework assignments] a little bit so that it is in line with my personality and how I want to be seen by others"* (Patient 2A). *"...It is the intention [to do the workbook assignments], but I don't do it. I rather tell about it [cravings] than to write these experiences down"* (Patient 1B).

The second subtheme to the grand own situation theme consisted of patients who mentioned that the amount of their personalization was influenced by their varying motivation. They sometimes just did not want to do the homework assignments or forgot to do the homework assignments. Besides, a relapse could influence the motivation to continue therapy in either a positive or a negative way. *"Sometimes, I just do not feel like doing it [workbook assignments] and I just do not do it"* (Patient 1A). One patient said that doing the workbook assignments for a longer period of time helped him to generate insights in triggers for craving. The therapeutic alliance influenced their motivation, mainly because a therapist would put things into perspective (also if a patient had a relapse).

Next to the thematic analysis, we analyzed the quantitative data of the patients and therapists. We combined all percentages of therapy protocol application and personalization by therapist and patients into one figure (see Figure 3). This was used in the second part of the focus group discussions, with other patients and therapists.

Figure 3. Range and median percentage of CBT application by therapists and patients.



3.3.3. PART 2: FOCUS GROUP SESSIONS WITH BOTH PATIENTS AND THERAPISTS

We first went through the quotes that focused on reasons for patients and therapists to personalize the therapy (protocol) and generated codes from these quotes. The codes of the therapists referred to personalization to keep or enhance the motivation of patients, to work on a connection of trust with their patient, and personalization of the therapy in order to align therapy to the problem of the patient. The codes of the patients referred to personalization by discussing what was happening in their life during a therapy session, and personalization of homework based on how they felt during therapy and at home. We went through the codes again which resulted in higher-level themes.

Since therapists reported that they always – in some way- personalize the therapy, most therapists and some patients had expected that therapists personalized more. One therapist thought that therapists could also have interpreted a strict therapy protocol application as applying the therapy protocol in a guideline way, meaning that therapists did not apply the detailed

and precise content of the therapy protocol sessions, but used these to assist them to make decisions about which elements of the therapy protocol sessions would be appropriate. *"I think that the therapists do follow the therapy protocol as a guideline, but that they noted this [strict application] down as applying it in an unchanged way."* (Therapist 5B). Themes that were also derived from the codes in the second part, focused on the enhancing the therapeutic alliance and on personalization based on the experience of therapists.

The first main theme of therapists that was derived from the quotes focused on enhancing the therapeutic alliance. *"Aligning to the need of the other [the patient] and small talk [with the patient] contributes to the personal connection with a therapist, which contributes to a more personal relationship that is needed to create openness and that a patient accepts help from a therapist"* (Therapist 4B). It was seen as crucial, in order for a patient to trust the therapist and work together to solve the problem of the patient. Two sub-themes were derived: personalization based on the individual situation of a patient and keeping or enhancing the motivation a patient.

The first subtheme to the grand therapeutic alliance theme, focused on the individual situation of a patient. In general, therapists first focus on the individual situation of a patient, followed by the relevant therapy protocol session that suited the situation best. They could also apply elements from different therapy protocol when a patient had other psychological problems. In this way, patients were helped with their problems at the same time. *"The patients often have multiple problems, so you have anxiety and mood protocols, or other ones"* (Therapist 4B)

The second sub-theme to the grand therapeutic alliance theme focused on keeping or enhancing the motivation of patients. They either did or did not apply the therapy workbook, mainly to prevent experiences of failure and keep the motivation to adhere to therapy if a patient forgets the workbook. *"You also have to prevent that it [filling in the workbook] becomes a failing experience...they can think, well if I can't even do that well.."* (Therapist 4B). In addition, therapists applied motivational interviewing to enhance the

motivation of patients. *“It is part of the attitude as a therapist, that you are empathic, you listen and align”* (Therapist 4B).

The therapy protocol helped therapists to structure therapy, but therapists differed in their opinion regarding protocol application. One therapist from location A followed the therapy protocol as strictly as possible, while another therapist from location B only used the therapy protocol to guide the therapy sessions. The therapist from location A mentioned that the therapy protocols helped to give guidance to the therapy sessions, while the therapist from location B found it more important to focus on the situation of a patient.

The second grand theme of the therapists focused on the experience of therapists that influenced the amount of personalization. More experienced therapists often have experience with different therapy protocols since therapy protocols are often changed or improved over time. This increased their knowledge, preferences and possibilities to personalize therapy protocols compared to less experienced therapists. Therefore, two therapists mentioned that the experience of therapists could also have influenced therapy protocol application and personalization.

Based on the quotes of the patients, we derived two main themes. The first grand theme focused on personalization based on their own personal situation. They personalized their homework, influenced by possible relapses and how they felt. *“I had to do exposure exercises once, for every day. But if I do not feel well, it does not work and I’m not going to let myself feel worse by doing another exercise”* (Patient 4B). The second grand theme focused on personalization based on the personal preferences of patients. How they worked on their therapy and prepared for a therapy session differed between patients based on what they preferred to do. For example, by shutting down the mobile phone when starting therapy or working on assignments on a computer instead of the workbook.

Table 2. Themes and sub-themes of the focus group discussions with therapists and patients.

Who	Main theme	Sub-themes
Therapists round 1	Use protocol as a toolbox	Personalization based on what patient needs
		Personalization based on own therapy-giving experiences
		Personalization to enhance therapeutic alliance
Patients round 1	Personalization based on own situation	Personalization to better match therapy with the daily life
		Personalization influenced by the varying motivation
Therapists round 2	Personalization to enhance therapeutic alliance	Personalization based on the individual situation of a patient
		Personalization to keep or enhance the motivation of patient
	Personalization based on experience	
Patients round 2	Personalization based on own personal situation	
	Personalization based on personal preferences	

3.4. DISCUSSION

Existing research focusing on the effect of eHealth in mental healthcare suggests overall small to medium effect sizes [37-41]. Moreover, research suggests that combining eHealth with therapist contact, i.e. blended eHealth, is more effective compared to fully online eHealth without therapist contact [42, 43]. One main reason for eHealth to be more effective, is that it can extend the reach of psychological therapy beyond the clinical setting, as technologies can be used anytime and anywhere [27, 28]. EHealth designers typically use the therapy protocols of evidence-based face-to-face therapies as a basis for the design of eHealth. However, not all parts of therapy protocols are always

applied in therapeutic practice [196, 210]. If eHealth designers do not take this into account, the designed eHealth might not optimally fit the existing therapeutic practice and impede implementation and motivation to adopt the eHealth by both therapists and patients. In the present study, we studied the proportion, type and reasons for personalization of a given therapy protocol by therapists and patients in focus group studies.

Results showed that in clinical practice, the therapy protocol is not fully applied but also personalized (see Table 2) (also found in [58-61]). The available therapy protocol is thus just one factor in a therapeutic process. Other factors that influence the therapeutic process are the personalization practices of therapists based on the needs of a patient, motivation of a patient, therapy-giving experiences of therapists, and the therapeutic alliance between the therapist and patient. Therapists estimated that they only strictly followed 48% of the protocol, adapted 30% of the protocol and replaced 22% of the protocol by other non-protocol therapeutic parts such as other therapy protocol elements. Other personalization practices that influence the amount of therapy protocol application is personalization of patients to better match therapy with their daily life, personal situation and preferences, and it was also influenced by their varying motivation. Patients estimated that they strictly followed 29%, 48% was adapted and they estimated that they replaced 23% of the therapy by other non-therapeutic elements.

It is important to mention the difference in personalization for therapists and patients. The estimations of patients and therapists regarding their amount of personalization are not only different because they may personalize less or more, but also because of their own share in the personalization process. Therapists already personalize a therapy protocol, of which their patients also personalize elements from in their daily life. Therapists know the whole content of the therapy protocol and patients do not. Therapists provide the patient with a partly personalized therapy. Therefore, patients can never fully know the whole possible content of a therapy protocol and have less personalization options of the standard therapy protocol. For example, therapists often mentioned that they did not use the therapy workbook to

prevent patients from experience feelings of failure if they either did not do the homework assignments or forgot to bring the workbook to therapy. However, by doing this they also prevented patients from trying to execute the homework assignments in their workbook. Besides, personalization by therapists can have both positive, no and negative effects [211-214]. For example, it may be that the elements that are personalized by a therapist or how a therapist personalizes specific protocol elements is not preferable with the preferences of a patient. This may influence the alignment of the therapy to a patient and may possibly lower motivation of a patient to adhere to the therapy. In general, most therapists in the second part had expected that therapists personalized more than was suggested by the estimated percentages of protocol application from therapists in the first part. A previous study that only focused on personalization by therapists found that therapists personalize more compared to what we found in our study [215]. A possible explanation for this difference is that they aimed to assess all types of activities in the general psychotherapeutic practice of eating disorders, instead of studying personalization practices of both patients and therapists by using a specific CBT protocol in youth addiction care as a case protocol.

The results of our study are important for eHealth design clients and eHealth developers, since they need to know what protocol elements in eHealth should and should not be open for personalization to facilitate implementation and patient engagement. Designers can implement the personalization practices by focussing on the function that personalization has in therapeutic practice (i.e. enhancing the motivation of patients to adhere to the therapy). However, since personalization may have both positive and negative therapeutic effects, it is important to know what elements are crucial elements to apply in practice to enhance therapeutic effects. Especially, since design can influence and enhance motivation to adhere or execute specific behavior. For example, by applying motivating elements from entertainment games (also called “gamification”). Gamification design in healthcare and mental healthcare has shown potential [71, 77, 78], e.g. by improving healthy behavior [78-89]. Based on the results of this study, eHealth designers are recommended to: a) study and copy at least the actual applied parts of a therapy protocol in eHealth, b)

co-design eHealth with therapists and patients so they can allocate the parts of the eHealth that should be open for user customization, and c) investigate if parts of the therapy protocol that are not actually applied by therapists or patients should be part of the eHealth. Otherwise, implementation would be negatively influenced, i.e. because the eHealth does not match the habits of therapists [199] or complexity of mental problems that patients experience [34]. Besides, validation studies of therapy protocols need to focus on the actual application of these protocols in therapeutic practice, as it can be considered as generally overestimated [198, 216, 217]. This may overestimate the benefit of therapy protocols to therapeutic effects. In the following paragraph we will elaborate on the three recommendations.

With regard to the first recommendation, our study showed that therapists and patients do not fully apply the therapy protocol. This information should be generated and implemented in the second product design phase of a Personalized Design Process [204]. In this phase, stakeholders such as therapists, patients and protocol developers can be involved to make the design of the product suitable to support the user during therapy and to ensure that it is technically possible to use the eHealth application during therapy and that the design of eHealth suits the therapeutic practice of a treatment centre. In this phase, the information of the applied therapy protocol elements by therapists and patients is generated so eHealth designers can at least copy these parts in eHealth. The eHealth designers can generate this information by, for example, recording therapy sessions of patients with therapists. Therapy protocol developers can listen to these recordings and rate what parts of a therapy protocol are applied in therapeutic practice.

As a second recommendation, the results of our study showed that therapists and patients personalized the therapy protocol by adjusting specific protocol parts and adding other (non-protocol) therapeutic parts. Why and how therapists and patients personalize is important information for eHealth designers, to select those parts in eHealth that should be open to personalisation for therapists and patients. This information can be generated

and implemented in the last tailoring phase of a Personalized Design Process [204] with patients and more and less experienced therapists. In this phase, the designed product is tailored to the individual user. It consists of two types of tailoring: user controlled customization and use-dependent adaptation. With user controlled customization, a user him or herself can tailor a product to own preferences and needs. Patients noted that they personalized the therapy based on their own personal situation and personal preferences, and it is thus also important to give them the opportunity to do so in the eHealth product. Therapists mentioned to personalize the therapy protocol based on the patient situation or their therapeutic experiences. By providing therapists the possibility to tailor the elements in eHealth, they can choose whether or not to use these during therapy with a specific patient. Especially by not forcing them to use all elements of the eHealth application. With use-dependent adaptation, a product automatically adapts itself to the user. For example, by not showing specific parts of a therapy protocol if the therapist always skips these in therapeutic practice or by tailoring the moments reminders pop-up to a patient who always experiences cravings after dinner.

As a third recommendation, we recommend eHealth designers to investigate if there are parts of the therapy protocol that are not actually applied by therapists or patients but should be part of the eHealth since they are crucial for the effect of therapy. The eHealth designer can generate this information by interviewing therapy protocol developers about the crucial therapy protocol parts. This information can be generated by involving stakeholders in the second product design phase of a Personalized Design Process [204]. For example, to allow the therapist to use the eHealth application as a toolbox, such as they use the therapy protocol, but ensuring the crucial elements not to be too easily personalized or skipped.

Our study has two limitations. The first concerns asking therapists and patients to quantify their own behaviour. It may be challenging for both to quantify this themselves. Other research also found that therapists overestimated the extent of therapy protocol application [218] or that it had the poorest reliability [219]. For example, not all respondents understood the

assignment as the indicated percentages of strict therapy protocol application of a patient and therapist overlapped with their other percentages. This overlapping is impossible, e.g. as one cannot strictly follow and change a therapy protocol at the same time. However, asking therapists and patients to quantify their own behaviour may still be a suitable technique when asking them only to estimate the amount of therapy protocol application and personalization. It is thus a suitable technique to generate first insights, but not to solely base results on this technique. A second limitation is that we did not take the therapeutic experience of the therapists and severity of the patients' condition into account [220]. Compared to less experienced therapists, more experienced therapists generally have more experience with other therapy protocols. This may influence their personalization practices. In addition, it is possible that the severity of a patient's condition could have influenced recruitment and results. Besides, this study was conducted with a limited amount of participants. This might have enhanced the possible influence of individual preferences regarding protocol application and personalization on the results [221]. Future research should take this into account, e.g. by conducting the study with a larger sample size while taking into account these background variables. In addition, when future researchers want to design a toolkit they should keep in mind to also involve actual eHealth designers, eHealth design employers and researchers. This is important, since the toolkit may otherwise not correspond with current practices of these target groups which would negatively influence implementation of the toolkit.

3.5. CONCLUSION

To optimize eHealth implementation, our study indicated that eHealth designers should know which therapeutic parts should be duplicated, which parts should be open to personalization possibilities, and which parts that are not applied in practice should be part of the eHealth design. In order to generate this information, we suggest eHealth designers to collaborate with therapists, patients, protocol developers, and mental healthcare managers during the design process of eHealth [204]. Not involving all these stakeholders enhances the chance that the designed eHealth might not

optimally fit the therapeutic practice and impede implementation. For example, therapy protocol designers know what protocol parts are crucial for the therapeutic effect but do not know how protocols are applied and personalized in therapeutic practice. Personalization practices can be implemented by actively co-designing with patients and more and less experienced therapists, to ensure that it is aligned to their preferences and capacities. Based on the presented research, we expect that the implementation of eHealth can be facilitated when stakeholder representatives, e.g. patients, therapists, protocol developers and mental healthcare managers, are involved in the design process by providing the eHealth developer with their needs and demands of therapy protocol application and personalization.

4A.

GAME DESIGN RELEVANCE OF PERSONALIZATION IN YOUTH MENTAL HEALTHCARE

To motivate therapists or patients to use eHealth, game elements are often applied to eHealth aiming to encourage interaction and to facilitate the achievement of aimed-for real-world goals such as behavioral change. Personalized gamification can enhance motivation of users enhance motivation to keep interacting with a product. This chapter describes a design method using a specific personalization technique, where cards were used that represent playful experiences, to examine whether the input of playful experiences is also experienced by other end-users from the same context in the actual design itself.

Based on: van Dooren, M. M. M., Spijkerman, R., Goossens, R. H. M., Hendriks, V. M., & Visch, V. T. (2014, October). PLEX as input and evaluation tool in persuasive game design: pilot study. In Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play (pp. 449-450).

4A.1. INTRODUCTION

This pilot study is part of a larger project on implementation guidelines for persuasive game design in youth addiction care: how to align the design to the user and how to implement it to the user context. Persuasive Game Design aims to create a user experienced game world to change the user behavior in the real world [63].

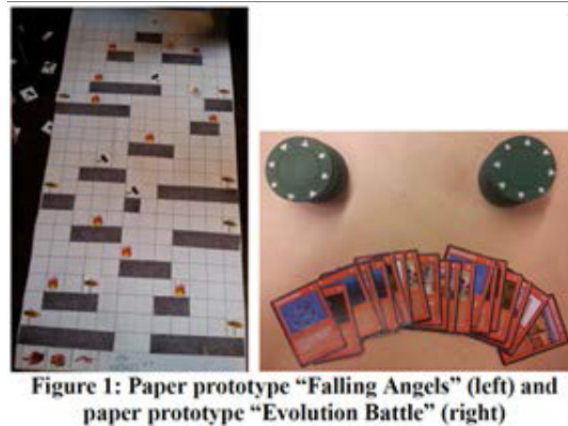
In order to adjust the user experience by game design, it is necessary to align user's game-related experiential preferences. In order to verify if the design of a game is matched to the user's preferences, it is important to use a tool that generates and evaluates the input from users. The playful experiences (PLEX) framework [72] is one example of such a tool. It consists of 22 PLEX cards and has two proposed design techniques for the user research input phase: a 'brainstorming'- and a 'scenario' technique [222]. Also, PLEX cards have been used without these techniques in the evaluation phase [223], but not in both phases together.

Currently, it is not clear yet whether one specific tool can be used for verification in the design process by applying it in both the user research input- and evaluation phase. In this study, PLEX experiences were used as a tool to map game experiences in both phases.

4A.2. METHODS

This study consisted of three phases: user research input phase, design phase and evaluation phase. In the user research input phase it was studied which PLEX cards motivated and which PLEX cards did not motivate addicted youngsters to continue playing a game for a longer period of time. Youngsters ($N=7$), in treatment at Mistral addiction clinic, participated in this phase and differed in age and comorbid problems. Mistral is part of Brijder, an addiction-care organization in the Netherlands. It is an open clinic that provides group treatment for approximately 14 youngsters who have stopped using substances. The participants received the PLEX cards, which presented motivating game experiences, and were asked to divide the cards into 'motivating' or 'not motivating' cards. In the design phase, a professional external game designer was asked to design two prototype games: one aiming

to elicit the most motivating PLEX experiences and another to elicit the least motivating PLEX experiences. In the evaluation phase another group of youngsters ($N=5$) in treatment at Mistral, evaluated both prototypes on the presence of PLEX experiences.



4A.3. RESULTS

In the user research input phase, the most motivating experiences were "competition" and "thrill" and the least motivating ones were "nurture" and "suffering". The most motivating experiences resulted in the paper prototype "Evolution Battle", where 10 organisms on cards, e.g., human and ranked from 1 to 10, battled for a survival of the fittest. The game was played in rounds of 10 seconds. The first round was started with betting one coin. In each round, a player could raise his/her bet, swap the organism or pass. After a pass the other player had one round to swap, raise or also pass. In the end, the cards with the organisms were compared. The fittest: the player that had the card with the highest number, received all the bets placed (see Figure 1).

PLEX Evolution Battle	
Competition	9
Thrill	2
Challenge	6
Completion	4
Relaxation	3
Control	3
Exploration	2
PLEX Falling Angels	
Nurture	6
Suffering	1
Completion	7
Humor	6
Control	4
Challenge	4
Competition	3
Fantasy	2
Exploration	2
Submission	2

Table 1: Evaluation of PLEX experiences in prototype “Evolution Battle” and prototype “Falling Angels”. A higher score indicates a higher presence of a PLEX experience.

The paper prototype based on the least motivating experiences, resulted in “Falling Angels”. Angels fell from the sky onto a world filled with platforms. The platforms contained all kinds of danger which made the angels suffer. Angels had to be guided safely towards heaven. Players could protect the angels with help from the “hands of God” represented by three symbols, i.e. a fist, an open hand and a pointing finger (see Figure 1).

To evaluate the game experiences of the paper prototypes, five youngsters played and rated both prototypes by means of PLEX. In line with expectations, our results showed that the prototype based on the most motivating PLEX experiences was preferred by four out of five participants. However, other experiences than those derived from the user research input phase were also reported. Furthermore, in the Falling Angels prototype, participants experienced other PLEX more strongly than the ones from the user research input phase (see Table 1).

4A.4. DISCUSSION

Our preliminary findings suggest that using motivating PLEX experiences for game design resulted in a better tailored prototype, since the prototype based on the most motivating PLEX experiences was preferred by a majority of the participants. However, the PLEX experiences derived in the user research input phase did not correspond one-on-one with the experiences reported in the evaluation phase, problematizing the application of PLEX as a general design tool for experience-based game design.

A possible explanation could be that the PLEX experiences may be multiple interpretable and can show overlap [3]. Furthermore, a game designer may interpret the PLEX experiences differently in comparison to naïve users of the game. Finally, designers might base their choices in the design process not solely on information about game experiences derived from the user research input phase.

More research is needed to draw more in depth conclusions on PLEX as a possible tool in both phases and to verify if the two prototypes differ significantly on motivation.

4B.

THE DESIGN AND APPLICATION OF GAME REWARDS IN YOUTH ADDICTION CARE

In the previous chapter, we described a design method and found that the experiences derived in the input phase did not correspond one-on-one with the experiences reported in the evaluation phase. In this chapter we will describe the effect of a specific design element: rewards. Rewards are the most typically used game-elements to foster motivation in entertainment gaming. However, it is unclear whether game-rewards are also effective in a healthcare context. Especially in our target group, i.e. youngsters with substance-related disorders, since these type of patients may be less sensitive to non-drug-related rewards than patients without a substance use disorder. Therefore, we first study if there are motivational differences between different types of game-reward. Secondly, we study the differences in reward type preferences between youngsters in therapy for substance dependence and youngsters without a substance use disorder. Concluding, the aim of this chapter is to investigate if we can apply game rewards in this population and if personalization of rewards would facilitate implementation.

Based on: van Dooren, M. M. M., Visch V. T., & Spijkerman R. (2019), The Design and Application of Game Rewards in Youth Addiction care, *Information*, 10(4), 125.

4B.1. INTRODUCTION

An evidence-based therapeutic strategy to motivate substance dependent individuals to remain abstinent is to add monetary-based rewards to evidence of successful behavioral change, e.g., substance-free urine tests [224]. Rewards can be seen as strong motivators to influence behavior change [225-228] and are a crucial aspect in the design of entertainment videogames to enhance not only feelings of enjoyment and flow [229] but also feelings of mastery, autonomy, and a sense of belonging [230]. Because it takes time for users to intend, start, and maintain behavior change, game elements, such as rewards, have often been used as motivational ingredients in Persuasive Game Design (PGD) [226, 231, 232].

The aim of PGD is to transport the users' real-world experience towards a (partial) game world experience that is more enjoyable and engaging than real-world experiences [63, 233, 234], thereby enhancing persistence of specific desired behavior in the real world, known as the transfer-effect [235, 236]. Research has shown that applying game elements in a serious context can positively influence health related problems and behaviors [83, 237], such as anxiety management [238], physical therapeutic exercise and fitness [239, 240], burn pain management [241], diabetes [242], and asthma [243]. However, research has also suggested that applying game elements in a serious context can reduce overall engagement and intrinsic motivation [244] or lead to unintended effects that distract players and lowers the overall effectiveness of an intervention [245]. Most importantly, game elements use extrinsic rewards, such as levels and points, to enhance engagement of users, while striving to enhance users' general feelings of competence, autonomy, and a sense of belonging and connectedness with others [233]. These three elements form the basic human psychological needs that facilitate users' motivation, both intrinsic and extrinsic, to execute specific behavior [230].

Thus, PGD seems to be fruitful for enhancing positive healthcare effects, since it helps players to aim for a given target experience or behavior. Crucial in the persuasive effect of a game design is the choice of the used game elements. These are the elements within a game that function as core motivators for a

play experience, such as *a challenge* in platform games, *social teaming* in soccer sport games, or *exploration* in role-playing games. Among these game elements, *rewards* are one of the most applied kind of elements. Sometimes rewards are designed as a core game-element in a game, such as the monetary rewards in gambling, and sometimes as a supportive game element, such as the weapons and powers you can earn as a reward for completing a challenge in MMORPGs. Although motivational effects of rewards in daily life have been studied extensively in psychological and neurocognitive studies [236, 246-250], there is surprisingly little fundamental research about the motivational effects of rewards in games.

In games, rewards are most typically applied in the form of monetary rewards, virtual points, and social rewards [228, 251]. These three reward types differ in their value of use. Monetary rewards have a dominant value in the real world outside the game. In contrast, virtual points have their dominant value within the game world, and social rewards, such as received compliments about your gameplay by your playmates, have a value in both the real world and the game world [252]. Monetary rewards consist of a tangible amount of money that a player receives for a specific performance [253, 254]. Virtual points are used as a scoring system or as a way to buy virtual goods that are usable in the game (e.g., better weapons). Scoring systems based on the earned player points are often a symbolic way of reflecting the players' progression, performance, achievement, and competence [253]. In social rewards, players give and receive compliments to and from other players, or they invite and are invited to join specific player groups. This type of reward includes positive incentives related to the general human need of feeling related to others [253] and receiving social recognition for specific behaviors [255, 256]. From a neurocognitive perspective, preliminary findings from Functional Magnetic Resonance Imaging (fMRI) research suggest that these three reward-types may activate specific areas in the brain [257]. For example, brain areas that have been linked to the processing of self-related and social information showed more activation when social rewards were gained than monetary rewards or performance feedback, such as points.

In the present paper we will investigate, for the purpose of serious game design, the motivational difference of the three basic types of game rewards: monetary rewards, social rewards, and virtual points. The application of game elements (such as game rewards) in a non-entertainment (i.e., “serious”) context is called “gamification” [182]. In order to study the application value of game rewards in serious contexts comprising specific user groups, we involved (a) adolescent patients with substance use disorders from a substance addiction care context and (b) a same-aged control group of high-school students without substance use disorders. The context of substance addiction therapy might benefit from the study of persuasive game design involving rewards, since reward-based game behavior and substance-use both derive their motivation from shared neurological dopamine systems. More specifically, video gaming is associated with dopamine release, and all addictive substances trigger increases in dopamine in a key region of the reward (limbic) system in the brain [258, 259]. Additionally, adding game-elements to an addiction therapy might make the therapy more engaging for patients, and hence enhance the therapeutic adherence [260]. While game-rewards may be particularly motivating for adolescents, it is not clear whether this also holds for adolescents with substance use disorders. Neurological findings suggest that—compared to non-dependent persons—the application of rewards may have less impact on substance dependent individuals due to a hyperactive dopamine system for psychoactive substances (alcohol, amphetamine, opiates, or marijuana) and a decreased sensitivity to stimuli that are not related to these substances [259, 261-266]. This “dampened” effect of non-substance related rewards in substance dependent persons informs our hypothesis that game-rewards may have a lower motivational effect in this population than in a non-dependent high-school population. Although we do have evidence that rewards can work in the clinical practice of addiction treatment—particularly when using monetary incentives following an evidence-based contingency management scheme [267-270]—neurocognitive findings indicate that natural rewards may have a lower impact on this population. It is unclear whether substance dependent individuals will be sufficiently motivated by game rewards, since this type of

individual may be more strongly motivated by the expected rewarding effect of substance use. To determine which types of rewards are suitable for persuasive games aimed at patients in mental health care, it is important to empirically test the potential impact of game rewards for specific patient groups, such as individuals with substance use disorders. The present study will, thus, focus on comparing the effects of the three basic separated reward types between a clinical sample of substance dependent adolescents and a control group of non-dependent high-school students. Because substance dependent individuals may show decreased sensitivity to rewards [259, 261-266].

We hypothesize that all separate reward types will be less motivating for them compared to their non-substance dependent counter-parts.

4B.2. METHOD

4B.2.1. ETHICS

The Medical Ethical Committee of the Leiden University Medical Centre in the Netherlands granted exemption for a full ethical application.

4B.2.2. PARTICIPANTS

Participants (aged between 12–24 years) were recruited from two locations in the Netherlands. A total of 32 non-substance dependent adolescents were recruited from a secondary school and 36 substance dependent adolescents were recruited from a substance addiction care facility. Due to computer problems during the test, we had to exclude 23 participants (16 substance dependent and 7 non-dependent adolescents). Approximately 50% of these participants ($N = 11$) did not play the game for all three types of rewards because of software problems. The other 50% of these participants ($N = 12$) unwillingly pressed the stop-button while playing, even though they did not want to stop playing the game. At the start of the experiment we clearly explained to participants that they could press the stop-button if they wanted to stop playing the game (see Figure 1). This was important for our analysis, since the stop-button was directly related with the dependent variable “play persistence”. However, since participants pressed the stop-button even

though they did not want to stop playing, either they did not understand this explanation or they pressed the button by accident. When participants did not play the game for all three types of rewards, we had to exclude them from the whole study as we could not compare their play persistence for the different types of rewards anymore.

The final study sample consisted of 45 participants, with 20 substance dependent and 25 non-dependent adolescents. The group of substance dependent adolescents contained fewer females (15%) compared to non-dependent adolescents (52%), matching the general substance dependence population that also consists of more males [271, 272]. We did not collect personal information regarding the type of substance dependence, since this was not the focus of the study. In addition, it was often comorbid and asking for this information might have decreased the participants' motivation to engage in the playtest study. Adolescents in Dutch addiction care most often receive therapy for cannabis, alcohol, and gaming. A smaller group receives therapy for stimulants (mainly amphetamine, but also cocaine or ecstasy) [273-275]. We tried to match the age of both substance dependent and non-dependent groups. The average age of the respondents from the secondary school was around 16 years old (14–18 years old), and patients who are in therapy at the youth addiction care clinic are generally around 18 years old (12–22 years old) [274].

4B.2.3. DESIGN

Per type of reward, participants were able to spend a maximum of 40 minutes playing the game. If participants used the maximum playing time with all types of rewards, the maximum playing time would be two hours. Participants in current study played the game with all types of rewards in a total of 30–60 min. The game consisted of a four by four grid with 16 buttons. Of these buttons, 8 randomly displayed multiplications of 2 up to 9, and the other 8 displayed possible answers of the multiplication products. Of these 8 possible answers of the products, 6 matched the outcomes and 2 were incorrect. Participants were instructed to match a multiplication product, and after each match the screen refreshed.

Participants received incremental rewards after a specific number of correct answers (after 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, and 42 correct answers). The screen showed how many correct matches were needed to obtain the next reward and how many rewards the participant had already earned. Participants could, thus, earn a total of 14 rewards per session and complete a maximum number of 315 products if they played the maximum play time and always answered correctly. During the whole game, the screen showed a “stop-playing” button at the top of the screen. This provided the participant with the possibility to stop playing the game at any moment when preferred (see Figure 1). After hitting the “stop-playing” button, a new game started with similar exercises but with another randomly chosen different reward type until the player had played for all three reward types. At the end of the study, all participants received 10 euros for their participation, regardless of their score in the game. The participants were not informed about the participation fee beforehand.

In total, participants played three game-sessions. In each session they would play for one of the three reward types: monetary rewards, virtual points, or a social reward (see Figure 2). Regarding the monetary reward, participants could receive 50 Eurocent per reward until they reached a total of 7 Euros. They received this reward type after the study. Regarding the virtual points, participants could receive 5 points per reward until they reached a maximum of 70 points. The third reward consisted of a social reward, where participants saw a pop-up picture of a randomly selected blurry face, with a thumbs up and a textual compliment. The blurry faces were taken from a pool of portraits of participants of the study that we photographed before starting the study. For ethical considerations we blurred the photographs to the extent that faces known to the participant were recognized but faces unknown to the participant were not. Participants received one compliment per reward moment, which could vary according to five different kinds of texts: “Well done!”, “Wonderful!”, “How smart!”, “Calculation tiger!”, “Thumbs up!”.

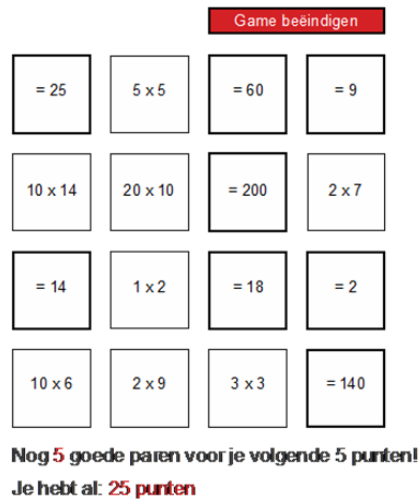


Figure 1. The tablet-based game showing the game-task to combine multiplications and outcomes. Translation of text in red button upper right: “Ending the Game”. Text below states: “Get another 5 correct combinations to receive 5 more points! You already have: 25 points”.



Figure 2. Examples of three types of rewards (translation from top to bottom: “You earned 5 more points”, “You earned 50 more Eurocents”, “Natasha, how smart!”).

4B.2.4. VARIABLES AND MEASURES

As the independent variable we used the type of reward (monetary rewards, virtual points, and social rewards,) and reward evaluation was considered as the dependent variable. We used time in minutes that users spent playing the game, until they hit the “stop-playing” button, as a measure of play persistence (time spent playing as a measure of persistence was also used in a previous study [276]). Participants could evaluate the reward by answering the following four questions on a five-point Likert scale (0 (= totally disagree), until (4 = totally agree)): (1) “I did not want to quit while winning/earning “the reward type” (only fill in if you have stopped before the end of the test); (2) “I wanted to continue playing because of “the reward type”; (3) “I think that “the reward type” is a good reward”; (4) “I am happy with the amount of “the reward type” I have won”.

4B.2.5. PROCEDURE

Participants first provided written informed consent for study participation, after which they received an iPad for use in the present study. At the start of the game, participants filled in their name and were instructed as a practice to first complete as many multiplications as possible within two minutes. After that, participants received information about how the game worked. They were also given the opportunity to ask questions if anything was unclear. If there were no questions or all questions were answered, the game started. After the third and last game-session, participants were asked some final questions about playing the game in general. For each respondent, all game sessions took place during one session, in which the order of the types of rewards was randomized.

4B.3. RESULTS

4B.3.1. STRATEGY OF ANALYSIS

All analyses were conducted in SPSS version 22. Since the data were not normally distributed, as shown by a Kolmogorov-Smirnov test, we applied nonparametric tests. Without the first item, Cronbach’s Alphas for the evaluation of monetary rewards, virtual points, and social rewards were respectively .84, .85, and .82.

4B.3.2. MANIPULATION CHECKS

According to the nonparametric independent samples tests there was no statistically Bignificant difference between our control variable “order of reward type” and time participants played with the rewards (all p -values $> = .20$). Furthermore, there was no significant difference between the “order of reward type” and reward evaluation of all types of rewards (all p -values $> = .29$).

4B.3.3. DIFFERENCE IN PLAYING TIME ACCORDING TO REWARD TYPES BETWEEN SUBSTANCE DEPENDENT AND NON-DEPENDENT ADOLESCENTS

To test differences in playing time we conducted a GEE-analysis (Generalized Estimating Equations), including playing time as the dependent variable, reward type as the within-subject variable, group (substance dependent vs. non-dependent) as a factor, and gender as a covariate (see Table 1). The significant effect of reward type (monetary, social, and virtual points) indicated that adolescents played longer for monetary rewards ($M = 24.35$, $SD = 11.39$) compared to social rewards ($M = 9.30$, $SD = 10.22$) or virtual points ($M = 12.06$, $SD = 11.15$). Results further showed significant effects for the factor group (substance dependent vs. non-dependent) ($X^2 = 13.77$, $p < .05$) and the covariate gender ($X^2 = 11.84$, $p < .05$). Regardless of type of reward and gender, adolescents with substance dependence ($M = 18.14$, $SD = 14.23$) played longer compared to non-dependent adolescents ($M = 12.91$, $SD = 10.84$). The significant effect of gender suggested that girls ($M = 16.83$, $SD = 12.27$) played longer compared to boys ($M = 14.36$, $SD = 12.89$), regardless of group and type of reward.

Table 1. Regression estimates for play consistency.

	B	SE	Wald X^2 (95% CI)	Sig
Virtual points	-12.29	1.91	41.37 (-16.04 to -8.55)	0.000
Social rewards	-15.05	2.26	44.40 (-19.47 to -10.62)	0.000
Monetary rewards	.	.	.	.
Substance dependent	7.20	1.94	13.77 (3.40 to 11.01)	0.000
Non-substance dependent	.	.	.	.
Gender	5.35	1.55	11.84 (2.30 to 8.40)	0.000

4B.3.4. DIFFERENCE IN REWARD EVALUATION ACCORDING TO REWARD TYPES BETWEEN SUBSTANCE DEPENDENT AND NON-DEPENDENT ADOLESCENTS

In a second GEE-analysis with reward evaluation as a dependent variable, we tested the effects of reward type and group while controlling for the covariate gender. The type of reward was the only significant variable ($X^2 = 30.61$, $p < 0.05$). Adolescents evaluated playing for monetary rewards ($M = 3.02$, $SD = 1.00$) significantly more positively than playing for virtual points ($M = 2.22$, $SD = 1.03$) or social rewards ($M = 2.35$, $SD = 1.03$) (see Table 2).

Table 2. Regression estimates for reward evaluation.

	B	SE	Wald X^2 (95% CI)	Sig
Virtual points	-0.88	0.17	28.38 (-1.21 to -0.56)	0.000
Social rewards	-0.66	0.16	16.64 (-.97 to -0.34)	0.000
Monetary rewards	.	.	.	.
Substance dependent	-0.02	0.19	0.01 (-0.39 to 0.36)	0.93
Non-substance dependent	.	.	.	.
Gender	-0.04	0.18	0.05 (-0.40 to 0.31)	0.82

4B.3.5. GENERAL RESULTS

Results showed that there was a statistically significant difference in playing time according to reward types. Participants played significantly longer when they were playing for monetary rewards compared to the other types of rewards. In addition, there was a statistically significant difference in participants' reward evaluations of the game according to reward type, and participants evaluated playing for money more positively compared to the other types of rewards. When comparing substance dependent and non-dependent participants, results showed that substance dependent participants played longer compared with non-dependent participants. In addition, regardless of type of reward, female participants played longer compared to male participants.

4B.4. DISCUSSION

In the present study we tested if the effects of three types of rewards (social, monetary, and virtual) on game play duration, and game evaluation differed between substance dependent versus non-dependent adolescents. Adolescence is a period in life that is characterized by increased risk taking, resulting from an overactive reward system in the brain [277], relative to childhood and adulthood [278, 279]. Therefore, rewards may have an increased motivating effect on adolescents and can be used as a useful incentive. However, it was unclear if, and which, game-based rewards would work in a substance addiction therapy context, based on the link found between a hyperactive dopamine system and a decreased sensitivity to natural rewards in substance dependent individuals [259, 261-266].

Our findings suggest that rewards can successfully motivate both substance dependent and non-dependent adolescents to continue their interaction with a game. When users interact more or for longer with a game, it is more likely that the transfer effect of the game will be achieved. Therefore, our findings confirm that rewards may successfully be applied in persuasive game design for both substance dependent and non-dependent adolescents to enhance motivation for tasks (e.g., therapy adherence). However, this study only focused on the effects of rewards on serious tasks and not therapeutic tasks. With serious tasks there is a direct interaction between rewards and behavior, but with therapeutic tasks the point of impact generally takes more time. In addition, in persuasive game design for therapeutic tasks it is needed to carefully match the rewards with the desired transfer effect in order to avoid confounding conflicts between the two, and to also study contributions to long-term therapy effects. This study shows that with serious tasks, rewards are suitable to enhance motivation to continue interaction with a product. More research is, however, needed to see if rewards are also effective for therapeutic tasks with a more long-term effect.

Our results further indicate that when receiving rewards, substance dependent adolescents played significantly longer than non-dependent adolescents. Both groups of adolescents did not differ in how they evaluated

the reward types. Overall, adolescents evaluated monetary rewards more positively compared to the other types of rewards. An explanation for this might be that game play duration was evoked by other (perhaps unconscious) processes or triggers that were not strongly linked to the explicit evaluation of all three types of game rewards. For example, substance dependent adolescents may experience their clinical “real world” context as less exciting and playful than how non-dependent adolescents experience their non-clinical real world. In terms of the persuasive game design model [63], the starting position of the participants with substance dependence might, thus, be positioned more towards the real world than the starting position of the high-school participants. This difference might influence the motivational effect of the designed mathematical game in transporting the user’s experience towards a game world. The motivational effect of a game might be stronger in a less playful environment than in an already playful environment. Future research has to be conducted to investigate this relationship between experienced real world position, effect of game, and its resulting game world experience.

The finding that participants with substance dependence played longer for the types of rewards was contrary to our expectations. We expected that participants with substance dependence would play shorter for any reward type during the experiment, as research showed that substance dependent individuals have an overall decreased reward sensitivity [259]. This previous hypothesis was confirmed in previous research by Kim et al. (2014), who compared the motivational effects of similar reward types, i.e., performance feedback, social rewards, and monetary rewards, between internet addicted adolescents and non-addicted adolescents. The outcomes of this particular study did suggest a decreased sensitivity to game rewards in participants with an internet addiction compared to non-addicted participants [265]. Our finding on the impact of monetary game rewards are in line with previous research showing that monetary incentives have successfully been applied in substance abuse therapy [267-269]. For virtual points and social game rewards our findings cannot be confirmed by previous clinical research,

although some forms of evidence-based therapies do apply to these types of incentives to reinforce non-drug related activities.

This study has some limitations that need to be mentioned. First, we did not differentiate the group of substance dependent adolescents according to their main type of substance problem, e.g., alcohol, cannabis, or stimulants, nor did we differentiate groups according to specific personality characteristics. Some studies have shown that different player groups, i.e., groups with different personality dimensions, can be more interested in, or motivated by, specific game-rewards than others [280]. Since studies have found that some personality traits are more associated with substance addiction than others, more research is needed to further explore this topic [281]. Secondly, although we knew the age range of patients that were admitted to the youth addiction care facility, we did not record the age of those who participated in our study and could not control for age as a covariate in our analyses. In addition, it is important to take into account the out-game value of rewards for users. Future studies should focus on the need for personalizing rewards and whether different player types, personality traits, and types of substances are linked to reward sensitivity [282, 283]. Secondly, although we tried to keep the intensity of the three reward types comparable, i.e., either one compliment, 5 points, or 0.50 Eurocents per reward, it is not certain that we succeeded in this. It is possible that participants' reward experiences were affected by how the rewards were designed [284]. Future studies could address this issue by testing a more sophisticated differentiation in types and intensity of rewards.

4B.5. REWARDS IN PERSUASIVE GAME DESIGN: IMPLICATIONS

The present study investigated if game-based rewards can be used as motivating game-elements in a persuasive game for adolescents with a substance use disorder. The results turned out to be positive, since the types of rewards motivated substance dependent adolescents in addiction care more compared to non-dependent adolescents in high-school. Thus, a persuasive game designer developing eHealth for an addiction care context

can consider using rewards to motivate patients. However, how rewards can best be applied in a persuasive game does not follow from our study. In the present section, we will provide suggestions for reward inclusion in persuasive games.

In persuasive game design practice, the choice for a motivating game element is not made at the start of a project. Following our Persuasive Game Design (PGD) method [260], gamification projects start by specifying the real world goal of a persuasive game, i.e., the “transfer effect”, followed by investigating the “user context”. The information gathered in these two stages is used in the next stage, the gamification design, which includes choosing and designing game elements for the game. The choice for the type, form, and interaction schedule of a reward will, thus, be influenced by the transfer goal and user context, as we will show in this section.

A transfer effect can be specified into four components (effect type, change type, point of impact, and domain), which all can influence the choice for a motivating game element. For instance, if the desired type of transfer effect in a persuasive game is to increase the social relatedness of employees on the work floor [285], a game designer might rather motivate the employees by social rewards, e.g., compliments, in the game instead of monetary rewards, which might lead to economic disparities among the employees and decrease social relatedness among them. In contrast, when the aim of a persuasive game is to increase self-efficacy among independent living elderly, monetary rewards might be considered as a central game element, since they can increase a person’s required resources to overcome real-life obstacles, to make their own choices, and thus enhance confidence in personal capabilities [286]. Other types of transfer effects, like learning, might not favor rewards as central game elements but rather motivate users by providing challenges or exploration opportunities.

Next to transfer type, a transfer effect is specified by its *change type* (initiating, altering, diminishing, or reinforcing a behavior) and its *point of impact* (i.e., when one expects the transfer effect to occur—during gameplay (e.g., exergames), directly after gameplay (learning games), or a long time after

gameplay (lifestyle change)) [260]. The expected point of impact of a transfer effect will influence design decisions regarding rewards. This will not so much influence what type of reward (social, monetary, points) will fit the persuasive game, but rather how a player can obtain a reward, i.e., the contingency of a reward design in a game. Rewards can be linked to the player's *tasks*, *performance*, or *engagement* [287]. For short-term initiating transfer effects, such as physical exercise in an exergame, rewards can be linked to the task (get a reward when the player has completed 10 sit-ups), to the performance (a reward when the player does 10 sit-ups in a short time), or to engagement (a reward when the player has played the game for 10 minutes). Long-term effects, such as a lifestyle change, might favor engagement contingent rewards (a reward every week the player eats healthy and does physical exercise). One might also design combinations of reward contingency relations. For instance, in a persuasive game with a transfer effect to quit smoking, one might start to earn rewards by completing tasks, e.g., not smoking for one day, apply performance-contingency after a week, receive a reward when the player has not smoked and has been active in sports, and use engagement-contingency after a few months by earning a reward when the player still has not smoked.

Especially when a transfer effect has a medium- or long-term point of impact, it is crucial to avoid player acclimation [288] of a reward; players might attribute high value at a reward during the beginning of the gameplay but might not be motivated by the same reward later on in the game. To account for such a decrease of motivation by reward, a game designer can vary the process of giving the rewards. Variation in rewards to maintain player motivation can be achieved by (1) varying the contingency of the reward (see the quit smoking example above), (2) the value of the reward (for instance increase the value of a reward gradually or provide an reward with unknown value, such as a "mystery box") [288], or (3) inserting variable reinforcements [289], such as a sudden rewards occurring at unexpected moments during the gameplay.

The design decision for the form and placement of a reward in a persuasive game does depend on the specific transfer effect, but it will also depend on the

user and context of use of a game. People can differ in their general response to rewards or they may be especially responsive to specific types of rewards. For example, compared to adults, adolescents appear particularly “reward-sensitive”, and hence show stronger neural and behavioral responses to rewarding stimuli [284, 290, 291]. Other studies suggest that responsiveness to a specific type of reward may be linked to gender [292, 293], personality traits, such as empathy or impulsivity [255], and mental disorder [294-296]. To optimize the design of PGD [297] and to develop the most suitable reward for a specific interaction of a specific individual, it is crucial to investigate the motivations and demographics of your target group. A useful method to tailor games to specific personality types is the Hexad framework [282]. This framework categorizes users into six types of player personalities loosely related to the Big Five personality traits: Disruptors (motivated by change), Socializers (motivated by relatedness), Philanthropists (motivated by purpose), Free Spirits (motivated by autonomy), Achievers (motivated by competence), or Players (motivated by extrinsic rewards). Although such a player type classification might work well to design entertainment games, the serious context of a persuasive game might crucially change the player type; someone might be a socializer in an entertainment game context but an achiever in a working context. Investigating if and how the playing motivation of a user differs in an entertainment and serious context is, thus, a crucial phase in the persuasive game design process and will influence design choices regarding rewards.

In the present study we used three basic types of game rewards (monetary, social, and point rewards). In game practice, and especially in entertainment games, other reward types are used as well, and they often occur in combinations. Schell (2008) lists a set of nine commonly used entertainment-based in-game rewards [288]. These include points and social rewards, such as praise, but also nested rewards that are provided when a player reaches a specific amount of points, such as prolonged play opportunity, unlocking a new level, perceiving a juicy spectacle, or improving character powers. Money, as a reward with an out-game value, also comes in variants, e.g., discounts or gift coupons. Just like the in-game rewards, these out-game rewards often are

paced during the gameplay by points—a player has to collect in-game points and can only exchange a predefined amount of points into a reward with out-game value.

4B.6. REWARDS IN PERSUASIVE GAME DESIGN: CASE STUDY

In a youth addiction care context, we involved patients and therapists in a Persuasive Game Design process aimed at realizing a transfer effect to enhance a patient's motivation to set and achieve cognitive behavioral therapy-related goals. To understand what game-experiences patients expected to be motivating, we used Playful Experiences (PLEX) cards representing 22 game experience categories [222]. The most motivating experience patients selected was the experience of “thrill” [298]. We then carried out brainstorm sessions with game designers from a serious game design agency in the Netherlands to generate the following game mechanics that we expected could motivate patients in a youth addiction care context [299]: risk taking, progression map system, selfie photograph feedback system, reward system, and personal values. These mechanics were evaluated by nine patients and eight therapists, who ranked them based on the expected motivational impact for the transfer effect. Interestingly, patients and therapists differed in their ranking. Patients rated risk taking and personal rewards as the best motivating mechanics, while therapists rated risk taking and external rewards as most favorable [299]. The preference of therapists regarding the external rewards seemed to correspond with current therapy techniques that already apply external rewards to patients by using contingency management [267]. However, it is essential for rewards to correspond with both the context of application, i.e., the addiction care context, and the preference of the end-user, i.e., the patient.

In order to optimize the motivational effect of a reward in a persuasive game, a game designer can tailor, as in the Personalized Design Process model [204], the reward as much as possible to the preference, type [191], or personality [300] of the end-user. Moreover, it is possible to design a game in which end-users can choose or generate their own rewards, or to let fellow players tailor

the rewards for them. In our persuasive game design for a therapy context, patients did not find our pre-set reward (a 3D printed token of a goat that was related to the level they achieved) motivating. Therefore, we wanted to provide them with a reward for their accumulated points that would be more personally relevant and motivating. This resulted in giving patients the opportunity to choose their own reward in collaboration with their therapist. In addition, we aimed to increase the patients' therapeutic involvement in goal setting by using mechanisms similar to those used in the "shared decision-making" approach in therapy [301]. The rationale for this adaptation was based on patients' negative evaluations of the pre-set tasks in setting goals. According to the patients, this procedure made it more difficult for them to set goals which were sufficiently challenging, personally relevant, and valuable. In the adapted version, both the therapists and patients could decide on which long-term therapy-related goals they would use together. This ensured that these goals were relevant for the patient's health objectives and of intrinsic value to the patient. In addition, patients could type in their own short-term tasks. In sum, in our iteration we included three opportunities to personalize the game: reward, (main) goals, and short-term tasks. However, it can be debated how much personalization would be possible and preferable in game design. For example, would it be preferable to design one game for each individual user, or to design one game that is so open that it can be fully personalized to each individual user? In both situations one can ask if these games would have enough overlap to be considered as the same game resulting in the same comparable effect.

4B.7. CONCLUSIONS AND FUTURE RESEARCH

Involving rewards as a basic game-element in persuasive game design to redesign psychotherapy has shown potential for youth addiction care, as substance dependent adolescents were more motivated by rewards compared to non-dependent adolescents. In the current study, participants received rewards based on a fixed reinforcement schedule. It would be interesting to explore different schedules for providing rewards, since specific users may prefer a variable schedule more than a fixed one, which can be used for personalization. In addition, it is interesting to study how the motivating

effects of rewards differ when embedded in a game and when isolated in shell-games. The mathematical game that was used in the current study can be considered a “shell-game”, since the rewards were not integrated with each task (i.e. calculation). Future studies can focus on possible differences in the effects of rewards in both integrated and shell games. We expect that monetary rewards are more effective in shell games compared to embedded games, since they have an external value outside the game.

Alignment of a reward to the transfer effect and user-context of a persuasive game will inform design decisions as to the most optimal reward type, form, and interaction structure for a given player and context. The present paper presented a start in fundamental research on the motivational effect of game-based rewards in persuasive games. Since rewards are so fundamental for human behavior and motivation, and thus for persuasive game research, future research is strongly welcomed, which on the one hand elaborates on reward design (e.g., reward (sub)types, combinations, and interactive structure), and on the other hand on users (e.g., personality and context of use).

5.

REFLECTIONS ON THE DESIGN, IMPLEMENTATION, AND ADOPTION OF A GAMIFIED EHEALTH APPLICATION IN YOUTH MENTAL HEALTHCARE

The previous chapters provided argumentation that it is important to personalize both the eHealth product and game elements and involve the stakeholders (e.g. users of the gamified eHealth product) in the design process. This was taken into account in the personalized design process of a gamified module of the therapy supportive “Luca app” and the design of the “Luca app” itself. Luca has been designed for youth mental healthcare and supports the patient to also work on their therapy at home. In this chapter we will first describe the overall design process of the gamified module of the Luca app, followed by a description of the other modules of the app that were developed by the Luca team. Following a preliminary evaluation, we applied a final design iteration to the app that was implemented in therapeutic practice. However, fewer therapists than expected used the app and the inflow of patients was low. In a series of qualitative interviews, we investigated their reasons for not using it. Based on the outcomes and our design process we identified recommendations to enhance implementation and adoption of eHealth in mental healthcare, which we describe in the final part of this chapter.

Based on: van Dooren, M. M. M., Siriaraya, P., Visch, V. T., Spijkerman, R., & Bijkerk, L. (2019). Reflections on the design, implementation, and adoption of a gamified eHealth application in youth mental healthcare, *Entertainment Computing*, 31, 1875-9521.

5.1. INTRODUCTION

Digital games have become a popular pastime for most people in today's society. Players are happy to spend considerable amounts of time and energy engaging on tasks and activities within a well-designed game environment. The term "Gamification" has been used to describe the approach of applying game elements to a non-game context [192]. These game elements are typically used to transform the usual experience of a non-game task into an experience that people find more gratifying, therefore making the task itself more engaging. This increase in user engagement makes gamification useful in a variety of domains such as learning and marketing.

In the field of healthcare, there is growing interest in applying games in order to improve health related outcomes, especially in the area of mental health [78]. For a long time, serious games have been developed and used to help manage symptoms related to various conditions such as depression, post-traumatic stress disorders (PTSD) and autism spectrum disorder (ASD) [302]. As for gamification, this approach could be particularly useful in transforming ordinary therapeutic practices into more gratifying experiences, thus helping to motivate patients to better adhere to the treatment process. This could be particularly useful for many of the therapeutic activities used in fields such as psychotherapy, where a substantial proportion of individuals with mental illness drop out of treatment [303]. Prior studies have argued that various therapeutic training tasks (such as Cognitive-Bias Modification tasks (see [304])) could be enhanced through the use of game elements (e.g. motivational feedback or a surrounding shell game system), making them more engaging for patients [245].

Despite the many potential benefits of gamification in mental healthcare, it is not as easy as it might first appear to design and develop effective gamification within this context. For any gamification to be effective and "meaningful", the design should take into account the needs, interests and capabilities of its users and the underlying tasks and usage context [305]. However, in the mental healthcare context, this can be particularly complex as the outcome of a gamified intervention depends on multiple stakeholders, and differing levels

of motivation are typically required to achieve the therapeutic objectives (i.e.: motivation to achieve long-term behavior change, motivation to engage with the treatment or to accomplish short term therapy objectives, motivation to use gamification within the therapeutic procedure, etc.). In addition, it is requisite that active and constant feedback from these stakeholders is integrated within the game system itself. For example, in certain therapeutic approaches, the therapeutic staff has to review whether the therapeutic activities have been accomplished satisfactorily before game rewards can be given, or before the player can progress to the next level. This requires the designer to not only consider player-game interaction, but also staff-game and player-staff interaction when designing the gamification. Finally, the gamification process itself warrants careful consideration as, in some cases, inappropriate integration of game elements could have an adverse effect on the underlying therapy. When gamifying computerized training tasks for instance, it was found that adding features such as real-time feedback to improve user engagement could lead to an unintended increase in cognitive load, thus distracting users and reducing the overall effectiveness of the training [245]. This means that it is difficult to find an appropriate balance between the health goal and game appeal when developing gamified therapeutic interventions [306].

As the application of gamification in mental healthcare is relatively new, there have as yet been few theoretical or practical guidelines established on how such issues could be addressed. Most existing game design frameworks and guidelines are based on serious games developed for other specific usage purposes (such as for the self-management of diseases [307]): knowledge which might not transfer well to designing games for mental healthcare problems. Overall, there have been few studies that provide case specific knowledge about the processes required to design and implement effective gamifications that are able to meet the complex demands of practical usage within a mental healthcare context. In mental healthcare, the majority of evidence-based therapies include psychotherapy, which can be defined as a treatment modality “in which the therapist and patient(s) work together to ameliorate psychopathologic conditions and functional impairment through

focus on the therapeutic relationship” [13]. One of the most frequently used and studied psychotherapies is cognitive behavioral therapy (CBT) (e.g. [15, 308, 309]).

5.2. RESEARCH THROUGH DESIGN: THE READYSETGOALS AS A DESIGN CASE STUDY FOR GAMIFICATION OF COGNITIVE BEHAVIORAL THERAPY

The overall aim of this paper is to provide more bottom-up design knowledge about the development of gamifications for CBT. In particular, the learnings and challenges for designing such gamifications are presented from a Research through Design (RtD) perspective [310, 311]. RtD methods aim to generate the knowledge to address so-called “wicked problems”: complex problems where different context areas overlap. A holistic approach that integrates theories from different domains is required to provide a solution (and as such would be appropriate for generating knowledge for designing mental healthcare gamifications) [310, 311]. The study highlights how various methods from the field of design (game design and user-centered design etc.) could be useful in helping to address the challenges encountered at each stage of the gamification design process. In addition, the results from applying such methods are discussed in detail to provide a case study for gamification design in youth mental healthcare.

As the theoretical basis of the gamification design process, the Persuasive Game Design (PGD) model [63] was used and played a key role in the design of the gamification, i.e. the ReadySetGoals application (Figure 1). This model proposes that games are essentially experience-defined. In daily life, users experience a real world. Through gamification design, it is possible to shift this ordinary “real-world” experience towards a more “game-like” experience. By adding game elements to real-world tasks, users are triggered to experience gratifying and motivating game world specific feelings during ordinary physical world activities. A transfer effect occurs when the experiences obtained by users in the game world successfully influence the player’s attitudes or behavior in the physical world.

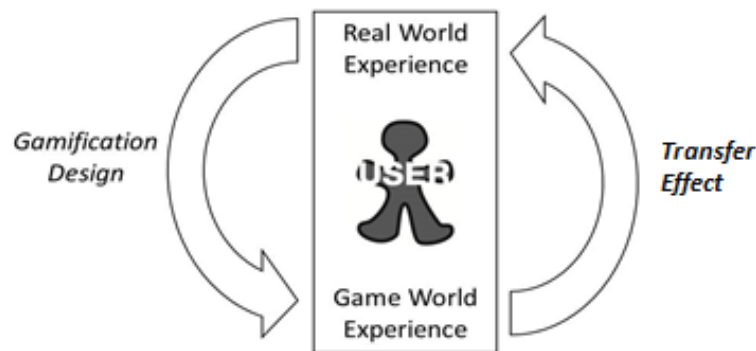


Figure 1. The Persuasive Game Design (PGD) model.

Using the ReadySetGoals application as a case study, the various questions that needed to be addressed when designing and developing mental healthcare gamifications were analyzed through the theoretical lens of the PGD model. The processes employed at each step to obtain those answers were then presented as a structural process, according to the model. Afterwards, the key challenges encountered during the design, development and implementation of the application were discussed, followed by design learnings. Overall, the objectives of this paper are to:

1. Present a case study of the iterative development of a gamification for mental healthcare.
2. Investigate, by Research through Design, a structural process for the design of gamifications that can meet the complex demands of mental healthcare.
3. Evaluate (qualitatively) the support of therapists for the therapeutic application of a new gamification.
4. Extend gamification knowledge in the mental healthcare domain by highlighting reflected learnings based on the practical experience of iteratively designing and developing a youth mental healthcare gamification.

The design and development process of the ReadySetGoals application consists of four key stages based on the theory of gamification outlined in the

PGD model – c.f. Siriaray et al 2018 (PGD cookbook method) [260]. These stages include:

1. Define Transfer Effect
2. Explore User Context
3. Design Gamification (RtD Concept Design Stage, Iterative Development, User Testing Stage)
4. Evaluate Gamification

Various methods from the field of user-centered design, serious game design and game development were used during each of these stages of the design and development of the ReadySetGoals application [260]. Feedback from diverse stakeholders such as domain experts, end users and game designers (totaling $N=44$) was incorporated into the design of the gamified application by means of the studies carried out at each stage of the process. Table 1 provides an overall summary. A detailed discussion of each stage is provided in the following section.

5.2.1. DEFINE TRANSFER EFFECT

The first stage of the gamification process involves the determination of the desired transfer effect. In the case of mental healthcare gamification, this involves examining the various procedures, activities and tasks used in the therapy process and determining which outcomes (cognitive or behavioral etc.) the gamification should aim to achieve. Two aspects in particular require consideration. The first is to evaluate whether the gamification approach itself can offer sufficient added value towards the designated transfer effect and to determine how useful the achieved transfer effect is towards the overall therapy objectives of CBT. For instance, if the retention of a specific procedure is found to obstruct the therapy outcome, such as in Cognitive Bias Modification training programs that require prolonged and repetitive training (see [312]), then the use of gamification, which has shown to be useful in improving user motivation, could be particularly valuable. The second aspect which should be considered is whether the transfer effect and the underlying activity or task used to achieve the transfer effect within the therapeutic context is suitable for gamification. Transfer effects which rely on outcomes

that are complex, time-consuming to measure or have an unclear relationship with their actions can be harder to gamify and therefore might not be adequately effective in practice.

5.2.2. EXPLORE USER CONTEXT

After identifying the desired transfer effects, the next stage involves examining the user's real-world context. In mental healthcare gamification it is particularly important to situate this analysis within the overall therapeutic context and to consider the related theoretical aspects underlying the therapy. In the specific case of the ReadySetGoals design, we aimed to understand more about three aspects of the present real-world therapeutic context: 1) the characteristics of the users (in this case, adolescent substance abuse patients), 2) the therapeutic context in which the gamification is to be implemented (youth substance abuse treatment) and 3) the context underlying the activity to be gamified (goal setting). This involved discussions with addiction treatment experts ($N = 2$) at the clinic. Based on this, a number of contextual features pertaining to each of these aspects were identified. These contextual features were later used to formulate the gamification concept.

With regard to 1) the characteristics of adolescent substance abusers, the personality characteristics of *sensation seeking and impulsivity* were commonly identified in people with addiction problems (e.g. [313-317]). This was further confirmed by an exploratory study which was carried out using PLEX cards. In this study, participants selected the playful experience of "thrill" as the most motivating experience [298]. Another aspect suggested in the discussions as being particularly effective in the addiction treatment context was the *use of rewards*, as rewards can motivate young patients undergoing addiction treatment to exhibit specific behavior [318]. As for the nature of the activity of goal setting itself, one approach which has been used successfully in therapeutic treatment to encourage the setting of achievable goals is to divide the tasks into *small steps*, starting from easily achievable steps to more difficult ones as people tend to perform better and to enjoy pursuing goals which provide sufficient challenge to match their current skills. In addition, the *feeling of accomplishment* derived from completing previous

goals could be leveraged within a feedback loop to encourage users to set and pursue new goals.

Table 1. The design and development process for the ReadySetGoals application

Stage	Objective	Method
1	Define Transfer Effect	- Discussion session with care staff (therapist practitioners at an addiction treatment center) (N=2) (role: domain experts)
Outcome: Appropriate transfer effect identified as “ <i>Encouraging users to set and follow through therapy goals which would result in positive therapy outcomes</i> ”		
2	Explore User Context	- PLEX card study with patients at a treatment center for addiction (age between 17-21 years) (N=7) (role: end users) - Discussion session with addiction experts (N=2) (a therapist practitioner and a care manager at an addiction treatment center) (role: domain experts)
Outcome: Sensation seeking, application of rewards, small steps and feelings of accomplishment identified as gamification opportunities		
3	Design Gamification	- Brainstorm session with game designers from a serious game design company (N=2) (role: design experts) - Questionnaire with patients in addiction care (role: end users) (N=9) and staff (role: stakeholders) (N=8). Staff members included care managers, system therapists and therapist practitioners.
Outcome: Design of core gameplay loop based on the risk-taking concept		
4	Evaluation Gamification	- Testing of early prototype with general users from a University (age 21-24) (N=5) (role: general users) - Testing of prototype with patients (role: end users) (N=6) and staff (role: stakeholders) (N=3) from a youth outpatient treatment center for substance abuse.
Outcome: Addition of narrative metaphor and improvement of the goal-setting mechanism through personalization		

5.2.3. DESIGN GAMIFICATION

The gamification concept design stage consists of two parts. The first part is to identify appropriate gamification concepts which align with the contextual factors identified in the previous stage. The subsequent part involves the construction of a core game loop. In the design of ReadySetGoals, brainstorming sessions for the first part were carried out in collaboration with game designers from &RANJ (a serious game design agency from the Netherlands) to generate ideas about the gamification mechanics or elements that could be useful in motivating players on the basis of the previous factors.

During the brainstorming session, five different game mechanics were identified with the potential to engage patients undergoing therapeutic

intervention for addiction. The mechanic of *risk-taking* was selected to appeal to the contextual factor of sensation seeking and impulsivity, by providing experiences with “thrill factor”. The *progression map system* was selected to appeal to the contextual factor of small steps and the *selfie photograph feedback system* to appeal to the contextual factor of a feeling of success and accomplishment. These factors were aimed at providing experiences of achievement and competence. In addition, the *tangible reward system* and *personal values reward system* were used as they can motivate patients to exhibit specific behavior. Afterwards, these game mechanics were expanded into gamification concepts, with the core gameplay of each concept built around the identified game mechanic. For instance, in the “*risk-taking*” gamification concept, the main task of the players involves placing an “*investment*” on their set goals, based on how likely they think they are to be able to complete the goal. Players receive bonus points if they succeed and lose points if they fail.

These gamification concepts were then evaluated by patients ($N = 9$) and care staff ($N = 8$). A questionnaire study was carried out whereby patients were asked to rank the order of the concepts they thought would be most enjoyable (activities representing the concepts were provided as examples). Meanwhile the care staff ranked the concept that they thought would work best with the patients and would be practical in the care setting. Interestingly, our results showed a discrepancy between patients and care staff in their preference for gamification concepts, suggesting that it would be useful to involve both groups of stakeholders in the design process. The results showed that the *risk-taking* (mean = 4.10/5.00) and *personal rewards* (mean = 3.90/5.00) were rated highest by the patients, while care staff rated *risk-taking* (mean = 3.50/5.00) and *external rewards* (mean = 3.50/5.00) as the joint most favorable. Based on this, the *risk-taking concept* was selected as the main gamification concept in our design.

5.2.3.1. CONSTRUCTING THE CORE GAMEPLAY LOOP

The later stage of the gamification concept design involved the construction of the core game loop. This element represents the repeating processes that drive the core action and the interaction between players and the game (the

main interaction-feedback loop). At the core of most game systems, the actions of the players are aimed at accomplishing certain in-game objectives and interactions for which the game provides feedback (see [319]).

While the game loop concept emerged from the traditional field of game design, we found that this concept was equally useful and applicable to gamification design. Like game designers, gamification designers must carry out the task of creating a structured gameplay experience for users. The core game loop is particularly useful to help achieve this. However, a key difference is that as the goal of gamification is to help users achieve the desired transfer effect, the game experiences often incorporate real-world elements during gameplay. In the case of mental healthcare gamification, the core game loop could be formulated by situating the core actions and interactions needed to achieve the therapeutic objectives within a game play loop, based upon the chosen gamification concept. Specifically, the formulation of such a game loop allows designers to better analyses whether the game mechanics used in the gamification design actually support the key actions or interactions which will lead to the desired therapeutic outcomes. The core game loop also serves as a shared language which facilitates communication between the game designers and practicing clinicians, by making the therapeutic procedure clearer to the game designers and informing the clinicians of how the game interaction process will work in practice. In the ReadySetGoals application, the core game loop was centered on the activity of successfully setting and achieving goals, and the risk-taking concept and the resulting game play system were formulated on the basis of the proposed premise (Figure 2).

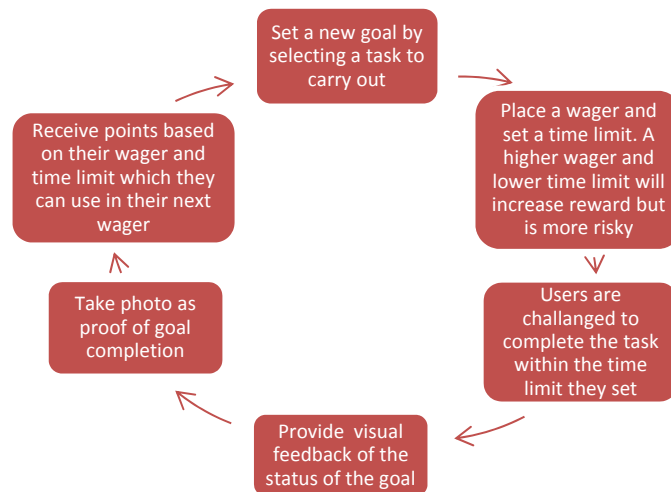


Figure 2. The core game loop of the ReadySetGoals

Afterwards, structural gameplay elements were added to support the core game loop. Structural gameplay elements represent the wider context of gameplay (progression systems, exploration, a narrative storyline, high score systems etc.) and can be used to enhance the core game loop experience, to encourage sustained engagement across the loops [320]. In the ReadySetGoals application design, these were not only selected to match the design of the risk-taking concept, but also to coincide with the contextual factors identified in the previous stages (i.e. small steps and application of rewards). A player progression-based reward system was implemented to make the accumulated points more meaningful and rewarding. In addition, to facilitate the transition from easier to more difficult goals, a skill-tree style difficulty progression system was implemented within which easier tasks had to be completed before proceeding to more difficult ones.

5.2.4. EVALUATION GAMIFICATION

A playable prototype based on the proposed core game loop was iteratively designed, developed and tested with users. The prototype was created and deployed as an Android mobile application using PhoneGap (<http://phonegap.com>) (Figure 3). Although the ReadySetGoals application was designed to be domain independent (objectives related to different

aspects of therapy can be used as goals), when testing the application, the care staff decided to focus on using the application to encourage participants to set goals to commence and pursue leisure activities. Such activities encourage participants to find alternative sources of reward and fulfilment that are inconsistent with drug use. Overall, five activities were available for selection (Reading, Watching Films, Football, Jogging and Photography), each representing alternative behaviors which are inconsistent with drug use. Altogether, 84 pre-defined tasks were provided, based on discussions with experts in each activity and further refined by three game designers. Care staff was asked to review the tasks to ensure suitability for the patients. To ensure anonymity, all the information was stored locally on the participants' phones.

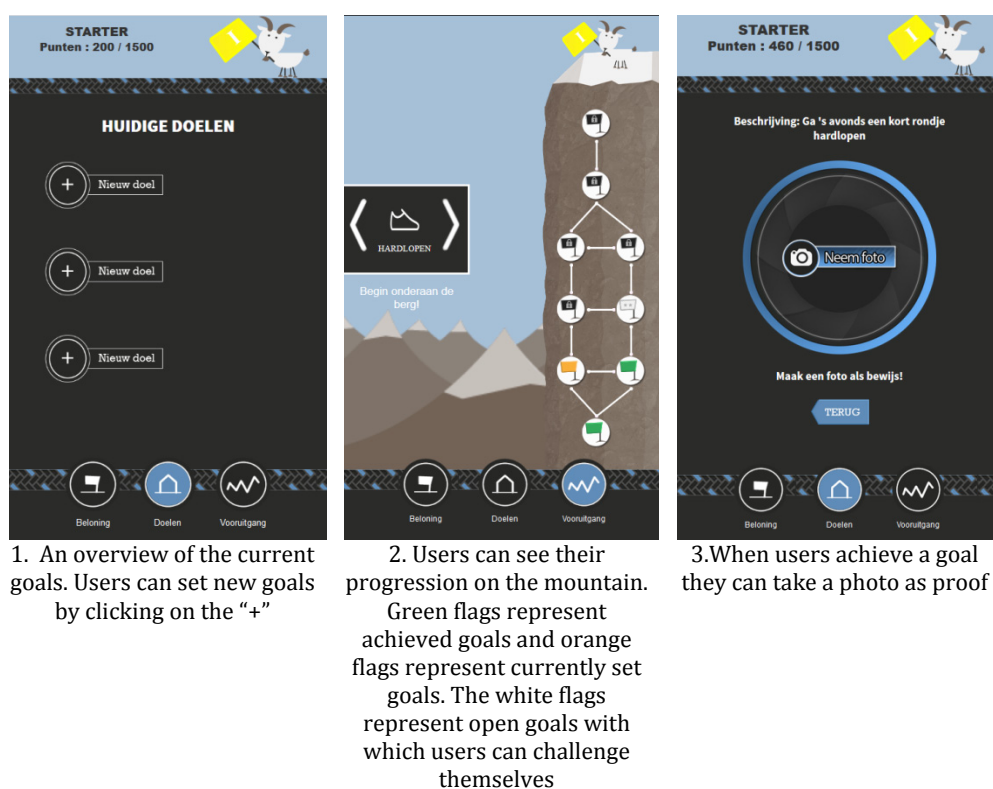


Figure 3: Screenshots of the ReadySetGoals Application

The application was first used in a user testing session with five participants (aged 21-24) recruited from the Delft University of Technology (two males,

three females) to investigate how players perceived the implementation of the game mechanics and to investigate issues related to general accessibility. In the testing session, participants were asked to set and complete goals using the application. A “Think Aloud” approach was adopted and participants were asked open-ended questions about their general experience with the application. This led to structural improvements to the content structure and navigation schema. In addition, the narrative metaphor of climbing a mountain was added to improve connectedness between accomplishing goals and progressing with overall therapy. The mountain represented a challenging obstacle, and the goals that had been accomplished so far were visualised with flags placed on the mountain, each representing a step that users had taken towards overcoming their obstacles.

5.2.3.1. THE IMPROVED READYSETGOALS APPLICATION PROTOTYPE

Screenshots of the ReadySetGoals application can be seen in Figure 3. In the application, participants start by setting a new goal which they want to pursue. They select which task in a specific leisure category (i.e. run X km in Y minutes) that they would like to take on as a challenge. Afterwards they select a time limit and use their accumulated points to place a wager on how likely they think it is that they will achieve the goal. Placing a higher wager or setting a lower time limit increases the potential reward, but is riskier as users lose the points put up for the wager if they fail. When users complete the goal, they take a photo with their phone as proof and receive their rewards in points, based on the risk level and the difficulty of the task. As shown in Figure 3, participants select tasks from the bottom of the mountain and move up to more difficult tasks as they progress. Finally, as a reward for accumulating enough points to reach a higher level rank, they are presented with a non-monetary reward at the end of the session, in the form of a 3D printed token depicting their level.

5.3. PRELIMINARY TESTING WITH TARGET AUDIENCE

Researchers recruited participants from a youth outpatient treatment center for substance abuse in the Netherlands. Three care staff members decided to participate in the study and were asked to recruit potential participants from

their patient population. Patients who agreed to participate in the study were asked to engage with the application for three to four weeks. The inclusion criterion was having an android phone and the exclusion criteria were having a gaming and/or gambling addiction. During the experiment, participants were asked to use the application freely. To ensure the validity of the goals, care staff was asked to review, during their therapy meetings, the goals that their patients had accomplished.

After the evaluation period, each participant was asked to fill out questionnaires about their general game experiences [321], and semi-structured interviews were carried out. Participants were also asked to rate various factors such as the value of the application in helping to motivate them to set goals and the value of various game elements such as the narration theme, on a 0 to 10 Likert scale. The semi-structured interviews covered topics such as the game mechanics, the potential usage of the application for therapy and suggestions on how to improve the application. As a reward, participants were presented with a cinema gift card worth 10 euros.

5.3.1. RESULTS AND SUGGESTIONS FOR ITERATIVE IMPROVEMENT

The results from the preliminary study provided key insights, highlighting multiple areas where the application could be further improved. Overall, six participants and three care staff participated in the interviews and questionnaires (one dropped out due to relapse and one participant was not able to use the application and was excluded from the study). Participants reported that the application was moderately useful in motivating them to achieve their goals (Mean Rating: 5.00/10.00, SD = 1.67) and reported a moderate sensation of achievement after achieving a goal by means of the application (Mean Rating: 5.50/10.00, SD = 2.59). One aspect that was perceived as particularly negative was the tasks that were used in the goal-setting process. In particular, the decision to provide pre-set tasks for participants to use in setting goals was negatively perceived. Predefined tasks allow for a more controlled provision of beneficial health objectives (which could be essential if the goals are related to serious therapeutic objectives, such as training activities that have rigid rules). However, when used in the

domain of leisure activities it appeared to be less useful and rendered far less satisfaction to the participants, as they felt that their autonomy had been constrained. *"I would feel prouder about achieving the goals if I had thought them up myself, then I would feel more motivated to achieve them"* (participant 2, female). The restrictive nature of pre-set tasks also meant that it was harder for participants to form goals which were sufficiently challenging, personally relevant and valuable. These aspects were frequently criticized during the interviews. So participants felt that the application was not very helpful in the formulation of goals (Mean Rating: 3.50/10.00, SD = 2.07) and that it was not sufficiently challenging (Mean Rating: 0.63/4.00, SD = 0.43).

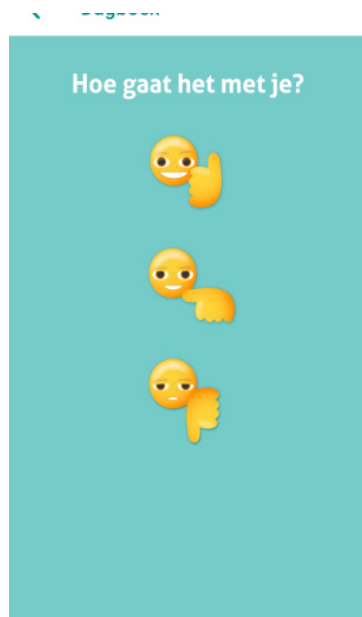
To improve this aspect, mechanisms similar to those used in the "shared decision-making" approach in therapy [301] were suggested as a useful addition to the gamification. This approach increases the patients' therapeutic involvement by allowing them to make collaborative decisions within the therapy, thus enhancing their feeling of autonomy, while the therapist guides them in keeping the goals relevant to their health objectives. A simple example of how this approach can be applied to the gamified application is to provide participants with "suggested goals" pre-developed by the care staff and to allow participants to modify these into their own goals.

Regarding the gamification design in general, participants particularly enjoyed the narration aspect. Participants experienced the theme and the representation of the skill-tree based progression mechanism as positive (Mean rating: 6.33/10.00, SD = 2.66) and felt that the narrative concept was one to which they could relate. The risk-taking mechanism was rated moderately in the application (Mean Rating: 5.67/10.00, SD = 2.16) and some users perceived this feature as being motivating in itself *"I did enjoy setting the points and tended to go 'all in' with my points so that there is more at stake."* (participant 5, male). To further improve this mechanism, a better reward for the accumulation of points would need to be provided, such as the social rewards gained from comparing performance and progress with others.

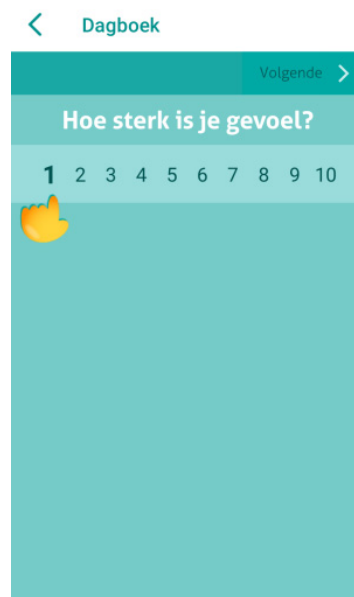
5.4. FINAL ITERATION OF THE READYSETGOALS GAMIFICATION

5.4.3. THE READYSETGOALS GAMIFICATION

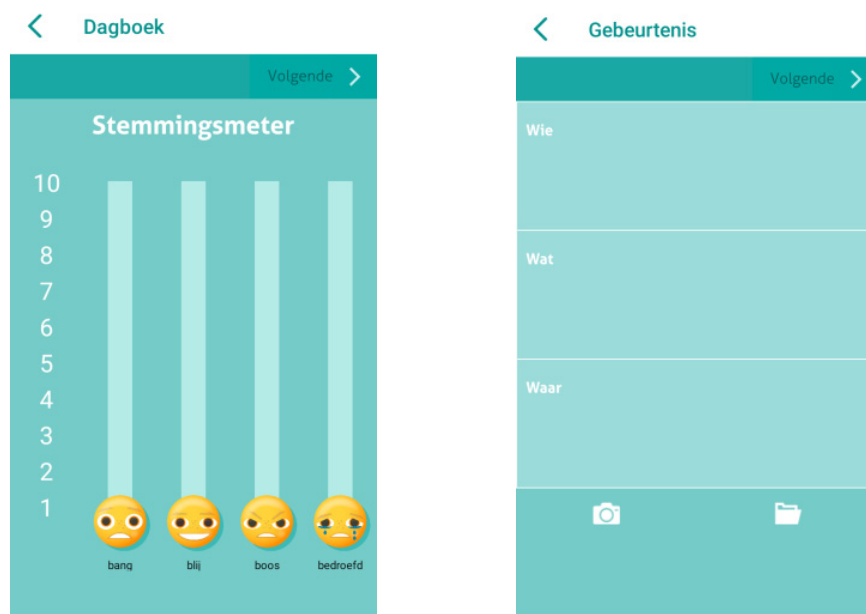
To implement the ReadySetGoals application, we collaborated with the “Luca” app project. The Luca app was designed to support patients in youth mental health or addiction treatment health care in their home environment and includes a number of therapy modules such as: 1) the medication alarm, in which patients can register the medications they have to take and can set an alarm to remind them, 2) the emergency plan, where patients prepare – together with their therapist – a plan of how to solve a future mental health crisis, 3) a chat, that allows therapists and their patients to quickly send each other short messages in an encrypted and safe manner, 4) an activity list, where patients record positive activities that reinforce their mental and physical well-being, 5) a diary in which patients register high-risk situations (for example situations that evoke a craving to use substances) and their mood. Figure 4 provides some screenshots of the diary which consists of three elements: 1) “ups & downs”, 2) “mood-measurement”, and 3) “registration”. With the “ups & downs”, patients can quickly register how they are doing by clicking on one of the three emoticons with either a thumbs up, thumbs sideways or thumbs down and grading this on a scale from 1 to 10 (screenshot 1 and 2 of Figure 4). They can also describe their state-of-mind and add a picture. With the “mood-measurement”, patients can register their mood by rating the intensity of the emotions (such as fear, happiness, anger, and sadness) which they have experienced during the day (screenshot 3 of Figure 4). Lastly, patients can register the difficult situations which triggered their emotions, by first noting information such as who they were with and information about the event that had occurred (screenshot 4 of Figure 4). A therapist can then discuss the content of the modules during face-to-face CBT sessions.



1. In the diary, users record how they are currently feeling by clicking on one of the emotion icons



2. In addition, users also register how strong their feelings are, by grading them on a ten-point scale



3. Next, users can grade specific aspects of their mood, by sliding the emoticons (scared, happy, angry, sad) to the suitable grade

4. Users can also describe specific situations by recording what they were doing and where the situation occurred. They can also take a photo for extra clarification

Figure 4: Screenshots of the diary module of the Luca app.

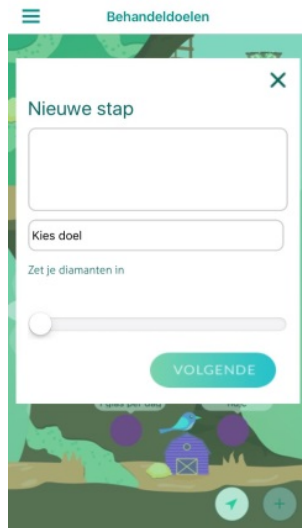
The therapy goals module is one of the Luca app modules (Figure 5). We implemented ReadySetGoals as a gamified version of this module. ReadySetGoals was improved, based on earlier feedback from end-users, by 1) enhancing user autonomy, 2) improving the intrinsic value of tasks, and 3) improving the narrative metaphor element. As users wanted more autonomy in selecting tasks while the tasks had to relate to the main therapy objective we adopted a shared-decision approach, as commonly applied in healthcare [301], to task selection. Specifically, patients could set their tasks themselves or in collaboration with their therapist. In addition, patients could set the number of points to be rewarded for the task together with their therapist,

and were given the option of writing comments on how difficult it was to (attempt to) fulfil the task.

To improve the intrinsic value of tasks, and to ensure that the long-term therapy-related goals were relevant for the patient's health objectives, both the therapists and patients decided on which long-term therapy-related goals they would work together. The therapists first selected the relevant area in life (e.g. mood / psychiatric problems, school / work / education, or substance use) and typed in the specific long-term goal. Patients could achieve these long-term therapy-related goals by setting and trying to achieve short-term therapy-related goals (i.e. the various tasks) in these areas. Patients typed in their own tasks, after selecting the corresponding long-term therapy-related goal, and set reminders of specific dates and times. In addition, patients chose their own rewards for the accumulated points in collaboration with their therapist. This made the rewards more personally relevant and motivating. During each therapy session, therapists evaluated the progress of the long-term therapy goals and set new goals once the tasks had been accomplished.

Lastly, to improve the narrative metaphor element, we enhanced the 'climbing a mountain' metaphor. The wager that patients could set when selecting a task was referred to as diamonds instead of points. This was because diamonds are perceived as having a higher objective value and because diamonds are often found in mountains or near mountain ranges. When patients achieved a task, they could take a photo and this would be displayed on the mountain to highlight the progress of their climb, and the achievement of their long-term therapy-related goal. To align the skill-tree based progression mechanism to the therapy structure, therapists estimated the amount of therapy sessions needed, and this helped determine the height of the mountain. Patients would reach the summit of the mountain when they completed therapy. We expected that this would motivate patients to visit therapy sessions. When patients attended a therapy session, the therapist evaluated the therapy goals in the therapy goals module of the app. In this way, patients would automatically progress to the next therapy session and thus climb visibly further up the mountain. Not attending a therapy session prevented patients from climbing the mountain.

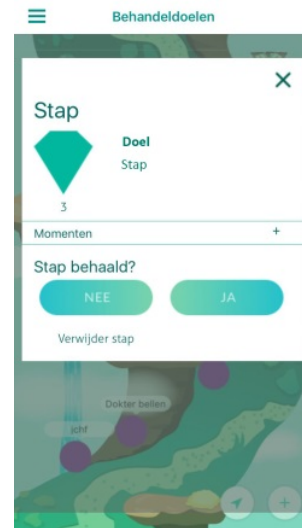
Chapter 5 | Reflections on the design, implementation, and adoption of a gamified eHealth application in youth mental healthcare



1. The user selects a relevant long-term therapy goal and formulates a short-term task. The user then bets diamonds on the set goal. Afterwards, the user clicks on the “volgende” (next) button



2. The user then estimates the difficulty of the task and proceeds by clicking on “opslaan” (save) button



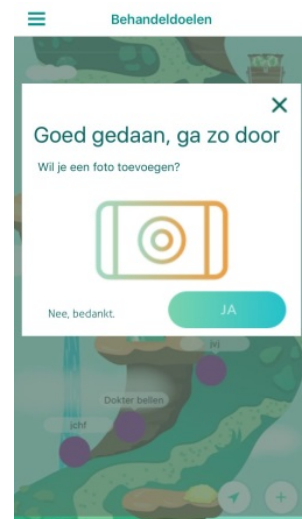
3. The user then sees an overview of the task and the corresponding goal. It is also possible to set reminders for the step



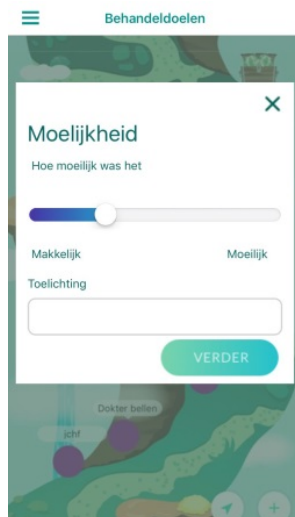
4. If a user wishes to set a reminder, he or she can select the date and time



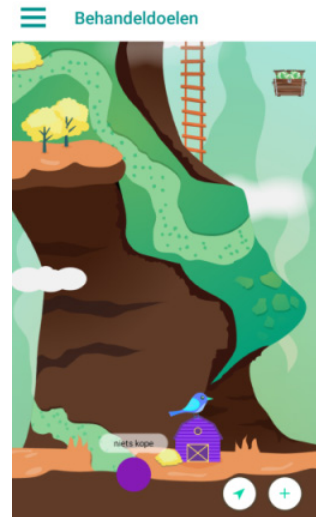
5. If a user has achieved the task, he or she clicks the “ja” (yes) button to proceed



6. The user can then take a photo of the goal or situation, for display on the mountain



7. The user will then see how difficult he or she had thought the task was before starting and describes how difficult the task was in practice



8. An overview of tasks set and agreed upon by patient and therapist is shown on the mountain screen. This screenshot shows a single task (in purple). By clicking on the "+", the user can set a new task. By clicking on the treasure box (top right), the user can see how many diamonds have been earned and how many have to be earned in order to gain the next reward. The user can navigate the mountain by scrolling. He or she can go back to the current session by clicking on the lower left button

Figure 5. Screenshots of the gamified therapy-goals module.

In summary, the process of using the gamified therapy goals module in the Luca app is as follows: When a patient wishes to set a goal, he/she selects a long-term goal and types in the short-term task (screenshot 1 of Figure 5), He then bets diamonds and gives feedback about how difficult he thinks the task will be (screenshot 2 of Figure 5). In addition, the patient can set a reminder time (screenshot 3 and 4 of Figure 5). At these specified times, a pop-up will appear on the patient's smartphone to remind him of the task. Once a task has been accomplished, the patient selects "yes" (screenshot 5 of Figure 5), can take a picture (screenshot 6 of Figure 5) and rates how difficult the task was in practice (screenshot 7 of Figure 5). If a patient takes a picture, it will be displayed on the mountain. The patient can discuss what task and therapy

goal has or has not been accomplished during the following therapy session. The last screenshot shows an overview on the mountain of the number of tasks that were set and agreed upon by patient and therapist before the current therapy session (represented by a purple dot).

5.5. IMPLEMENTATION OF THE LUCA APP AND EVALUATION BY THERAPISTS

When writing this paper, we were testing the general effect of the gamification, by conducting a non-randomized pre-post (eight weeks) study. In this study we contrasted two conditions: one that was gamified and one that was not gamified, to evaluate the Luca app with a gamified therapy goals module and the Luca app with a non-gamified therapy goals module in a youth mental healthcare setting (both mental health and addiction care). The non-randomized prospective study that we planned was a study with an A-B design among 60 youngsters in youth mental healthcare who used the therapy-supportive Luca app in the context of outpatient cognitive behavioral therapy (CBT, their regular therapy). Our exclusion criteria comprised of patients with problematic gaming or gambling behavior, who received inpatient treatment less than 3 months prior to the start of therapy, had a (light) mental disorder, acute suicidal or psychotic complaints, or an insufficient command of the Dutch language. According to our study protocol, the first 30 youngsters who participated in the study would receive - besides CBT - the Luca app with a non-gamified therapy goals module and the following 30 youngsters would receive the Luca app with a gamified therapy goals module. We expected that a higher frequency of use of the Luca app would be related to better therapy outcomes (i.e. less psychological complaints/substance use, higher therapy retention, higher motivation for therapy); that the Luca app with a gamified therapy goals module would be more frequently used than the Luca app with a non-gamified therapy goals module and that youngsters who received the Luca app with a gamified therapy goals module would have better therapy outcomes than the youngsters who received the Luca app with a non-gamified therapy goals module. At the start of the study, the therapists were trained in the use of the Luca app and given a leaflet with screenshots and instructions for the Luca

app and both the gamified and non-gamified modules, and they understood how the therapy goals module would be used for therapy. However, the inflow of patients in the Luca study was low, and at the time of writing it was uncertain whether the study could be finalized as planned according to our protocol.

5.5.1. QUALITATIVE MID-STAGE EVALUATION

During the study, the participant influx was much lower than expected, which motivated us to conduct a qualitative evaluation with therapists in order to investigate the causes for this low research participation by patients and therapists. To solicit opinions and receive feedback about the potential advantages or disadvantages of using gamification as part of the treatment, we carried out semi-structured phone-interviews of about half an hour with therapists who had participated in the study. The interviews focused on topics such as the design of the Luca app (expectations, usability, look-and-feel) and their opinions about its integration in therapy and experimentation. A total of nine participating therapists (one male and eight females) were interviewed. They had used the Luca app for therapy but had not yet implemented the gamified therapy goals module within therapy. Five therapists worked at the youth mental healthcare institution and four at the youth addiction care clinic. At the start of the interview, therapists provided informed consent for recording the interview and the anonymous use of their data. We used thematic analysis for the iterative analysis of the data [207, 208]. Secondly, similar codes were grouped together into higher level codes and themes were created from the recurring codes. We went through our data several times until we felt that our coding had achieved saturation. Finally, the codes were refined by two researchers who critically discussed and reviewed the themes.

5.5.2. ETHICAL CONSIDERATIONS

Various steps were taken to ensure the confidentiality and anonymity of the participants in the interviews and the ethicality of this study. Participation of therapists was voluntary and consent was verbally obtained. Data were anonymized at the earliest possible stage.

5.5.3. RESULTS

Overall, three themes were identified on the basis of the results of the thematic analysis. The first was related to the fittingness of gamification with individual users. Patients in youth mental healthcare have various types of mental health issues and disorders and it was a common opinion that gamification might only be beneficial to a certain group of patients. In addition, gamification may be more suitable for younger adolescents than older adolescents, since younger patients may not be intrinsically motivated for behavioral change and to actively adhere to therapy and corresponding therapeutic tasks. Therefore, younger patients need more extrinsic motivation to adhere to therapy, and the feeling was that gamification might play a more prominent role with this age group. The second theme was related to the fittingness of eHealth with face-to-face practice. Blended eHealth has the advantage of extending the reach of psychological therapy beyond the clinical setting [29]. However, integration with current therapeutic practices remains complex and the personalization of the design remains an important aspect of the implementation of such technology. In addition, technical instability issues can have huge impact on eHealth and gamification for a serious context such as youth mental healthcare, and this can cause the therapist to lose trust in the digital solution. The last theme was related to a distortion of the therapeutic alliance caused by eHealth and gamification. At the start of therapy, patients are often not motivated for behavioral change. We found that the therapists preferred to first motivate users during face-to-face contacts, by applying motivational interviewing and building up a therapeutic alliance, before employing a gamification and eHealth application.

5.6.1. FITTINGNESS OF GAMIFICATION TO INDIVIDUAL USERS

The first theme identified from our analysis was related to the therapists' expectation that the gamification would only be suitable for a certain group of users. During the interviews, five therapists mentioned that the gamification of the therapy goals module would be more suitable and motivational for younger patients and less for older adolescent patients. According to these therapists, older adolescents would be more intrinsically motivated to adhere to therapy than younger patients. Lower intrinsic motivation in younger

relative to older individuals is also reflected in other studies [322]. In the case of youth mental healthcare, younger patients may not see the importance and necessity of actively adhering to therapy and corresponding therapeutic tasks. Therefore, younger patients require more extrinsic motivation to adhere to therapy, which therapists feel might offer a more prominent role to gamification. In addition, one therapist felt that gamification was comparable to other techniques currently used in youth addiction care, such as contingency management, a type of intervention that uses rewards to enhance the motivation of patients to adhere to therapy [267].

“Younger patients often find it more difficult to understand how to go about it, and gamification can make it more interesting. For example, if they can earn something with it that can make a difference. Older patients have more internal motivation and younger ones have to be more extrinsically motivated.”
(Therapist G, male)

Patients in youth mental healthcare can have a variety of mental health disorders, such as anxiety and mood, impulse control and addiction disorders (some suffer from multiple disorders simultaneously) (e.g. [323]). Although ReadySetGoals was designed for youth addiction care, the therapists felt that this gamification could also be applied to other mental healthcare domains. However, gamification might be more suitable for certain groups of patients with specific mental disorders. One such observation was made concerning the gamified goal-setting module in this study. Two therapists thought that the gamification would be particularly motivating for patients with an Attention Deficit Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD). Patients with these conditions need either extra stimulation to become motivated or tend to achieve hyper-focus within specific tasks. Research has shown that when game elements were added to cognitive tasks, there was a slight alleviation of performance problems in children with ADHD [324, 325]. However, in contrast, another therapist felt that the design of the therapy goals module and gamification would not be suitable for patients with ADHD. In order to set therapeutic tasks, patients needed to click through a number of screens and the therapist felt that this would cause patients with ADHD to lose attention.

“If I look at the target group ADD and ADHD, they need external input. In a game they can get some kind of hyper-focus that makes it fun.” (Therapist F, female)

Another therapist mentioned that gamification would be beneficial to patients with autism, since they can be more focused on the task thanks to the orderly and clear design of the gamification. In the literature, however, there is limited research on the beneficial effect of gamification for patients with autism, though there have been past studies that suggest that the use of gamification may help individuals with autism to recognize the emotion and facial expressions of others [326]. Lastly, another therapist thought that gamification would be motivating for patients with a game addiction or symptoms of compulsive gaming¹. This therapist also thought that the app was not suitable for patients with suicidal thoughts (another exclusion criterion for the study). When patients with suicidal thoughts experience a crisis, a therapist needs to react immediately. However, if a therapist does not check the app daily, and the patient contacts a therapist through the app, there is a chance that these crisis situations are missed. Therefore, it would be preferable that these patients call the therapist rather than using the app.

“Autism patients can be more focused on that [order and clearness of games]” (Therapist C, female)

“...and I think that especially game youngsters [are easily motivated by it]. It’s a shame [that they are excluded from participation]” (Therapist B, female)

On the subject of specific game elements, one therapist found the progression feedback system with the mountain to be very effective, especially when patients do not accomplish their therapeutic tasks. She gave an example of a patient with an anxiety disorder who was helped to confront fears using exposure therapy. This patient felt as though she had not achieved anything in her therapy, after failing to complete a therapeutic task. According to the therapist, the mountain (the skill-tree based progression mechanism) may help these kinds of patients, since it registers small progressions and makes

¹ Patients with a game addiction or compulsive gaming were excluded from the study, mainly because these types of patients could be more or differently motivated by game elements than others, influencing the (generalisability of the) results.

these progressions visible. In this way, patients are better able to see some form of progression and achievement when they go to therapy sessions (because even though patients may not have completed a therapeutic task, going to a therapy session is an achievement in itself).

"The visualization of the mountain is very effective." (Therapist D, female)

"After not having achieved the next task, an exposure patient felt like she had not achieved anything. The mountain can help with this [feeling of not achieving anything]." (Therapist D, female)

5.6.2. FITTINGNESS OF EHEALTH WITH FACE-TO-FACE PRACTICE

Most participants viewed and evaluated the application as a blended eHealth therapy tool. The Luca application was designed in such a way that it can support face-to-face therapy. For example, patients can keep track of their goals, emotions and substance use, which therapists can also review outside therapy sessions. Prior studies have shown that using digital technology in such a way to deliver mental healthcare (also referred to as eHealth) can improve psychosocial therapy [24-26] in adults (e.g. [37-39]), adolescents and children (e.g. [40] [41]).

"The fact that it is somehow digital. Normally you give lots of different kinds of stencils on which they [patients] have to note things down. This is just their mobile phone, which they already carry around in their hands." (Therapist H, female)

It is understandable that the therapists' evaluations placed a strong emphasis on the ease of integration of the application into therapy as a part of the treatment process. Despite their positive expectations, therapists did not use the app frequently. Six therapists found it difficult to integrate the application with therapeutic practice, especially when there was a divergence from a one-to-one translation of the CBT protocol. For instance, the application uses different words for specific assignments than the commonly used therapy protocol, and this caused confusion. In addition, the use of the Luca app and explaining to patients about the Luca experiment was not a part of the usual routine of the therapists. Combined with their already busy work schedule,

this caused some of the participants to attribute a low priority to the Luca application during their therapy work. All therapists mentioned they were busy at work and six mentioned that as a result they had given the Luca app low priority and/or had forgotten to introduce Luca.

"The app should be identical to the CBT protocol. Now it is something added on to the protocol, with different formulations and different ways of writing things down. This confuses us as well.." (Therapists E, female)

"I have a lot to think about, and the Luca experiment is not my first priority." (Therapist C, female)

"It's easier to add some notes when using paper. That is what I found most difficult. I noticed that I am more into the paper version. I think you just have to get used to it. If you do it for a longer period of time it becomes easier and more familiar." (Therapist H, female)

However, this was not true for all the participants, as two therapists explicitly mentioned they were able to integrate the app and use it productively within their therapy. For example, one therapist noticed that when using the app during therapy, the therapy went faster and that the patients were able to work with the app efficiently.

Six therapists also found that there was not enough personalization in the design of the therapy goals module and that it was too structured and/or too difficult to use. The therapists thought that it was not easy to set a goal and a task and they did not like having to select a relevant area in life when setting long-term therapy goals. In addition, they thought that the evaluation of the therapeutic tasks and goals was not handily implemented. However, they found the idea of the therapy goals module useful. For example, one therapist mentioned that in face-to-face therapy the overview of goals and tasks can give patients the chance to see a pattern that reveals why some goals and tasks are or are not achieved and whether there are specific situations in which achieving those goals and tasks becomes more difficult.

"Regarding the therapy goals: I did not apply it [with patients] because it was so cumbersome, and I thought that if even I lose the overview, then my patients will for sure." (Therapist G, male)

"There was no room for personalization. You had to choose from areas to define a therapy goal. Sometimes I just put the goal somewhere, even if it was not a perfect fit, so I was creative with it" (Therapist B, female)

"How goals are done now is quite complicated, it's not how I would like it." (Therapist G, male)

"I noticed that there was a maximum number of characters that you could type. Sometimes this was a bit too limited for me. So then you are not trying to think of a suitable goal but you're thinking of a goal that fits the Luca app." (Therapist I, female)

From the data of the interviews, we also observed multiple instances of how technical instability issues decreased the level of trust in the application as a supportive tool for therapy. Especially at the start of the experiment, the Luca app suffered from technical instabilities such as crashing during use. In addition, there were a few instances when the therapists were unable to access the application due to internet connection problems. Although errors and bugs in games are quite tolerable when designing gamification in a non-mental healthcare context, they could have a considerable impact in a serious context such as youth mental healthcare. For example, two out of five of the therapists who experienced technical instabilities mentioned that this impaired their trust in the app as a therapy support tool and decreased their motivation to use the application.

"I noticed there were a lot of technical issues, which reduced my motivation to use it" (Therapist F, female)

Most of the technical difficulties were encountered in the early stage of the usage. For some therapists this may have influenced their motivation and willingness to use the application. However, to limit the negative influence on motivation and willingness, technical support was provided promptly to address these issues.

Most of the benefits cited by the participants were related to the mobility and portability aspects of the application. All the therapists saw benefits in the mobile nature of the app, such as how patients can be reminded of therapeutic tasks and goals. The therapists felt that this helped them to maximize the time utility of the therapy, as the app could link the therapy and therapy assignments to the home context of patients. They also thought that it was more interactive than the original workbook.

“Great idea, this is going to be a great success. They easily forget a workbook, but as they always carry their phone around, so that problem is solved.”
(Therapist A, female)

“It would work better than the workbook, generate more information, it would be a better reminder for patients regarding what have I learned, what did we discuss, what were my goals? And that I could make use of it in between [the therapy sessions]” (Therapist E, female)

The chance for patients to perform their tasks immediately and record their progress was another positive factor that was cited. In the Netherlands, around 99 % of the youngsters and adolescents aged 12-25 years old own a smartphone [29]. As most users already use their smartphone for other leisure-related activities, they did not have to add another device to their daily routine. This makes it easier for them to perform therapeutic tasks more regularly.

5.6.2. DISTORTION OF THERAPEUTIC ALLIANCE BY EHEALTH AND GAMIFICATION

Because the Luca experiment ran at a youth mental healthcare and a youth addiction care center with different types of patients and therapy protocols, it was important that patients in the experiment received CBT at the earliest stage of their therapy. Otherwise, there were too many other elements that could influence the effects. We thought that the gamification would enhance the motivation of patients for behavioral change. However, we observed several incidences where this expectation conflicted with existing therapeutic practice.

Our interview data showed that the therapists prefer to motivate patients themselves before employing the gamification and eHealth application. During the interviews, therapists explained that patients are often not motivated for behavioral change at the start of therapy. Therefore, therapists generally start therapy by first focusing on enhancing the patients' motivation by applying motivational interviewing. In addition, therapists work on building initial trust with their patient, allowing them to work together in an effective way. This "therapeutic alliance" is also an indicator for positive therapy outcomes [35].

"Making contact is important, I would not use the Luca app immediately after intake." (Therapist E, female)

"...and on the other hand, if I introduce it during the intake or the first therapy session, they [patients] are a bit hesitant. So I apply it at a later stage, and start by enhancing motivation [by personal face-to-face therapy]." (Therapist G, male)

Despite the purpose of adding gamification to the application to enhance motivation, the therapists seem to prefer to initially motivate patients for therapy themselves, rather than to rely solely on the gamification aspect of the system. In the interviews, four therapists mentioned this issue explicitly. Enhancing the motivation of patients for behavioral change, and lowering ambivalence to change, is often performed using motivational interviewing which improves therapy engagement and outcome (e.g. [327] for substance abuse). As designers, we had thought that gamification would enhance this motivation, but gamification designers have to be realistic about the potential and suitability of gamification in therapeutic practice and have to account for the preferences of therapists in enhancing the motivation of users (i.e. patients). It should also be mentioned that some patients remain unmotivated no matter what system is presented to them. Four therapists mentioned that certain patients cannot be motivated to adhere to their therapy. In some cases, this is because patients are only motivated to adhere to their therapy in a limited way and want to focus on working directly on their problems, rather than engaging in additional activities, even those which can make therapy more fun.

“Some of the youngsters thought it was really a significant achievement that they were in therapy at all, and did not want to invest any more time [using Luca / participating in Luca experiment].” (Therapist B, female)

“...I was really surprised that some patients thought that it [using the Luca app] was not for them.” (Therapist H, female)

5.7. DISCUSSION: REFLECTION AND LEARNINGS FOR EHEALTH DESIGN

Overall, a number of challenges were encountered throughout the process of designing the ReadySetGoals application. Similar to serious games and gamifications in other domains, there is an expectation for the designed game to not only be entertaining for users but also to motivate them to realize a specific, beneficial real-world effect [328]. In mental healthcare gamifications, these benefits and the gamified underlying activity are generally situated within a therapeutic context where the treatment process involves active participation from various stakeholders (care managers, therapists etc.), each with their own set of expectations. Therefore, it was essential to incorporate the feedback of the patients as well as the therapy specialists and practitioners, especially during the early stages of the design process, and to establish clear communication with the stakeholders. In particular, the formulation of a core game loop model to show how the game mechanics relate to the underlying therapeutic process was useful in bridging the gap of understanding between professional game designers and clinical staff and facilitating a fruitful discussion.

5.7.1. MANAGING STAKEHOLDER EXPECTATIONS THROUGH FRAMING

One key learning highlighted in this study is the importance of careful framing and communication about the nature of a therapeutic gamification, to help manage stakeholder expectations. A particularly interesting observation was how the dual (and often unclear) nature of a mental healthcare gamification as both a “game” and a “therapeutic tool” caused a conflict in expectations with patients and care staff. The expectations held of a “therapeutic tool”, namely to fulfil a serious role in supporting therapy and improving well-being in the real

world seemed inconsistent with the expectations of a game, which is mostly viewed as a non-serious way to provide entertainment for players in a context distinct from the real-world. In addition, when patients viewed the gamification as a “game”, it lacked the usual characteristics of their expectation of “entertainment games” (by not having an immersive storyline etc.). For those with high expectations, these inconsistencies made the gamification less appealing. However, if the real-world therapeutic aspect is less evident than the game world aspect, patients and staff become skeptical about the benefits and are less inclined to accept the game in their therapeutic context.

One example from the qualitative evaluation with therapists was their interpretation of the gamification as a therapy-supportive application. Most therapists viewed and evaluated the application from the perspective of a blended e-health therapy tool but found it difficult to integrate the application into therapeutic practice. For example, the use of language in the application caused confusion as it did not relate clearly to specific therapy protocols. In addition, the structure of the application did not fit the structure of specific therapy protocols and therapists wanted to enhance the motivation of patients first, before applying the eHealth application.

Processes similar to that of framing could be particularly beneficial in helping to align user expectations. To enhance the framing of the app as a therapy-supportive application in youth mental healthcare, one should make explicit **what and how** such an app can do to support both therapists and patients. This will prevent therapists from having other expectations or concerns such as that eHealth and gamification will distort the therapeutic alliance. The value of framing in making certain aspects of information more salient and therefore more noticeable and meaningful to audiences [329] could also help highlight the perceived therapeutic value of the gamification and avoid raising unintended expectations of it simply being a “game”. For instance, some researchers cautioned on using the word “game” when describing the system to players as it could raise unintended expectations and demotivate them to engage with it [245]. Equally, we cannot frame the app as a “therapeutic application”. In this case, therapists may have expectations of the application being a medical application that strictly follows a specific therapy protocol.

What was particularly interesting was how the design of the gamification itself could have a similar effect in “framing” the gamification for users. The staff seemed initially to be more positive towards such “gamifications” when the gameplay mechanics could be easily understood and the underlying gaming activity could be related clearly to the desired transfer effect in a real-world. This seems to allow the perceived benefits to be more easily visualized compared to when the design is centered on a gamification activity that is too complex and cannot easily be linked to a beneficial transfer effect.

5.7.2. INTEGRATING THERAPEUTIC ASPECTS IN A GAME WORLD EXPERIENCE

Another complexity (i.e. wicked problem aspect) encountered when designing mental healthcare gamifications is that, depending on the nature of the gamified therapy or activity, the scope of the real-world context involved in the gamification can vary considerably. While gamification of simpler computerized training tasks (such as Interpretation Bias Training where users are trained to interpret ambiguous scenarios in a positive manner) is less influenced by the real-world context (as the interactions required to achieve the transfer effect are fully confined within the digital “game world”), those which are designed to support more behavioral based treatment approaches, such as the ReadySetGoals application, can be significantly influenced by the real-world context. In such treatment, achieving the desired transfer effect relies mainly on interactions in the real world. Thus, there is often a requirement for constant interaction between the game world and the real world.

A number of instances were observed where this could have unintended effects on the design of the gamification. When interactions in the real world are included in the game world, it becomes more difficult for the game designer to accurately structure the player’s experience in advance, as the game world is no longer a closed environment. As a result, certain game design approaches, such as those which stimulate gameplays of progression (where the gameplay experience is based on a structured or sequential set of challenges [330]), become more difficult to implement as this requires the designer to carefully control the scope of the players experience [331]. For

example, in the ReadySetGoals gamification, a key element to the implementation of the risk-taking mechanism is to understand how challenging the tasks are for players, so that more points can be awarded when players take risks to accomplish tasks with higher difficulty levels. However, since the real-world experience varies greatly for each patient, it is very difficult to know beforehand how challenging the tasks will be. In some cases, the real-world experience can even override the experiences of the intended game rules (for instance, the real-world task could be so easy as to negate the time-pressure challenge from the risk-taking mechanic). Such problems highlight the problem of accurately integrating real-world aspects within healthcare gamifications.

Another example which we encountered was related to the motivational affordance of gamification. There was a conflict concerning whether increasing the motivation of patients should be the role of the gamification or of the therapist. We thought that gamification would motivate patients for behavioral change and that therapists would also motivate the patients independently. However, there was a problem when combining both. According to the therapists who participated in the interviews, they felt that it was necessary to first enhance the motivation of patients for behavioral change and to build a therapeutic alliance, before employing gamification and eHealth applications. We had thought that the gamification could enhance this motivation for behavioral change, but this did not suit the routines used by the therapists as part of their practice. Therefore, designers should be flexible when applying and studying an eHealth application and gamification in the therapeutic process. For example, by providing more scope in the design for enhancing a therapeutic alliance during the initial therapy sessions.

5.7.3. THE VALUE OF PERSONALIZATION IN YOUTH MENTAL HEALTHCARE GAMIFICATION

To better integrate real-world elements within the game world, it is essential for the gamification to be able to correspond to a broad range of patient characteristics and context. Providing a real-world experience that users can relate to would make them more aware of the potential therapeutic benefits of the youth mental healthcare gamification, thus helping to better manage user

expectations. In the interview study, the therapists thought that the gamified and non-gamified therapy goals module of the Luca app was too structured and inflexible for a variety of patient types. In designing the application, we aimed for room for personalization of therapy goals but we also needed a structure to preserve an overview of the relationships between long-term and short-term therapy goals. To this end, we structured the way long-term therapy related goals can be set and defined categories for goals in the form of life areas to help patients and therapists to set long-term therapy-related goals. We had discussed procedural task generation for goal setting, but found it too complex to generate goals which would both fit with user interest (in this case the patients) as with the overall therapeutic outcome. However, the life areas were too diverse and not always suitable for each therapy goal. Lastly, according to therapists, gamification may not be suitable for every type of patient: gamification may be more suitable for younger adolescents than older adolescents, since younger patients may not see the importance and necessity of actively adhering to therapy and corresponding therapeutic tasks.

One approach which we believe could be useful in helping to better manage user expectations is the use of personalization, adaptation and tailoring techniques in the gamification [204]. This could be done either explicitly by manually personalizing the game content (such as through a shared decision-making process with stakeholders) or more implicitly, through automatic adaptation based on a player modelling technique (see [332]). Adaptive techniques which are able to automatically adjust the level of challenge based on performance in the real-world (such as [333]) could also be particularly useful. Such mechanisms allow for a better control over the influence of real-world aspects in the game.

5.8. CONCLUSION

In this paper, we discussed in detail the process used to design, develop, and improve the ReadySetGoals application, a gamified mobile application aimed at supporting therapy within youth addiction care. The overall process involved four key stages in which various formative research methods were utilized with 53 participants from varying backgrounds (professional game

designers, therapists etc.). These stages include identifying the transfer effect, investigating the real-world context, creating a core game loop and iterative development and testing, first with general users and then with the targeted audience and care staff. Afterwards, we implemented the improved ReadySetGoals gamification as a module within a therapy support application called “Luca” which was not only used in youth addiction care but also in youth mental healthcare.

The overall design process provided several valuable lessons and reflections for designing mental healthcare gamifications. This includes the value of user-centered design approaches to incorporate stakeholder feedback throughout the design process and aligning user expectations through framing. The Research through Design methodology was particularly useful in this regard with the various artefacts and prototypes at each iterative stage serving both to generate situated design knowledge as well as to align stakeholder expectations. In addition, we also discussed how the interactions between the game world and the real world could cause difficulty in gameplay design, especially when real-world elements are incorporated with traditional game mechanics.

Usage of new eHealth by therapists is essential to successfully conduct an evaluation study on eHealth outcomes and adoption of eHealth by therapists is essential for future successful implementation of eHealth in a healthcare system. Even though we trained therapists in the use of the Luca app and gamification and we reminded them of the study, there are some lessons to be learned from the therapists that were interviewed. Firstly, therapists need to be better informed about the beneficial effect of gamification and the fittingness of gamification with individual users. Therapists that participated in the interviews thought that gamification would be more motivating for younger adolescent patients compared to older ones. However, they do not know for certain if this is actually the case. Since therapists are fairly cautious in applying new tools in therapy, as they do not always see the benefits, the gamification should be designed in such a way that it is flexible and allows for a return to a non-gamified intervention if players do not find it motivating. We expect that this will make therapists less cautious in applying gamification in

therapeutic practice with a variety of patients, as they can always go back to a “normal” non-gamified version. In addition, it is important to manage the stakeholder expectations of eHealth by informing therapists in detail about the fittingness of eHealth with face-to-face practice. For example, the fact that eHealth is not a copy-paste of the therapy protocol but supports general assignments and tasks of CBT that a patient can execute outside a therapy room. Lastly, therapists need to know when eHealth and gamification can be applied in the therapeutic process. For example, therapists thought that eHealth and gamification distorted the therapeutic alliance and wanted to enhance the motivation of patients for behavioral change themselves, before applying eHealth and gamification. Therefore, it is important to explicitly allow therapists the freedom to apply eHealth and gamification when they think it is most suitable in a design process, so that it does not distort the therapeutic alliance. Even though this may conflict with a study set-up, it will enhance future adoption and the influx of new participants in an evaluation study.

One of the limitations of this study is that the used research methods were mainly generative or formative in nature. Although these methods are essential in providing answers to the questions encountered during the development of the gamification, more research is needed to properly evaluate the effectiveness of the desired transfer effect of ReadySetGoals (see [334]). In particular, a key disadvantage of the Research through Design approach is the blurring of the overall transfer effect. For example, would the factors found in this design stage that make the game more entertaining also make the overall gamification more effective health-wise? In the future, experimental studies need to be carried out to compare the effectiveness of a gamification integrated in a therapeutic approach as opposed to regular therapy. Another limitation is that the presented case study focuses on a specific therapeutic domain, i.e. youth mental health and addiction treatment health care, and treatment type, i.e. Cognitive Behavioral Therapy. To develop a generalizable framework, the sequential design stages need to be tested with gamifications designed for other therapeutic domains and treatment types.

The key contribution of this paper is to provide more knowledge about designing gamifications for the mental healthcare domain. A detailed description of the structural process used to develop the ReadySetGoals application as well as the reflected learnings of gamification design in this context are provided. In addition, case-specific examples of the various methods used to address the challenges encountered at each stage of the design process are also provided to add more bottom-up knowledge to this domain. In the future, the structural design processes employed in this study can be used as the basis for the development of a generic framework for gamification in mental healthcare.

6.

GENERAL DISCUSSION AND IMPLICATIONS

This chapter describes the implications of the previous described chapters and provides suggestions for future research.

The aim of this dissertation was to study the added value of personalized gamification in eHealth as a design factor to enhance implementation potential of eHealth interventions in youth mental healthcare. EHealth interventions in mental healthcare are often focused on the therapeutic content and provide limited interaction motivation for the users causing much drop-out in usage (e.g. [335, 336]). When transforming an existing face-to-face therapy into a blended eHealth therapy, users should be motivated to use the eHealth product. This motivation can be enhanced by using gamification as a design technique. Based on theory and previous studies, Persuasive Game Design seemed successful to enhance this motivation and consequently the efficacy and implementation of Persuasive Game Design (e.g. [63, 260, 337, 338]). Since there was a lack of research on successful implementation techniques of gamified eHealth interventions, personalization was suggested as a design technique for a successful implementation. However, clear and shared concepts of what personalization entails and the effects on health related outcomes were lacking.

Since the nature and effect of personalization in persuasive game design had never been systematically studied, and thus making assumptions regarding the benefits of personalization ungrounded, we conducted a literature study and developed a model to study the interaction experience, behavior and health related transfer effects of personalization in persuasive game design for healthcare (**Chapter 2**). We defined ‘personalization’ in this thesis as the involvement of stakeholders (e.g. end-users and domain experts) across the Personalized Design Process (PDP) phases: Problem Definition, Product Design and Tailoring. Our literature review showed that in the current design processes stakeholders were most often involved in the Product Design and Tailoring phase. Because a majority of the studies were of low methodological quality, we could only suggest that it is important to involve stakeholders across the PDP-phases in order to increase the alignment of the product, the interaction time with the product, and consequently to positively influence the health related transfer effect.

Personalization is also often applied in mental healthcare, such as in the application of therapy protocols in clinical practice. Therapists often adapt a

therapy protocol to the individual situation of a patient, e.g. by using the therapy protocol as a “toolbox” and choosing the tools they think fit the patients best or combining elements from therapy protocols to target multiple problems of the patient at the same time. Designers of eHealth for mental healthcare often rely on the existing therapy protocols, consisting of therapy sessions in which specific themes are discussed that are intended to evoke the therapeutic effects. However, modification of therapy protocols by therapists and patients is common practice [196]. If eHealth designers do not take the therapeutic practice of therapy protocols into account, it is more likely that the final eHealth design does not suit the therapeutic practice which in its turn negatively influences implementation.

To provide recommendations for eHealth designers on how to take this into account, we wanted to generate information about the proportion, type and reasons for personalization of a given therapy protocol by conducting focus-group discussions with patients and therapists in youth addiction care (**Chapter 3**). Results showed that therapists and patients both personalized the therapy protocol. In addition, both therapists and patients adapted the therapy and added other non-protocol therapeutic parts. Based on these results the following recommendations for eHealth designers were presented to enhance alignment of eHealth to the therapeutic practice and implementation: a) study and copy at least the actual applied parts of a therapy protocol in eHealth, b) co-design eHealth in such a way that both therapists and patients can personalize specific parts of the final eHealth design, and c) investigate if parts of the therapy protocol that are not presently applied by therapists or patients should be part of the eHealth application.

However, it was unknown how design methods could be applied for eHealth gamification within a youth mental healthcare context. Therefore, we used a specific design method with cards that represent playful experiences, to examine whether the input of playful experiences was also experienced by other end-users from the same context in the actual design itself (**Chapter 4A**). We found that using only one design method to enhance personalization is not sufficient, since the experiences that were used in the design of the

prototype did not correspond one-on-one with the experiences that were reported by other users who played the prototype. Therefore, we concluded that stakeholders (e.g. users) should be involved in multiple phases of a Personalized Design Process and not only at the start, to ensure that the product is still aligned to preferred experiences and limit possible individual preferences of stakeholder types that cannot be generalizable to the specific stakeholder type

We also wanted to study the effect of a specific design element in a youth mental healthcare context. The motivation of patients to use eHealth can be enhanced by making it more appealing, by applying Persuasive Game Design (PGD). For example, by using challenge and completion as game-elements to engage patients with cystic fibrosis to carry out flow-volume tests, where the patients assumed the role of a fireman and had to blow on a breathing apparatus in order to put out fire in the game [260]. However, it was unclear what game-elements would be suitable for gamification in the whole youth mental healthcare. Therefore, we studied if rewards (the most used motivator) would be suitable to apply within a substance dependence therapy context, as patients with substance-related disorders may be less sensitive to non-drug-related rewards than patients without a substance use disorder. Therefore, we studied differences in reward type preferences between youngsters in therapy for substance dependence and youngsters without a substance use disorder (**Chapter 4B**). Results suggested that, in contrast to our expectations, substance dependent participants were not less motivated by the types of rewards compared to non-substance dependent participants, and even more motivated by monetary rewards.

The previous chapters provided argumentation for personalization to enhance implementation of gamified eHealth. This was taken into account in the design process of an eHealth application for youth mental healthcare (**Chapter 5**). However, even when eHealth is personalized and gamified, implementation can still be negatively influenced by negative expectations of stakeholders about the effect of a therapeutic gamification, a limited integration of the eHealth product within current therapy, and a lack of personalization in the design of an application. In addition, the way an evaluation is set-up can

negatively influence implementation of an eHealth application. Personalization to the context of application is thus needed when designing eHealth, gamification and setting-up an experiment. This is useful information for future iterations of the eHealth application to enhance its implementation potential.

In sum, this thesis has provided knowledge on how to improve implementation potential of eHealth within a youth mental healthcare context. Since not all game-elements are suitable or motivating for specific users or user-groups, the gamified eHealth product should be personalized. This personalization process can be structured by using the Personalized Design Process model we have developed.

The research that is described in this dissertation was part of the NextLevel project. The broader goal of NextLevel was to generate game design principles for mental healthcare related eHealth, validate the added value of game design in eHealth, and to study whether implementation of eHealth could be facilitated by personalization design in (youth) mental healthcare.

6.1. IMPLICATIONS

The studies that are described in this dissertation have two main implications for eHealth design in youth mental healthcare. The first focusses on personalization in gamification of eHealth and that the motivational effect of gamification can be enhanced if stakeholders are more actively involved in the design phases of a gamification. The second implication notices that the set-up of effect-studies should be adapted to the context of application to limit invasiveness of therapeutic practice and to enhance feasibility of the study.

6.1.1. IMPLICATIONS OF PERSONALIZED GAMIFICATION IN EHEALTH

The implementation potential of a gamified eHealth can be enhanced if stakeholders are actively involved in the design process. Gamification can enhance motivation of users to use eHealth, but the motivational effect of game-elements can differ across users and user-groups. When a gamified eHealth product is not only designed in a co-creative way and it is possible to tailor the end-product to individual users, it is more likely that the product is

better adopted by the end-users. In this way, they not only see the necessity of the problem that the product tries to support, but are also motivated to use the product by the specific game-elements.

Personalization in (youth) mental healthcare

In (youth) mental healthcare, it is currently unclear what exact therapy protocol elements are crucial for enhancing therapeutic effects. For example, research in therapy for psychosis showed that delivering both cognitive and behavioral techniques (e.g. enhancing self-regulatory strategies) was associated with better therapy outcomes compared to partial therapy that only involved engagement and assessment [339]. However, what specific parts of the therapy significantly improved therapy-effects remained unclear. This can be studied by eliminating and adding individual therapy protocol elements while at the same time focusing on the therapeutic effect. However, since protocol elements interact, it may never be fully clear what protocol elements ensure therapeutic effects.

Therapy protocols are often personalized in face-to-face (youth) mental healthcare practice by both therapists and patients to match their personal preferences and situation (e.g. [340]). This can facilitate protocol implementation [204], enhance patients' engagement [210, 216, 341, 342] and positively influence the therapeutic alliance [343]. Therefore, information regarding crucial therapy protocol elements is important for information for therapists, so they know which elements they can and cannot personalize while still ensuring therapeutic effects. However, it is also important information for eHealth designers to limit iterations in a design, especially since there often seems to be little time or money to implement changes in already designed products [202]. Many eHealth interventions are based on a one-size-fits-all approach, e.g. by copying the therapy protocol, and are not personalized to the user and user context. This may enhance the patient's feelings that the eHealth product is unresponsive to their individual needs [344]. In addition, not aligning the eHealth product to therapeutic practice may limit implementation. For example, when eHealth does not suit how therapists use the therapy protocol (making the intervention less flexible and personalized, e.g. to maintain or enhance motivation in patients to change) or

if therapists have negative expectations about the benefits of eHealth compared to face-to-face therapy [199-201]. For successful implementation within this context, both therapists and patient as user are important to take into account.

Designing blended eHealth to support youth mental healthcare

Therapists noticed that patients in youth addiction care found it difficult to think of non-substance related activities. We therefore decided to design a blended eHealth to increase the reach of traditional face-to-face therapy, and to support homework compliance of therapy [345]. More specifically, we focused on leisure-related goal-setting and provided patients with pre-set leisure goals they could select. However, patients did not find these goals challenging nor personally relevant and wanted more freedom in setting goals. An important lesson that can be drawn by this, is that what an end-user wants does not have to be in line with what others may think end-users need and that it is important to take the time to get to know this user-information. We therefore enhanced personalization in goal-setting by letting therapists and patients choose their own therapy goals instead of letting them select pre-set goals.

We designed the ReadySetGoals application to support goal-setting in youth mental healthcare, a method that is used in therapy for multiple disorders in (youth) mental healthcare and other contexts. However, it is possible that the motivating effects of the chosen game-elements and/or method of goal-setting are different between different types of patients in youth mental healthcare. For example, patients with addiction problems generally have significantly higher levels of impulsivity and sensation-seeking personality traits [346] while patients with depression problems generally have higher levels in traits such as neuroticism and conscientiousness. It can be assumed that individuals with different personality traits are more motivated by different game-elements. For example, individuals with higher sensation seeking and impulsivity levels seem to be more motivated by a “betting” system compared to individuals with higher levels of conscientious [347]. One option to cover this, is by tailoring the game-elements to the personality type of the patient.

Tailoring game elements in eHealth

When tailoring a product to individual users, one can also choose to connect game-rewards to personality traits. Tailoring games to specific personality types has already been done in the Hexad framework [282]. This framework categorizes users into six types of player personalities loosely related to the Big Five personality traits. In addition, research has shown that the personality of individuals plays a large role in the perceived persuasiveness of various persuasive strategies used in healthcare contexts [347]. Furthermore, research showed that individuals with higher levels of sensation seeking and impulsivity are more motivated by thrill and use of rewards [298]. However, it may be that personality profiles, as defined in “real life”, are different in the context of (serious) games. For example, someone might be a socializer in a (serious) game context but an achiever in a (real life) working context. A user thus can have multiple identities, both in a real and game world, since they might want to achieve and experience different things in different contexts. It may also be that there is one consistent factor present in both worlds, but this should be investigated.

Goal-setting in different contexts

The general structure of goal-setting, first setting long-term goals followed by short-term tasks that work towards the long-term goal(s), is the same in different contexts. However, there are also some differences in goal-setting across contexts. For example, goal-setting in a face-to-face physical rehabilitation context is different from goal-setting in a youth mental healthcare context. In physical therapy, a physical therapist/physiotherapist first identifies the physical goal(s) of the patient (e.g. being able to play field hockey again) and sets-up a plan of shorter-term goals that need to be achieved in order to reach the long-term goal(s). A patient has to physically perform the tasks, in order to reach the longer-term goals. In (youth) mental healthcare, the goals are a different type of behavioral goals (e.g. do not smoke cannabis), but in the end aim to improve the psychological aspect of a patient (e.g. improve a relationship with a family member). Therefore, it may be interesting to design a gamified eHealth application to help patients with goal-setting in a different context. Since the ReadySetGoals application already

motivated patients in youth mental healthcare to set and achieve goals, and the problem (enhancing motivation of users to set and achieve goals) is the same in different contexts, other users should be involved in the product design phase to improve and align the ReadySetGoals to the new user context. These other users from a different context should first evaluate the already designed ReadySetGoals application. Firstly, to see how suitable the way goal-setting is designed would be within their context and secondly, to see how motivating they find the game-elements.

Effects of personalized gamification in eHealth

There may be multiple reasons why personalized gamification in eHealth may have a positive effect on interaction motivation and corresponding health related transfer effects. With personalized gamification of eHealth, one aligns the design to the preferred experience, capacity and context of a user (e.g. as suggested by [202]). Often, eHealth design focusses more on the content (such as therapy techniques and elements) than on the interaction with the actual user [348]. This may result in a mismatch between the design, user experience, capacity and context and as a consequence enhance drop-out rates and lower implementation potential. For example, individuals with specific personality traits are more motivated by some experiences than others (e.g. [347]). In addition, some contexts of use may be more suitable for specific designs than others. For example, an application that aims to enhance physical activity is more suitable for someone that has the space and freedom compared to someone that has to stay in a hospital bed for a longer period of time.

Often, the problem that the to-be designed product aims to solve is defined by others than the user (e.g. designers of therapy programs, managers, etc.). However, it is possible that the problem is not experienced by the users themselves. This will lower implementation, because they do not see the importance of the eHealth product. Therefore, future eHealth designers are advised to also involve both patients and therapists when choosing the problem that a gamified eHealth product will focus on. Especially experienced patients should be involved, since they already have experience with therapy and the difficulties they encountered during their therapy process. For

example, these type of patients know what therapy-items influenced their therapy adherence, and can have a clearer idea of what is required within the eHealth design to support them within this process. Involving patients is already being done within a youth mental healthcare context, where the problem that mental health therapy will focus on is defined at the start of therapy by both therapists and patients. A patient usually first presents with one or multiple mental health issues and the therapist and patient together decide what type of therapy will be used to tackle the mental health problem(s). This is done by using suggestions from the therapists in order to select the right evidence-based type of therapy and to tackle the patient's problem and the patient preferences [349-351]. In this way, the therapy suits the context and capacity of the patient.

Limitations of personalization in gamified eHealth

When designing the gamified eHealth product, one should keep in mind that there is a limitation regarding the amount of personalization during the design process. Stakeholders, like therapists and patients, should be involved and provide input for the designer. However, the actual design should be done by the designers since they are the most experienced in this aspect (e.g. to implement stakeholder's insights into the design). Therefore, it is important for a designer to guide users and other stakeholders in this process and ask the right questions about their interests, capacity and context. Enhancing the engagement of specific individuals within a user group can be done by tailoring the product. This is important, since a product will never fully suit all users within a user group. By tailoring a product, one can focus more on enhancing the engagement of specific users. Next to the beneficial effects on motivation and health related outcomes, the added value of this type of personalization as a design technique is also the easiest type to test. For example, by comparing an eHealth application that uses only general therapy parts with an eHealth application that also consists of other problem-specific modules that can be tailored to the individual patient.

Most importantly, designers and researchers should make explicit what is personalized in an eHealth design. This will benefit further structuring of the personalization process, which is important for designers and researchers to

clarify how they have applied personalization and what personalization aspects are effective. Personalization in the first phase of a PDP (problem definition) may be more difficult compared to personalization in the other two phases of a PDP. When defining the problem that the product aims to solve, it is important that the problem is also acknowledged by the users themselves. Otherwise, it may be possible that a product is designed but not experienced as needed or necessary by the target group.

Effects of personalized gamification in eHealth

However, the effect of personalization compared to no personalization across a whole PDP has not been studied yet. The results of the studies described in this dissertation only suggest that personalization across all phases can enhance motivation and/or engagement to interact with an eHealth product. In the literature, personalization has shown beneficial effects in product design and tailoring. For example, by using health related behaviors of users to motivate them for weight loss [352] or tailoring content to motivate users to adhere to their medication by using their own input [353]. An interesting question that arises when focusing on the PDP, is when there is enough personalization in a product. For example, if one has to personalize a product based on age, type of disorder, cultural background, and/or the gender of the user. In general, there should be a balance between the amount of money and time spent and the amount of personalization that is put into a product. This is because it is impossible to perfectly personalize a product and there should be a moment when personalization can be seen as “enough”.

Concluding, this dissertation showed that the implementation potential of a gamified eHealth can be enhanced if stakeholders are actively involved in the design process. Since eHealth is often focused on the therapeutic content instead of enhancing interaction motivation, personalized gamification can enhance motivation of users to use a product [298, 318] and that they see the necessity of the problem that the product tries to support. However, the effect of personalization compared to no personalization across a whole PDP has not been studied yet and results of the studies described in this dissertation only suggest that personalization across the whole PDP can enhance motivation and/or engagement to interact with an eHealth product.

6.1.2. IMPLICATIONS FOR THE SET-UP OF FUTURE EHEALTH EVALUATION METHODS WITHIN THIS FIELD

When trying to study the added effect of gamification and personalization, we noticed that the set-up of the evaluation study was not matching the therapeutic practice. This is needed to limit invasiveness in the context of application and to enhance implementation potential of the study in therapy practice. If the set-up of an evaluation method is not aligned to the context of application, it will be more difficult to successfully run the study. Especially when therapists are crucial for the influx of patients, and the set-up of the evaluation method does not suit current therapeutic practice, they will be less motivated to do extra work such as motivating patients for participation or use an extra product during therapy.

When the ReadySetGoals was implemented in the Luca app as a therapy-goals module, we wanted to study the beneficial effect of gamification. Being the golden standard evaluation method, we therefore started a non-randomized pre-post study and contrasting the Luca app with a gamified therapy-goals module to the Luca app with a non-gamified therapy-goals module. However, the inflow of patients in the Luca study was low, and at the time of writing it was uncertain whether the study could be finalized as planned according to our protocol. Since patients from both youth addiction care and youth mental healthcare would participate in the study, we thought it was important to keep some elements in the set-up of the study as constant as possible. For example, patients could only participate if they were at the start of their therapy and if they received individual Cognitive Behavioral Therapy. However, we noticed that because patients could only participate if they were at the start of their therapy, therapists often did not inform their patients about the experiment. Therapists found it more important to first build a therapeutic relationship with their patients, one of the factors related to better therapy retention of patients (e.g. [354]), before they started therapy and wanted to mention the existence of the application and study. When we set-up the study, we should have taken this into account and make the start of a study more flexible (e.g. start introducing a study after the therapeutic alliance has been build). In addition, we should have made clear what we meant with CBT, since therapists found the definition of CBT unclear. For example, in youth mental

healthcare different types of therapy protocols are often combined due to comorbidities, compared to youth addiction care. Therefore, the content of what is considered CBT often differs between the two contexts, which makes it important for researchers to make it explicit when they consider CBT to be CBT.

If a study set-up is not in line with the current therapeutic practice, therapists and patients may thus not be fully willing to participate in an experiment. In addition, different types of evaluations could be more suitable within specific contexts than others. The classical validation methods that use randomized controlled trial procedures do not seem to be suitable enough to measure the potential of gamification and serious games [178]. For example, since the practice of RCTs is different and much stricter compared to therapeutic practice. Therefore, one should try to find methods that can study the beneficial effects of personalization within this context. For example, it could be that multiple $N = 1$ studies are more suitable within this context. With multiple $N = 1$ studies, less participants are needed who are more intensively followed compared to those in RCTs. This would indeed mean that more time and effort is needed by participating patients and therapists, but also that only a few participants are needed to test the effect of an intervention. For example, if a few therapists participate in a study they would only need to involve one or two patients instead of a large number. However, it is also possible that multiple $N = 1$ studies are less suitable for this context, since patients often have comorbidities. This would make it difficult to generalize the results of a few patients to a whole patient population. To reduce the risk that psychological improvements are due to the treatment-as-usual, it can also be suitable to use multiple baseline studies within a (youth) mental healthcare context. Multiple baseline studies, same as multiple $N = 1$ studies, are much more flexible in implementation and evaluation of interventions than the large studies such as RCT's [355]. With these type of studies, the moment a patient starts with participating in the study differs. In this way, the best moment for implementing the product will be known. This knowledge can be used by therapists. In addition, the continuous assessment allows detailed examination of patterns of change over time. However, results of multiple-baseline and $N=1$ studies lack generality of obtained effects which is especially

a limitation in a context where individuals can have multiple problems (i.e. comorbid disorders such as in youth mental healthcare) [355].

Another possibility that can enhance the feasibility of a study set-up is the involvement of likewise participants that will participate in co-creating the set-up of a study. Especially in studies that are run in mental healthcare contexts, therapists are the ones who have to recruit patients. Since they are experts in current therapeutic practice, they can help in aligning the set-up of an experiment to this context. When we interviewed therapists in the focus group discussions, we discovered that their main reason for not explaining the experiment to their patients was that they wanted to enhance the therapeutic alignment with and motivation of their patients first. If we knew that the start of the Luca experiment should have been with this offset of delay in the therapeutic process, this threshold could have been prevented.

6.1.3. IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH AND EHEALTH DEVELOPMENT

The studies described in this dissertation are relevant for design researchers and healthcare professionals. Design researchers now have an understanding of personalized design in healthcare (Chapter 2) and know how they can align a design to youth mental healthcare (Chapter 3). In addition, they know that different game design methods are needed when focussing on the personalisation of experiences in design (Chapter 4A) and that game elements can be implemented to motivate youngsters in an addiction care context (Chapter 4B). Lastly, they can use the learnings from our exemplary design implementation case (Chapter 5). Healthcare professionals now have additional information that there is a difference between therapy protocols and the therapeutic practice of these therapy protocols. They can use this information to improve therapeutic practice, e.g. by updating therapy guidelines, providing training and/or more supervision to ensure evidence-based therapeutic practice (Chapter 3). In addition, healthcare professionals know that rewards are as motivating for youngsters with substance dependence compared to non-dependent youngsters and that monetary rewards are even more motivating for youngsters with substance dependence, even though youngsters with substance dependence have an overall

decreased reward sensitivity. This might be an extra motivation for healthcare professionals to apply (monetary) rewards to motivate youngsters with substance dependence to engage and remain in therapy (Chapter 4B). Lastly, healthcare professionals can use our case-study learnings for development and implementation of gamified eHealth (Chapter 5).

Based on the description of the design process of our gamified eHealth therapy, we recommend design researchers to link high quality research to the development of gamified eHealth. More precise: design researchers are recommended to study the effects of the whole design and the effects of specific design-elements (e.g. the effects on willingness or motivation to use the design, health-related effects, etc.). Currently, we cannot draw definite conclusions about whether and when involving stakeholders in a Personalized Design Process has added value in terms of effect. Therefore, research is needed to test the effect of the product and to ensure that the aim is achieved. Today, many eHealth applications are on the market of which the efficacy has not been established. This is really important, in order to prevent possible negative effects [356], especially if users only rely on eHealth. Since 2018, The National eHealth Living Lab (NeLL) facilitates the development and validation of and research on eHealth in multidisciplinary teams. For example, they have found that patients with COPD cannot trust on eHealth apps and websites because of limited or non-existing evidence [357]. Therefore, it is important to test the effect of an application before bringing it to the market. The PDP can be used as a structure for designing eHealth. This will enhance the chance of a successful implementation and that the product does what one wants it to do.

The gamification and eHealth in this dissertation focused mainly on the patient as an end-user in a youth mental healthcare context. However, a youth mental healthcare context consists of more stakeholders than just patients, like therapists and managers. Stakeholders are important for development of eHealth (gamified or not gamified) when they can help to align the product to the context and user's preferences, needs and competences, which in turn can enhance motivation of users to interact with the product and consequently implementation potential. This is because stakeholders with different expertise (e.g., in design, the health context, or in their own

preferences) have different points of view and can provide more complete insights into what the product should consist of and focus on. In addition, involving stakeholders can help to manage their expectations with regard to the intervention through framing. For example, negative expectations of therapists, important for implementation in therapeutic practice, about the benefits of eHealth compared to face-to-face therapy [199-201].

Design researchers should make explicit **what** a gamified eHealth application can support both therapists and patients and **how** this is possible, and convince them that eHealth and gamification will not distort the therapeutic alliance. One could do this by making demos with examples of often-used therapeutic situations that one can recognize.

To conclude, it is important to integrate therapeutic aspects when designing personalized and gamified eHealth and setting-up studies to test the effects of such eHealth applications. However, there is also a limitation regarding practical feasibility concerning the amount of stakeholder involvement. It is essential that these types of applications are able to correspond with therapeutic practice and a broad range of patient characteristics. EHealth designers have to know why and how patients and therapists personalize their therapy, in order to identify the parts in eHealth design that should be open to personalization in order to facilitate engagement and implementation, while still ensuring positive therapeutic effects. A designer can work on the above aspects by collaborating with all stakeholders in specific contexts, which can be structured by using the Personalized Design Process model. It is expected that the above will enhance implementation and improve the effect of gamified eHealth.

REFERENCES

- [1] J. Ormel *et al.*, "Mental health in Dutch adolescents: a TRAILS report on prevalence, severity, age of onset, continuity and co-morbidity of DSM disorders," *Psychological Medicine*, vol. 45, no. 2, pp. 345-360, 2015.
- [2] R. C. Kessler *et al.*, "Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's World Mental Health Survey Initiative," *World Psychiatry*, vol. 6, no. 3, pp. 168-176, 2007.
- [3] E. Hazen, S. Schlozman, and E. Beresin, "Adolescent psychological development: a review," (in eng), *Pediatr Rev*, vol. 29, no. 5, pp. 161-7; quiz 168, May 2008.
- [4] L. Steinberg, "Cognitive and affective development in adolescence," (in eng), *Trends Cogn Sci*, vol. 9, no. 2, pp. 69-74, Feb 2005.
- [5] D. A. Sturman and B. Moghaddam, "The neurobiology of adolescence: Changes in brain architecture, functional dynamics, and behavioral tendencies," *Neuroscience & Biobehavioral Reviews*, vol. 35, no. 8, pp. 1704-1712, 2011/08/01/ 2011.
- [6] S. Burnett and S.-J. Blakemore, "The Development of Adolescent Social Cognition," *Annals of the New York Academy of Sciences*, vol. 1167, no. 1, pp. 51-56, 06/24 2009.
- [7] R. W. Larson, G. Moneta, M. H. Richards, and S. Wilson, "Continuity, stability, and change in daily emotional experience across adolescence," *Child development*, vol. 73, no. 4, pp. 1151-1165, 2002.
- [8] R. C. Kessler, C. L. Foster, W. B. Saunders, and P. E. Stang, "Social consequences of psychiatric disorders, I: Educational attainment," *The American journal of psychiatry*, vol. 152, no. 7, p. 1026, 1995.
- [9] D. M. Fergusson and L. J. Woodward, "Mental health, educational, and social role outcomes of adolescents with depression," *Archives of General Psychiatry*, vol. 59, no. 3, pp. 225-231, 2002.
- [10] D. M. Fergusson, I. J. Horwood, and E. M. Ridder, "Show me the child at seven: the consequences of conduct problems in childhood for psychosocial functioning in adulthood," *Journal of Child Psychology and Psychiatry*, vol. 46, no. 8, pp. 837-849, 2005.
- [11] S. L. Andersen, A. Tomada, E. S. Vincow, E. Valente, A. Polcari, and M. H. Teicher, "Preliminary evidence for sensitive periods in the effect of childhood sexual abuse on regional brain development," *The Journal of neuropsychiatry and clinical neurosciences*, vol. 20, no. 3, pp. 292-301, 2008.
- [12] L. M. Bylsma, B. H. Morris, and J. Rottenberg, "A meta-analysis of emotional reactivity in major depressive disorder," *Clinical Psychology Review*, vol. 28, no. 4, pp. 676-691, 2008/04/01/ 2008.
- [13] D. A. Brent and D. J. Kolko, "Psychotherapy: definitions, mechanisms of action, and relationship to etiological models," (in eng), *J Abnorm Child Psychol*, vol. 26, no. 1, pp. 17-25, Feb 1998.
- [14] D. Cottrell and P. Boston, "Practitioner review: The effectiveness of systemic family therapy for children and adolescents," *Journal of Child Psychology and Psychiatry*, vol. 43, no. 5, pp. 573-586, 2002.

References

- [15] M. A. Reinecke, N. E. Ryan, and D. L. DuBois, "Cognitive-behavioral therapy of depression and depressive symptoms during adolescence: a review and meta-analysis," *Journal of the American Academy of Child and Adolescent Psychiatry*, vol. 37, no. 1, pp. 26-34, 1998.
- [16] S. Cartwright-Hatton, C. Roberts, P. Chitsabesan, C. Fothergill, and R. Harrington, "Systematic review of the efficacy of cognitive behaviour therapies for childhood and adolescent anxiety disorders," *British journal of clinical psychology*, vol. 43, no. 4, pp. 421-436, 2004.
- [17] J. R. Weisz *et al.*, "What five decades of research tells us about the effects of youth psychological therapy: A multilevel meta-analysis and implications for science and practice," (in eng), *Am Psychol*, vol. 72, no. 2, pp. 79-117, Feb-Mar 2017.
- [18] S. T. Gaynor, P. S. Lawrence, and R. O. Nelson-Gray, "Measuring Homework Compliance in Cognitive-Behavioral Therapy for Adolescent Depression Review, Preliminary Findings, and Implications for Theory and Practice," *Behavior modification*, vol. 30, no. 5, pp. 647-672, 2006.
- [19] B. T. Mausbach, R. Moore, S. Roesch, V. Cardenas, and T. L. Patterson, "The relationship between homework compliance and therapy outcomes: An updated meta-analysis," *Cognitive Therapy and Research*, vol. 34, no. 5, pp. 429-438, 2010.
- [20] E. Hans and W. Hiller, "Effectiveness of and dropout from outpatient cognitive behavioral therapy for adult unipolar depression: A meta-analysis of nonrandomized effectiveness studies," *Journal of Consulting and Clinical Psychology*, vol. 81, no. 1, p. 75, 2013.
- [21] H. Xiao, J. A. Hayes, L. G. Castonguay, A. A. McAleavey, and B. D. Locke, "Therapist effects and the impacts of therapy nonattendance," (in eng), *Psychotherapy (Chic)*, vol. 54, no. 1, pp. 58-65, Mar 2017.
- [22] V. Dale *et al.*, "Exploring treatment attendance and its relationship to outcome in a randomized controlled trial of treatment for alcohol problems: secondary analysis of the UK Alcohol Treatment Trial (UKATT)," (in eng), *Alcohol Alcohol*, vol. 46, no. 5, pp. 592-9, Sep-Oct 2011.
- [23] A. M. de Haan, A. E. Boon, J. T. de Jong, M. Hoeve, and R. R. Vermeiren, "A meta-analytic review on treatment dropout in child and adolescent outpatient mental health care," *Clinical Psychology Review*, vol. 33, no. 5, pp. 698-711, 2013.
- [24] G. Eysenbach, "What is e-health?," *Journal of Medical Internet Research*, vol. 3, no. 2, p. e20, 2001.
- [25] C. Pagliari *et al.*, "What Is eHealth (4): A Scoping Exercise to Map the Field," *Journal of Medical Internet Research* vol. 7, no. 1, p. e9, 3/31 2005.
- [26] H. Oh, C. Rizo, M. Enkin, and A. Jadad, "What is eHealth (3): a systematic review of published definitions," *Journal of Medical Internet Research* vol. 7, no. 1, p. e1, 2005.
- [27] G. Andersson, P. Cuijpers, P. Carlbring, H. Riper, and E. Hedman, "Guided Internet-based vs. face-to-face cognitive behavior therapy for psychiatric and somatic disorders: a systematic review and meta-analysis," (in eng), *World Psychiatry*, vol. 13, no. 3, pp. 288-95, Oct 2014.

- [28] I. Titzler, K. Saruhanjan, M. Berking, H. Riper, and D. D. Ebert, "Barriers and facilitators for the implementation of blended psychotherapy for depression: A qualitative pilot study of therapists' perspective," *Internet Interventions*, vol. 12, pp. 150-164, 2018/06/01/ 2018.
- [29] (2018, December 28). *Internet; toegang, gebruik en faciliteiten*.
- [30] S. Helbig and L. Fehm, "Problems with homework in CBT: Rare exception or rather frequent?," *Behavioural and cognitive psychotherapy*, vol. 32, no. 3, pp. 291-301, 2004.
- [31] N. Kazantzis, F. P. Deane, and K. R. Ronan, "Homework Assignments in Cognitive and Behavioral Therapy: A Meta-Analysis," *Clinical Psychology: Science and Practice*, vol. 7, no. 2, pp. 189-202, 2000.
- [32] D. Lupton, "The digitally engaged patient: Self-monitoring and self-care in the digital health era," *Social Theory & Health*, vol. 11, no. 3, pp. 256-270, 2013.
- [33] J. Wentzel, R. van der Vaart, E. T. Bohlmeijer, and J. E. W. C. van Gemert-Pijnen, "Mixing Online and Face-to-Face Therapy: How to Benefit From Blended Care in Mental Health Care," *JMIR Mental Health*, vol. 3, no. 1, p. e9, 2016.
- [34] R. van der Vaart, M. Witting, H. Riper, L. Kooistra, E. T. Bohlmeijer, and J. E. W. C. van Gemert-Pijnen, "Blending online therapy into regular face-to-face therapy for depression: content, ratio and preconditions according to patients and therapists using a Delphi study," *BMC Psychiatry*, journal article vol. 14, no. 1, p. 355, December 14 2014.
- [35] A. O. Horvath and B. D. Symonds, "Relation between working alliance and outcome in psychotherapy: A meta-analysis," *Journal of Counseling Psychology*, vol. 38, no. 2, pp. 139-149, 1991.
- [36] S. R. Shirk, M. S. Karver, and R. Brown, "The alliance in child and adolescent psychotherapy," *Psychotherapy*, vol. 48, no. 1, p. 17, 2011.
- [37] C. Sundström, M. Blankers, and Z. Khadjesari, "Computer-Based Interventions for Problematic Alcohol Use: a Review of Systematic Reviews," *International Journal of Behavioral Medicine*, vol. 24, no. 5, pp. 646-658, 2017/10/01 2017.
- [38] N. Boumparis, E. Karyotaki, M. P. Schaub, P. Cuijpers, and H. Riper, "Internet interventions for adult illicit substance users: a meta-analysis," *Addiction (Abingdon, England)*, vol. 112, no. 9, pp. 1521-1532, 2017.
- [39] G. Andrews *et al.*, "Computer therapy for the anxiety and depression disorders is effective, acceptable and practical health care: An updated meta-analysis," *Journal of Anxiety Disorders*, vol. 55, pp. 70-78, 2018.
- [40] X. Ye *et al.*, "Effectiveness of internet-based interventions for children, youth, and young adults with anxiety and/or depression: a systematic review and meta-analysis," *BMC health services research*, vol. 14, no. 1, p. 313, 2014.
- [41] L. Farrer *et al.*, "Technology-Based Interventions for Mental Health in Tertiary Students: Systematic Review," *Journal of Medical Internet Research*, vol. 15, no. 5, p. e101, 2013.
- [42] G. Andersson and P. Cuijpers, "Internet-based and other computerized psychological treatments for adult depression: a meta-analysis," *Cogn Behav Ther*, vol. 38, 2009.

- [43] V. Spek, P. Cuijpers, I. Nyklíček, H. Riper, J. Keyzer, and V. Pop, "Internet-based cognitive behaviour therapy for symptoms of depression and anxiety: a meta-analysis," *Psychological Medicine*, vol. 37, no. 3, pp. 319-328, 2007.
- [44] R. M. F. Kenter *et al.*, "Costs and effects of Internet cognitive behavioral treatment blended with face-to-face treatment: Results from a naturalistic study," *Internet Interventions*, vol. 2, no. 1, pp. 77-83, 2015/03/01/ 2015.
- [45] H. Christensen, K. M. Griffiths, and L. Farrer, "Adherence in internet interventions for anxiety and depression," (in eng), *J Med Internet Res*, vol. 11, no. 2, p. e13, Apr 24 2009.
- [46] T. L. Dunn, L. M. Casey, J. Sheffield, P. Newcombe, and A. B. Chang, "Dropout from computer-based interventions for children and adolescents with chronic health conditions," *Journal of health psychology*, vol. 17, no. 3, pp. 429-442, 2012.
- [47] W. van Ballegooijen *et al.*, "Adherence to Internet-based and face-to-face cognitive behavioural therapy for depression: a meta-analysis," *PLoS One*, vol. 9, no. 7, p. e100674, 2014.
- [48] M. Wilhelmsen *et al.*, "Motivation to persist with internet-based cognitive behavioural treatment using blended care: a qualitative study," *BMC Psychiatry*, vol. 13, 2013.
- [49] S. K. Orlowski *et al.*, "Participatory research as one piece of the puzzle: a systematic review of consumer involvement in design of technology-based youth mental health and well-being interventions," *JMIR human factors*, vol. 2, no. 2, 2015.
- [50] T. Mattelmäki, & Sleeswijk Visser, F., "Lost in Co-X - Interpretations of Co-design and Co-creation," in *Proceedings of the 4th World Conference on Design Research (IASDR2011): Diversity and Unity*, Delft, The Netherlands, 2011, vol. 31.
- [51] R. M. Ryan and E. L. Deci, "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being," *American psychologist*, vol. 55, no. 1, p. 68, 2000.
- [52] A. DeSmet, D. Thompson, T. Baranowski, A. Palmeira, M. Verloigne, and I. De Bourdeaudhuij, "Is Participatory Design Associated with the Effectiveness of Serious Digital Games for Healthy Lifestyle Promotion? A Meta-Analysis," (in English), *Journal of Medical Internet Research*, Original Paper vol. 18, no. 4, p. e94, 2016.
- [53] E. B.-N. Sanders and P. J. Stappers, "Co-creation and the new landscapes of design," *CoDesign: International Journal of CoCreation in Design and the Arts*, vol. 4, no. 1, pp. 5-18, 2008.
- [54] E. Frias-Martinez, S. Y. Chen, and X. Liu, "Evaluation of a personalized digital library based on cognitive styles: Adaptivity vs. adaptability," *International Journal of Information Management*, vol. 29, no. 1, pp. 48-56, 2// 2009.
- [55] R. K. McHugh and D. H. Barlow, "The dissemination and implementation of evidence-based psychological treatments: a review of current efforts," *American Psychologist*, vol. 65, no. 2, pp. 73-84, 2010.

- [56] A. Hogue, S. Dauber, J. Samuolis, and H. A. Liddle, "Treatment Techniques and Outcomes in Multidimensional Family Therapy for Adolescent Behavior Problems," *Journal of Family Psychology* vol. 20, no. 4, pp. 535-543, 2006.
- [57] S. W. Stirman *et al.*, "Modifications to Cognitive Therapy by Community Mental Health Providers: Implications for Effectiveness and Sustainability," *Psychiatric Services*, vol. 64, no. 10, pp. 1056-1059, 2013.
- [58] K. M. Carroll and B. J. Rounsaville, "A vision of the next generation of behavioral therapies research in the addictions," *Addiction*, vol. 102, no. 6, pp. 850-869, 2007.
- [59] C. B. Taylor and V. Y. Chang, "Issues in the dissemination of cognitive-behavior therapy," *Nordic Journal of Psychiatry*, vol. 62, no. 47, pp. 37-44, 2008.
- [60] A. O. Horvath, A. C. Del Re, C. Flückiger, and D. Symonds, "Alliance in individual psychotherapy," *Psychotherapy*, vol. 48, no. 1, pp. 9-16, 2011.
- [61] S. R. Shirk, G. Gudmundsen, H. C. Kaplinski, and D. L. McMakin, "Alliance and outcome in cognitive-behavioral therapy for adolescent depression," *Journal of Clinical Child & Adolescent Psychology*, vol. 37, no. 3, pp. 631-639, 2008.
- [62] M. Blankers, T. Donker, and H. Riper, "Wetenschappelijke evidentie en uitdagingen voor de praktijk. E-MENTAL HEALTH IN NEDERLAND," *De psycholoog*, vol. 2013, pp. 12-23, 2013.
- [63] V. T. Visch, N. J. H. Vegt, H. Anderiesen, and K. van der Kooij, "Persuasive Game Design: A model and its definitions," presented at the CHI Workshop Designing Gamification: Creating Gameful and Playful Experiences, Paris, France, 2013.
- [64] T. Holocher-Ertl, B. Kieslinger, and C. M. Fabian, "Designing for the users or with the users? A participatory design approach for science teaching in schools," in *Proceedings of the 2012 eChallenges Annual Conference*, Lisbon, Portugal, 2012.
- [65] C. Spinuzzi, "The Methodology of Participatory Design," *Technical Communication*, vol. 52, no. 2, pp. 163-174, // 2005.
- [66] M. Steen, M. Manschot, and N. De Koning, "Benefits of Co-design in Service Design Projects," *International Journal of Design, Benefits, Co-Design, Service Design, Cases* vol. 5, no. 2, pp. 53-60, 2011.
- [67] C. K. Prahalad and V. Ramaswamy, "Co-creation experiences: The next practice in value creation," *Journal of Interactive Marketing*, vol. 18, no. 3, pp. 5-14, 2004.
- [68] C.-I. Teng, "Customization, immersion satisfaction, and online gamer loyalty," *Computers in Human Behavior*, vol. 26, no. 6, pp. 1547-1554, 11// 2010.
- [69] C. P. Lin, H. N. Huang, S. W. Joe, and H. C. Ma, "Learning the determinants of satisfaction and usage intention of instant messaging," *Cyberpsychology & Behavior*, vol. 11, no. 3, pp. 262-267, 2008.
- [70] A. Dijkstra, "The persuasive effects of personalization through: Name mentioning in a smoking cessation message," *User Modeling and User-Adapted Interaction*, vol. 24, no. 5, pp. 393-411, Dec 2014.
- [71] D. Johnson, S. Deterding, K.-A. Kuhn, A. Staneva, S. Stoyanov, and L. Hides, "Gamification for health and wellbeing: A systematic review of the literature," *Internet Interventions*, vol. 6, no. Supplement C, pp. 89-106, 2016.
- [72] H. Korhonen, M. Montola, and J. Arrasvuori, "Understanding playful user experience through digital games," in *International Conference on Designing*

- Pleasurable Products and Interfaces, DPPI09*, France, 2009: Compiegne University of Technology.
- [73] L. Sherry John, "Flow and Media Enjoyment," *Communication Theory*, vol. 14, no. 4, pp. 328-347, 2006.
 - [74] A. K. Przybylski, C. S. Rigby, and R. M. Ryan, "A motivational model of video game engagement," *Review of General Psychology*, vol. 14, no. 2, p. 154, 2010.
 - [75] A. Uysal and I. G. Yildirim, "Self-Determination Theory in Digital Games," in *Gamer Psychology and Behavior*, B. Bostan, Ed. Cham: Springer International Publishing, 2016, pp. 123-135.
 - [76] S. Bakkes, C. T. Tan, and Y. Pisan, "Personalised gaming: a motivation and overview of literature," in *Proceedings of the 8th Australasian Conference on Interactive Entertainment: Playing the System*, 2012, p. 4: ACM.
 - [77] L. Sardi, A. Idri, and J. L. Fernández-Alemán, "A Systematic Review of Gamification in e-Health," *Journal of Biomedical Informatics*, 2017.
 - [78] T. M. Fleming *et al.*, "Serious games and gamification for mental health: current status and promising directions," *Frontiers in psychiatry*, vol. 7, p. 215, 2017.
 - [79] T. A. Dennis and L. O'Toole, "Mental Health on the Go: Effects of a Gamified Attention Bias Modification Mobile Application in Trait Anxious Adults," (in eng), *Clin Psychol Sci*, vol. 2, no. 5, pp. 576-590, Sep 1 2014.
 - [80] T. Fleming *et al.*, "Serious games for the treatment or prevention of depression: a systematic review," *Revista de Psicopatología y Psicología Clínica*, vol. 19, no. 3, pp. 227-242, 2014.
 - [81] L. Gamberini, G. Barresi, A. Majer, and F. Scarpetta, "A game a day keeps the doctor away: a short review of computer games in mental healthcare," *Journal of CyberTherapy & Rehabilitation*, vol. 1, no. 2, pp. 127-149, 2008.
 - [82] J. J. Santamaria *et al.*, "Serious games as additional psychological support: a review of the literature," *Journal of CyberTherapy and Rehabilitation*, vol. 4, no. 4, pp. 469-477, 2011.
 - [83] A. DeSmet *et al.*, "A meta-analysis of serious digital games for healthy lifestyle promotion," *Preventive medicine* vol. 69, pp. 95-107, 2014.
 - [84] P. M. Kato, "Video games in health care: Closing the gap," *Review of General Psychology*, vol. 14, no. 2, p. 113, 2010.
 - [85] H. L. Horne-Moyer, B. H. Moyer, D. C. Messer, and E. S. Messer, "The Use of Electronic Games in Therapy: a Review with Clinical Implications," *Current Psychiatry Reports*, journal article vol. 16, no. 12, p. 520, 2014.
 - [86] J. Li, Y.-L. Theng, and S. Foo, "Game-Based Digital Interventions for Depression Therapy: A Systematic Review and Meta-Analysis," *Cyberpsychology, Behavior, and Social Networking*, vol. 17, no. 8, pp. 519-527, 2014/08/01 2014.
 - [87] V. Brezinka, "Computer games supporting cognitive behaviour therapy in children," *Clinical child psychology and psychiatry*, vol. 19, no. 1, pp. 100-110, 2014.
 - [88] H. M. Lau, J. H. Smit, T. M. Fleming, and H. Riper, "Serious Games for Mental Health: Are They Accessible, Feasible, and Effective? A Systematic Review and Meta-analysis," *Frontiers in Psychiatry*, vol. 7, p. 209, 2016.

- [89] S. M. Kelders, M. Sommers-Spijkerman, and J. Goldberg, "Investigating the Direct Impact of a Gamified Versus Nongamified Well-Being Intervention: An Exploratory Experiment," (in English), *J Med Internet Res*, Original Paper vol. 20, no. 7, p. e247, 2018.
- [90] F. M. Brooks, K. L. Chester, N. C. Smeeton, and N. H. Spencer, "Video gaming in adolescence: factors associated with leisure time use," *Journal of Youth Studies*, vol. 19, no. 1, pp. 36-54, 2016.
- [91] A. Deacon and K. O'Farrell, "The use of serious games and gamified design to improve health outcomes in adolescents with chronic disease: A review of recent literature," 2016.
- [92] M. Brown, N. O'Neill, H. van Woerden, P. Eslambolchilar, M. Jones, and A. John, "Gamification and Adherence to Web-Based Mental Health Interventions: A Systematic Review," *JMIR Mental Health*, vol. 3, no. 3, p. e39, 08/24 2016.
- [93] G. Mireya Silva, A. Raposo, and M. Suplino, "Exploring Collaboration Patterns in a Multitouch Game to Encourage Social Interaction and Collaboration Among Users with Autism Spectrum Disorder," (in English), *Computer Supported Cooperative Work (CSCW)*, pp. 1-27, 2014/12/10 2014.
- [94] S. Raghupathy and A. L. Forth, "The HAWK2 program: a computer-based drug prevention intervention for Native American youth," (in eng), *The American journal of drug and alcohol abuse*, vol. 38, no. 5, pp. 461-7, Sep 2012.
- [95] C. Holmgård, G. N. Yannakakis, K. I. Karstoft, and H. S. Andersen, "Stress Detection for PTSD via the StartleMart Game," *In proceedings of the Humaine Association Conference on Affective Computing and Intelligent Interaction (ACII)*, pp. 523 - 528, 2013.
- [96] M. Glasemann, A. M. Kanstrup, and T. Ryberg, "Design and exploration of a mobile game scenario in a diabetic youth camp," *IADIS International conference Mobile Learning*, pp. 132-140, 2010.
- [97] J. Hollingdale and T. Greitemeyer, "The changing face of aggression: The effect of personalized avatars in a violent video game on levels of aggressive behavior," *Journal of Applied Social Psychology*, vol. 43, no. 9, pp. 1862-1868, Sep 2013.
- [98] E. B.-N. Sanders, "From user-centered to participatory design approaches," *Design and the social sciences: Making connections*, pp. 1-8, 2002.
- [99] R. Profitt and B. Lange, "User centered design and development of a game for exercise in older adults," *International Journal of Technology, Knowledge & Society*, vol. 8, no. 5, pp. 95-112, 2012.
- [100] R. Mugge, J. P. L. Schoormans, and H. N. J. Schifferstein, "Incorporating consumers in the design of their own products. The dimensions of product personalisation," *CoDesign*, vol. 5, no. 2, pp. 79-97, 2009/06/01 2009.
- [101] S. S. Sundar and S. S. Marathe, "Personalization versus Customization: The Importance of Agency, Privacy, and Power Usage," *Human Communication Research*, vol. 36, no. 3, pp. 298-322, 2010.
- [102] A. Dijkstra, "The Psychology of Tailoring-Ingredients in Computer-Tailored Persuasion," *Social and Personality Psychology Compass*, vol. 2, no. 2, pp. 765-784, 2008.

- [103] S. M. Noar, N. G. Harrington, and R. S. Aldrich, "The Role of Message Tailoring in the Development of Persuasive Health Communication Messages," *Annals of the International Communication Association*, vol. 33, no. 1, pp. 73-133, 2009/01/01 2009.
- [104] B. S. Fjeldsoe, A. L. Marshall, and Y. D. Miller, "Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service," *American Journal of Preventive Medicine*, vol. 36, no. 2, pp. 165-173, 2// 2009.
- [105] M. L. A. Lustria, J. Cortese, S. M. Noar, and R. L. Glueckauf, "Computer-tailored health interventions delivered over the Web: review and analysis of key components," *Patient education and counseling*, vol. 74, no. 2, pp. 156-173, 2009.
- [106] S. Easterbrook, "Resolving Requirements Conflicts with Computer-Supported Negotiation," in *In Requirements Engineering: Social and Technical Issues*, M. Jirotko, and Goguen, J., Ed.: USA: Academic Press, 1994, pp. 41-65.
- [107] A. van Boeijen, J. Daalhuizen, J. Zijlstra, and R. van der Schoor, *Delft Design Guide: Design Methods*. Amsterdam: BIS Publishers, 2013.
- [108] D. Szebeko and L. Tan, "Co-designing for Society," *Australasian Medical Journal*, vol. 3, no. 9, pp. 580-590, 2010.
- [109] V. Baert, E. Gorus, T. Mets, C. Geerts, and I. Bautmans, "Motivators and barriers for physical activity in the oldest old: a systematic review," (in eng), *Ageing research reviews*, vol. 10, no. 4, pp. 464-74, Sep 2011.
- [110] P. Krebs, J. O. Prochaska, and J. S. Rossi, "A meta-analysis of computer-tailored interventions for health behavior change," (in eng), *Preventive medicine*, vol. 51, no. 3-4, pp. 214-21, Sep-Oct 2010.
- [111] D. B. Portnoy, L. A. Scott-Sheldon, B. T. Johnson, and M. P. Carey, "Computer-delivered interventions for health promotion and behavioral risk reduction: a meta-analysis of 75 randomized controlled trials, 1988-2007," (in eng), *Preventive medicine*, vol. 47, no. 1, pp. 3-16, Jul 2008.
- [112] D. A. Lieberman, C. H. Bates, and S. Jiyeon, "Young Children's Learning With Digital Media," *Computers in the Schools*, vol. 26, no. 4, pp. 271-283, 2009.
- [113] S. N. Merry, K. Stasiak, M. Shepherd, C. Frampton, T. Fleming, and M. F. G. Lucassen, *The effectiveness of SPARX, a computerised self help intervention for adolescents seeking help for depression: randomised controlled non-inferiority trial*. 2012.
- [114] R. Moss-Morris, P. McCrone, L. Yardley, K. van Kessel, G. Wills, and L. Dennison, "A pilot randomised controlled trial of an Internet-based cognitive behavioural therapy self-management programme (MS Invigor8) for multiple sclerosis fatigue," *Behaviour research and therapy*, vol. 50, no. 6, pp. 415-421, 2012.
- [115] S. Crovato, G. Mascarello, A. Pinto, and L. Ravarotto, "Testing a serious game for communicating food risk to young consumers: "A mysterious poisoning"," *Proceedings of the 5th International Conference on Education and New Learning Technologies: Edulearn13*, pp. 283-289, 2013.
- [116] K. C. Organista, N. J. Alvarado, A. Balblutin-Burnham, P. Worby, and S. R. Martinez, "An Exploratory Study of HIV Prevention with Mexican/Latino

- Migrant Day Laborers," *Journal of HIV/AIDS & Social Services*, vol. 5, no. 2, pp. 89-114, 2006.
- [117] A. L. McGaffey, D. J. Abatemarco, I. K. Jewell, S. K. Fidler, and K. Hughes, "Fitwits MD (TM): An Office-Based Tool and Games for Conversations about Obesity with 9- to 12-Year-Old Children," *Journal of the American Board of Family Medicine*, vol. 24, no. 6, pp. 768-771, Nov-Dec 2011.
 - [118] P. Singh and I. Niranjana, "Using groupwork in the designing and playing of board games in occupational health and safety," *Groupwork*, vol. 22, no. 3, pp. 65-82, 2012.
 - [119] J. M. Cahill, "Health Works: Interactive AIDS education videogames," *Computers in Human Services*, vol. 11, no. 1-2, pp. 159-176, 1994.
 - [120] S. Costa *et al.*, "An approach to promote social and communication behaviors in children with autism spectrum disorders: Robot based intervention," *Proceedings of the 20th IEEE international symposium on robot and human interactive communication: RO-MAN*, pp. 101 - 106 2011.
 - [121] S. Cobb *et al.*, "Applied virtual environments to support learning of social interaction skills in users with Asperger's Syndrome," *Digital Creativity*, vol. 13, no. 1, pp. 11-22, 2002.
 - [122] B. Schmitz, R. Klemke, J. Walhout, and M. Specht, "Attuning a mobile simulation game for school children using a design-based research approach," *Computers & Education*, vol. 81, pp. 35-48, Feb 2015.
 - [123] A. S. Alklind Taylor, P. Backlund, H. Engstrom, M. Johannesson, and M. Lebram, "The birth of Elinor: a collaborative development of a game based system for stroke rehabilitation," in *Proceedings of the 2nd International Conference in Visualisation*, 2009, pp. 52-60.
 - [124] M. Gotsis *et al.*, "Skyfarer: Design Case Study of a Mixed Reality Rehabilitation Video Game," presented at the In Design, User Experience, and Usability. User Experience Design for Diverse Interaction Platforms and Environments, third International Conference, DUXU: Design, User Experience, and Usability, 2014.
 - [125] N. v. H. Nijhof, J. van Rijn, H. van Gemert-Pijnen, J.E.W.C., "The behavioral outcomes of a technology-supported leisure activity in people with dementia," *Technology and Disability*, vol. 24, no. 4, pp. 263-273, 2013
 - [126] A. McGaffey, K. Hughes, S. Fidler, F. D'Amico, and M. Stalter, "Can Elvis Pretzley and the Fitwits improve knowledge of obesity, nutrition, exercise, and portions in fifth graders?," *International Journal of Obesity*, vol. 34, no. 7, pp. 1134-1142, Jul 2010.
 - [127] R. Bailey, K. Wise, and P. Bolls, "How avatar customizability affects children's arousal and subjective presence during junk food-sponsored online video games," *CyberPsychology & Behavior*, vol. 12, no. 3, pp. 277-283, Jun 2009.
 - [128] A. Ben-Sasson, L. Lamash, and E. Gal, "To enforce or not to enforce? The use of collaborative interfaces to promote social skills in children with high functioning autism spectrum disorder," *Autism*, vol. 17, no. 5, pp. 608-622, Sep 2013.

References

- [129] C. S. González, C. Collazos, J. L. González, P. Toledo, and F. Blanco, "The importance of human factors to enhance the user experience in videogames," *International Symposium on Computers in Education*, pp. 1-4, 2012.
- [130] G. D. Cohen, "Two new intergenerational interventions for Alzheimer's disease patients and families," *American Journal of Alzheimer's Disease and Other Dementias*, vol. 15, no. 3, pp. 137-142, May 1, 2000 2000.
- [131] A. M. Hussaan and K. Sehaba, "Adaptive Serious Game for Rehabilitation of Persons with Cognitive Disabilities," *Proceedings of the 13th International Conference on Advanced Learning Technologies*, pp. 65-69, 2013.
- [132] Y. Kim, "Can your avatar improve your health? the impact of avatar customization (Doctoral dissertation)," *Pennsylvania State University*, 2010.
- [133] H. H. Lund and C. B. Nielsen, "Modularity for modulating exercises and levels - observations from cardiac, stroke, and COLD patients therapy," presented at the Proceedings of the 8th International Conference on Ubiquitous Robots and Ambient Intelligence, 2011.
- [134] M. Chilcott and A. Smith, "Ageing Well and Learning through Online Immersive Participation Using a Multi-user Web 3D Environment," *Proceedings of the Third International Conference on Games and Virtual Worlds for Serious Applications*, pp. 70 - 75, 2011.
- [135] S. Albiol-Pérez *et al.*, "A Novel Virtual Motor Rehabilitation System for Guillain-Barre Syndrome. Two Single Case Studies," (in Eng), *Methods of Information in Medicine*, vol. 54, no. 2, pp. 127-134, Jan 22 2015.
- [136] C. Boulanger *et al.*, "Stroke rehabilitation with a sensing surface," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2013, pp. 1243-1246.
- [137] M. S. Cameirao, S. B. Badia, E. D. Oller, and P. F. Verschure, "Neurorehabilitation using the virtual reality based Rehabilitation Gaming System: methodology, design, psychometrics, usability and validation," (in eng), *Journal of Neuroengineering and Rehabilitation*, vol. 7, p. 48, 2010.
- [138] S. S. Kuys, K. Hall, M. Peasey, M. Wood, R. Cobb, and S. C. Bell, "Gaming console exercise and cycle or treadmill exercise provide similar cardiovascular demand in adults with cystic fibrosis: a randomised cross-over trial," (in eng), *Journal of Physiotherapy*, vol. 57, no. 1, pp. 35-40, 2011.
- [139] J. C. Metzger *et al.*, "Assessment-driven selection and adaptation of exercise difficulty in robot-assisted therapy: a pilot study with a hand rehabilitation robot," *Journal of Neuroengineering and Rehabilitation*, vol. 11, Nov 2014, Art. no. 154.
- [140] C. R. Lyles *et al.*, "Qualitative Evaluation of a Mobile Phone and Web-Based Collaborative Care Intervention for Patients with Type 2 Diabetes," *Diabetes Technology & Therapeutics*, vol. 13, no. 5, pp. 563-569, May 2011.
- [141] J. Wainer, B. Robins, F. Amirabdollahian, and K. Dautenhahn, "Using the humanoid robot KASPAR to autonomously play triadic games and facilitate collaborative play among children with autism," *IEEE Transactions on Autonomous Mental Development*, vol. 6, no. 3, pp. 183-199, 2014.

- [142] H. K. Yuen, H. L. Breland, L. K. Vogtle, K. Holthaus, D. L. Kamen, and D. Sword, "The process associated with motivation of a home-based Wii Fit exercise program among sedentary African American women with systemic lupus erythematosus," *Disability and Health Journal*, vol. 6, no. 1, pp. 63-68, Jan 2013.
- [143] M. Gonzalez-Franco, S. Gilroy, and J. O. Moore, "Empowering patients to perform physical therapy at home," *Proceedings of the 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society* pp. 6308 - 6311, 2014.
- [144] I. Sparrer, T. A. Duong Dinh, J. Ilgner, and M. Westhofen, "Vestibular rehabilitation using the Nintendo(R) Wii Balance Board -- a user-friendly alternative for central nervous compensation," (in eng), *Acta Otolaryngol*, vol. 133, no. 3, pp. 239-245, Mar 2013.
- [145] L. C. Abroms *et al.*, "Text2Quit: Results from a pilot test of a personalized, interactive mobile health smoking cessation program," *Journal of Health Communication*, vol. 17, no. Suppl 1, pp. 44-53, May 2012.
- [146] J. Choi and A. Medalia, "Intrinsic motivation and learning in a schizophrenia spectrum sample," *Schizophrenia Research*, vol. 118, no. 1-3, pp. 12-19, May 2010.
- [147] A. Gouaïch, N. Hocine, L. Van Dokkum, and D. Mottet, "Digital-pheromone based difficulty adaptation in post-stroke therapeutic games," in *Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium*, 2012, pp. 5-12.
- [148] C. Peretz, A. D. Korczyn, E. Shatil, V. Aharonson, S. Birnboim, and N. Giladi, "Computer-based, personalized cognitive training versus classical computer games: A randomized double-blind prospective trial of cognitive stimulation," *Neuroepidemiology*, vol. 36, no. 2, pp. 91-99, Apr 2011.
- [149] M. Plow and M. Finlayson, "A qualitative study exploring the usability of Nintendo Wii Fit among persons with multiple sclerosis," *Occupational Therapy International*, vol. 21, no. 1, pp. 21-32, Mar 2014.
- [150] M. Frutos-Pascual, B. G. Zapirain, and A. M. Zorrilla, "Adaptive Tele-Therapies Based on Serious Games for Health for People with Time-Management and Organisational Problems: Preliminary Results," *International Journal of Environmental Research and Public Health*, vol. 11, no. 1, pp. 749-772, Jan 2014.
- [151] W. Lee, Y. M. Chae, S. Kim, S. H. Ho, and I. Choi, "Evaluation of a mobile phone-based diet game for weight control," *Journal of Telemedicine and Telecare*, vol. 16, no. 5, pp. 270-275, 2010.
- [152] M. E. Hoque, J. K. Lane, R. El Kaliouby, M. Goodwin, and R. W. Picard, "Exploring speech therapy games with children on the autism spectrum," in *In INTERSPEECH, 10th Annual Conference of the International Speech Communication Association*, 2009, pp. 1455-1458.
- [153] J. R. Octavia and K. Coninx, "Adaptive Personalized Training Games for Individual and Collaborative Rehabilitation of People with Multiple Sclerosis," *Biomed Research International*, 2014, Art. no. 345728.
- [154] K. Ustinova, J. Perkins, W. Leonard, and C. Hausbeck, "Virtual reality game-based therapy for treatment of postural and co-ordination abnormalities

References

- secondary to TBI: A pilot study," *Brain Injury*, vol. 28, no. 4, pp. 486-495, Apr 2014.
- [155] M. A. Padilla-Castañeda *et al.*, "A virtual reality system for robotic-assisted orthopedic rehabilitation of forearm and elbow fractures," in *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2013, vol. 11, pp. 1506-1511.
 - [156] B. Bossavit and A. Pina, "Designing Educational Tools, Based on Body Interaction, for Children with Special Needs Who Present Different Motor Skills," in *Proceedings of the 2014 International Conference on Interactive Technologies and Games 2014*, pp. 63-70.
 - [157] J. H. Shin, H. Ryu, and S. H. Jang, "A task-specific interactive game-based virtual reality rehabilitation system for patients with stroke: a usability test and two clinical experiments," *Journal of Neuroengineering and Rehabilitation*, vol. 11, Mar 2014, Art. no. 32.
 - [158] M. Shepherd, T. Fleming, M. Lucassen, K. Stasiak, I. Lambie, and S. N. Merry, "The design and relevance of a computerized gamified depression therapy program for indigenous maori adolescents," (in eng), *JMIR Serious Games*, vol. 3, no. 1, p. e1, 2015.
 - [159] R. Cornejo, D. Hernandez, M. Tentori, and J. Favela, "An ambient casual game to promote socialization and active ageing," in *In Collaboration and Technology, 20th International Conference*, 2014, pp. 75-88.
 - [160] F. Lu, K. Turner, and B. Murphy, "Reducing adolescent obesity with a mobile fitness application: study results of youth age 15 to 17," *IEEE Healthcom, 15th International Conference on E-Health, Networking, Application & Service*, pp. 554 - 558, 2013.
 - [161] H. M. Edwards, S. McDonald, T. Zhao, and L. Humphries, "Design requirements for persuasive technologies to motivate physical activity in adolescents: A field study," *Behaviour & Information Technology*, vol. 33, no. 9, pp. 968-986, Sep 2014.
 - [162] L. Bartoli, F. Garzotto, M. Gelsomini, L. Oliveto, and M. Valoriani, "Designing and evaluating touchless playful interaction for ASD children," in *Proceedings of the 2014 conference on Interaction Design and Children*, 2014, pp. 17-26.
 - [163] D. Coyle and G. Doherty, "Clinical Evaluations and Collaborative Design: Developing new technologies for mental healthcare interventions," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* 2009, pp. 2051-2060.
 - [164] J. D. Johnston, A. P. Massey, and R. L. Marker-Hoffman, "Using an alternate reality game to increase physical activity and decrease obesity risk of college students," *Journal of Diabetes Science and Technology*, vol. 6, no. 4, pp. 828-838, 2012.
 - [165] M.-G. Kim *et al.*, "Designing robot-assisted Pivotal Response Training in game activity for children with autism," in *Proceedings of IEEE International Conference on Systems, Man, and Cybernetics*, 2014, pp. 1101-1106.

- [166] E. I. Barakova, P. Bajracharya, M. Willemsen, T. Lourens, and B. Huskens, "Long-term LEGO therapy with humanoid robot for children with ASD," *Expert Systems*, vol. 32, no. 6, pp. 698-709, 2015.
- [167] H. A. Hernandez *et al.*, "Design of an exergaming station for children with cerebral palsy," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2012, pp. 2619-2628.
- [168] N. Hocine, A. Gouaïch, S. A. Cerri, D. Mottet, J. Froger, and I. Laffont, "Adaptation in serious games for upper-limb rehabilitation: an approach to improve training outcomes," *User Modeling and User-Adapted Interaction*, vol. 25, no. 1, pp. 65-98, 2015.
- [169] R. de Oliveira, M. Cherubini, N. Oliver, and Acm, "MoviPill: Improving Medication Compliance for Elders Using a Mobile Persuasive Social Game," in *Proceedings of the 12th ACM international conference on Ubiquitous computing*, 2010, pp. 251-260.
- [170] E. Tsekleves, I. T. Paraskevopoulos, A. Warland, and C. Kilbride, "Development and preliminary evaluation of a novel low cost VR-based upper limb stroke rehabilitation platform using Wii technology," (in Eng), *Disability and Rehabilitation: Assistive Technology*, vol. 11, no. 5, pp. 413-422, Nov 13 2014.
- [171] A. A. Rizzo *et al.*, "Virtual Iraq: Initial case reports from a VR exposure therapy application for combat-related post traumatic stress disorder," in *Virtual Rehabilitation*, 2007, pp. 124 - 130.
- [172] P. Hekkert and H. N. Schifferstein, "Introducing product experience," *Product experience*, pp. 1-8, 2008.
- [173] P. Desmet and P. Hekkert, "Framework of product experience," *International Journal of Design*, vol. 1, no. 1, pp. 57-66, 2007.
- [174] H. Oinas-Kukkonen, "A foundation for the study of behavior change support systems," (in English), *Personal and Ubiquitous Computing*, vol. 17, no. 6, pp. 1223-1235, 2013/08/01 2013.
- [175] S. J. Brown, D. A. Lieberman, B. A. Gemeny, Y. C. Fan, D. M. Wilson, and D. J. Pasta, "Educational video game for juvenile diabetes: results of a controlled trial," *Informatics for Health and Social Care*, vol. 22, no. 1, pp. 77-89, 1997.
- [176] P. M. Kato, S. W. Cole, A. S. Bradley, and B. H. Pollock, "A video game improves behavioral outcomes in adolescents and young adults with cancer: a randomized trial," *Pediatrics*, vol. 122, p. e305, 2007.
- [177] A. C. McPherson, C. Glazebrook, D. Forster, C. James, and A. Smyth, "A randomized, controlled trial of an interactive educational computer package for children with asthma," *Pediatrics*, vol. 117, pp. 1046-1054, 2006.
- [178] K. van der Kooij, E. Hoogendoorn, R. Spijkerman, and V. Visch, "Validation of Games for Behavioral Change: Connecting the Playful and Serious," *The International Journal of Serious Games*, vol. 2, no. 3, pp. 63-75, 2015.
- [179] B. Laugwitz, T. Held, and M. Schrepp, *Construction and evaluation of a user experience questionnaire*. Springer, 2008.
- [180] J. Brooke, "SUS-A quick and dirty usability scale," *Usability evaluation in industry*, vol. 189, no. 194, pp. 4-7, 1996.

References

- [181] T. L. Mayes, I. H. Bernstein, C. L. Haley, B. D. Kennard, and G. J. Emslie, "Psychometric properties of the Children's Depression Rating Scale-Revised in adolescents," *Journal of child and adolescent psychopharmacology*, vol. 20, no. 6, pp. 513-516, 2010.
- [182] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: defining "gamification"," presented at the Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, Tampere, Finland, 2011.
- [183] R. Hunicke, LeBlanc, M., Zubek, R. , "MDA: A Formal Approach to Game Design and Game Research," *Proceedings of the Challenges in Game AI Workshop, Nineteenth National Conference on Artificial Intelligence.*, 2004.
- [184] S. J. Hu, "Evolving Paradigms of Manufacturing: From Mass Production to Mass Customization and Personalization," *Procedia CIRP*, vol. 7, no. 0, pp. 3-8, // 2013.
- [185] J. Watts and M. Hirst, "User participation in the early stages of building design," *Design Studies*, vol. 3, no. 1, pp. 11-18, 1982/01/01 1982.
- [186] W. D. Hoyer, Chandy, R., Dorotic, M., Krafft, M., & Singh, S. S. , "Consumer cocreation in new product development," *Journal of Service Research*, vol. 13, no. 3, pp. 283-296, 2010.
- [187] I. Katz and A. Assor, "When choice motivates and when it does not," *Educational Psychology Review*, vol. 19, no. 4, pp. 429-442, 2007.
- [188] G. N. Miceli, F. Ricotta, and M. Costabile, "Customizing customization: A conceptual framework for interactive personalization," *Journal of Interactive Marketing*, vol. 21, no. 2, pp. 6-25, 2007.
- [189] K. Miller, S. Rodger, B. Kipping, and R. M. Kimble, "A novel technology approach to pain management in children with burns: A prospective randomized controlled trial," (in eng), *Burns*, vol. 37, no. 3, pp. 395-405, May 2011.
- [190] E. Malbos, R. M. Rapee, and M. Kavakli, "Creation of interactive virtual environments for exposure therapy through game-level editors: Comparison and tests on presence and anxiety," *International Journal of Human-Computer Interaction*, vol. 29, no. 12, pp. 827-837, Dec 2013.
- [191] R. Orji, J. Vassileva, and R. L. Mandryk, "Modeling the efficacy of persuasive strategies for different gamer types in serious games for health," *User Modeling and User-Adapted Interaction*, vol. 24, no. 5, pp. 453-498, 2014.
- [192] S. Deterding, M. Sicart, L. Nacke, K. O'Hara, and D. Dixon, "Gamification. using game-design elements in non-gaming contexts," presented at the CHI '11 Extended Abstracts on Human Factors in Computing Systems, Vancouver, BC, Canada, 2011.
- [193] T. Baranowski *et al.*, "Games for Health for Children-Current Status and Needed Research," (in eng), *Games for health journal*, vol. 5, no. 1, pp. 1-12, Feb 2016.
- [194] M. Lynskey and W. Hall, "The effects of adolescent cannabis use on educational attainment: a review," *Addiction*, vol. 95, no. 11, pp. 1621-1630, 2000.
- [195] J. R. Weisz, B. Weiss, S. S. Han, D. A. Granger, and T. Morton, "Effects of psychotherapy with children and adolescents revisited: a meta-analysis of

- treatment outcome studies," (in eng), *Psychological Bulletin*, vol. 117, no. 3, pp. 450-468, May 1995.
- [196] S. J. E. Bruijnicks, G. Franx, and M. J. H. Huibers, "The implementation and adherence to evidence-based protocols for psychotherapy for depression: the perspective of therapists in Dutch specialized mental healthcare," (in eng), *BMC Psychiatry*, vol. 18, no. 1, p. 190, Jun 14 2018.
 - [197] S. Gibson, S. L. Brand, S. Burt, Z. V. R. Boden, and O. Benson, "Understanding treatment non-adherence in schizophrenia and bipolar disorder: a survey of what service users do and why," *BMC Psychiatry*, journal article vol. 13, no. 1, p. 153, May 29 2013.
 - [198] M. E. Addis and A. D. Krasnow, "A national survey of practicing psychologists' attitudes toward psychotherapy treatment manuals," *Journal of Consulting and Clinical Psychology*, vol. 68, no. 2, pp. 331-339, 2000.
 - [199] M. Wilhelmsen *et al.*, "Norwegian General Practitioners' Perspectives on Implementation of a Guided Web-Based Cognitive Behavioral Therapy for Depression: A Qualitative Study," *Journal of Medical Internet Research*, vol. 16, no. 9, p. e208, 2014.
 - [200] M. Kivi, M. C. M. Eriksson, D. Hange, E.-L. Petersson, C. Björkelund, and B. Johansson, "Experiences and attitudes of primary care therapists in the implementation and use of internet-based treatment in Swedish primary care settings," *Internet Interventions*, vol. 2, no. 3, pp. 248-256, 2015/09/01/ 2015.
 - [201] J. Bengtsson, S. Nordin, and P. Carlbring, "Therapists' Experiences of Conducting Cognitive Behavioural Therapy Online vis-à-vis Face-to-Face," *Cognitive Behaviour Therapy*, vol. 44, no. 6, pp. 470-479, 2015/11/02 2015.
 - [202] H. Scholten and I. Granic, "Use of the Principles of Design Thinking to Address Limitations of Digital Mental Health Interventions for Youth: Viewpoint," (in English), *J Med Internet Res*, Viewpoint vol. 21, no. 1, p. e11528, 2019.
 - [203] G. M. Schippers, M. Smeerdijk, and M. J. M. Merckx, *Handboek CGT bij middelengebruik en gokken* Utrecht: Perspectief Uitgevers, 2014.
 - [204] M. M. M. Van Dooren, V. T. Visch, R. Spijkerman, R. H. M. Goossens, and V. M. Hendriks, "Personalization in Game Design for Healthcare: a Literature Review on its Definitions and Effects," *International Journal of Serious Games*, vol. 3, no. 4, pp. 3-28, 2016.
 - [205] B. C. O'Brien, I. B. Harris, T. J. Beckman, D. A. Reed, and D. A. Cook, "Standards for reporting qualitative research: a synthesis of recommendations," (in eng), *Acad Med*, vol. 89, no. 9, pp. 1245-51, Sep 2014.
 - [206] K. Charmaz and L. L. Belgrave, "Grounded theory," *The Blackwell encyclopedia of sociology*, 2007.
 - [207] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual Res Psychol*, vol. 3, 2006.
 - [208] J. Aronson, "A pragmatic view of thematic analysis," *The qualitative report*, vol. 2, no. 1, pp. 1-3, 1994.
 - [209] A. Tong, P. Sainsbury, and J. Craig, "Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus

- groups," *International Journal for Quality in Health Care*, vol. 19, no. 6, pp. 349-357, 2007.
- [210] B. C. Chu and P. C. Kendall, "Therapist Responsiveness to Child Engagement: Flexibility Within Manual-Based CBT for Anxious Youth," *Journal of Clinical Psychology*, vol. 65, no. 7, pp. 736-754 2009.
- [211] D. Schulte, R. Künzel, G. Pepping, and T. Schulte-Bahrenberg, "Tailor-made versus standardized therapy of phobic patients," *Advances in Behaviour Research and Therapy*, vol. 14, no. 2, pp. 67-92, 1992.
- [212] J. Morgenstern, K. A. Blanchard, T. J. Morgan, E. Labouvie, and J. Hayaki, "Testing the effectiveness of cognitive-behavioral treatment for substance abuse in a community setting: within treatment and posttreatment findings," *Journal of Consulting and Clinical Psychology*, vol. 69, no. 6, p. 1007, 2001.
- [213] J. T. Levitt, L. S. Malta, A. Martin, L. Davis, and M. Cloitre, "The flexible application of a manualized treatment for PTSD symptoms and functional impairment related to the 9/11 World Trade Center attack," *Behaviour Research and Therapy*, vol. 45, no. 7, pp. 1419-1433, 2007.
- [214] D. A. Chambers, R. E. Glasgow, and K. C. Stange, "The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change," *Implementation Science*, journal article vol. 8, no. 1, p. 117, 2013.
- [215] D. L. Tobin, J. D. Banker, L. Weisberg, and W. Bowers, "I know what you did last summer (and it was not CBT): a factor analytic model of international psychotherapeutic practice in the eating disorders," (in eng), *The International Journal of Eating Disorders*, vol. 40, no. 8, pp. 754-157, Dec 2007.
- [216] P. C. Kendall, B. C. Chu, A. Gifford, C. Hayes, and M. Nauta, "Breathing life into a manual: Flexibility and creativity with manual-based treatments," *Cognitive and Behavioral Practice*, vol. 5, no. 2, pp. 177-198, 1998.
- [217] H. F. Zickgraf *et al.*, " Interpersonal Factors Are Associated with Lower Therapist Adherence in Cognitive-Behavioural Therapy for Panic Disorder," *Clinical Psychology & Psychotherapy*, vol. 23, no. 3, pp. 272-284, 2016.
- [218] A. Hogue, S. Dauber, E. Lichvar, M. Bobek, and C. E. Henderson, "Validity of Therapist Self-Report Ratings of Fidelity to Evidence-Based Practices for Adolescent Behavior Problems: Correspondence between Therapists and Observers," *Administration and Policy in Mental Health and Mental Health Services Research*, vol. 42, no. 2, pp. 229-243, 2015/03/01 2015.
- [219] K. M. Peavy *et al.*, "Treatment adherence and competency ratings among therapists, supervisors, study-related raters and external raters in a clinical trial of a 12-step facilitation for stimulant users," (in eng), *Journal of substance abuse treatment*, vol. 47, no. 3, pp. 222-228, 2014.
- [220] V. Tschuschke *et al.*, "The role of therapists' treatment adherence, professional experience, therapeutic alliance, and clients' severity of psychological problems: Prediction of treatment outcome in eight different psychotherapy approaches. Preliminary results of a naturalistic study," *Psychotherapy Research*, vol. 25, no. 4, pp. 420-434, 2015.
- [221] A. Hackshaw, "Small studies: strengths and limitations," *European Respiratory Journal*, vol. 32, no. 5, pp. 1141-1143, 2008.

- [222] J. Arrasvuori *et al.*, "Applying the PLEX framework in designing for playfulness," presented at the Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces, Milano, Italy, 2011.
- [223] Andr *et al.*, "The playful experiences (PLEX) framework as a guide for expert evaluation," presented at the Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces, Newcastle upon Tyne, United Kingdom, 2013.
- [224] D. R. Davis, A. N. Kurti, J. M. Skelly, R. Redner, T. J. White, and S. T. Higgins, "A review of the literature on contingency management in the treatment of substance use disorders, 2009–2014," *Preventive Medicine*, vol. 92, pp. 36-46, 2016.
- [225] J. Q. Purnell, R. Gernes, R. Stein, M. S. Sherraden, and A. Knoblock-Hahn, "A systematic review of financial incentives for dietary behavior change," *Journal of the Academy of Nutrition and Dietetics*, vol. 114, no. 7, pp. 1023-1035, 2014.
- [226] E. L. Giles, S. Robalino, E. McColl, F. F. Sniehotta, and J. Adams, "The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis," *PLOS ONE*, vol. 9, no. 3, p. e90347, 2014.
- [227] E. Mantzari, F. Vogt, I. Shemilt, Y. Wei, J. P. Higgins, and T. M. Marteau, "Personal financial incentives for changing habitual health-related behaviors: a systematic review and meta-analysis," *Preventive Medicine*, vol. 75, pp. 75-85, 2015.
- [228] F. Luthans and A. D. Stajkovic, "Reinforce for performance: the need to go beyond pay and even rewards," *The Academy of Management Executive (1993-2005)*, vol. 13, no. 2, pp. 49-57, 1999.
- [229] P. Sweetser and P. Wyeth, "GameFlow: a model for evaluating player enjoyment in games," *Computers in Entertainment (CIE)*, vol. 3, no. 3, pp. 3-3, 2005.
- [230] R. M. Ryan, C. S. Rigby, and A. Przybylski, "The motivational pull of video games: A self-determination theory approach," *Motivation and emotion*, vol. 30, no. 4, pp. 344-360, 2006.
- [231] J. O. Prochaska, J. C. Norcross, and C. C. DiClemente, "Applying the stages of change," *Psychotherapy in Australia*, vol. 19, no. 2, pp. 10-15, 2013.
- [232] J. Cameron, K. M. Banko, and W. D. Pierce, "Pervasive negative effects of rewards on intrinsic motivation: the myth continues," *The Behavior Analyst*, vol. 24, no. 1, pp. 1-44, 2001.
- [233] C. I. Muntean, "Raising engagement in e-learning through gamification," in *Proc. of the 6th International Conference on Virtual Learning, ICVL 2011*, Cluj-Napoca, Romania, 2011, pp. 323-329.
- [234] J. Hamari, J. Koivisto, and H. Sarsa, "Does gamification work?--a literature review of empirical studies on gamification," in *Proc. of the 47th Hawaii International Conference on System Sciences, HICSS 2014*, Waikoloa, Hawaii, 2014, pp. 3025-3034: IEEE.
- [235] R. Garris, R. Ahlers, and J. E. Driskell, "Games, motivation and learning: a research and practice model," *Simulation Gaming*, vol. 33, pp. 441-467, 2002.
- [236] C. P. Cerasoli, J. M. Nicklin, and M. T. Ford, "Intrinsic motivation and extrinsic incentives jointly predict performance: a 40-year meta-analysis," (in eng), *Psychological Bulletin*, vol. 140, no. 4, pp. 980-1008, Jul 2014.

References

- [237] M. Papastergiou, "Exploring the potential of computer and video games for health and physical education: A literature review," *Computers & Education*, vol. 53, no. 3, pp. 603-622, 2009.
- [238] A. Patel *et al.*, "Distraction with a hand-held video game reduces pediatric preoperative anxiety," *Pediatric Anesthesia*, vol. 16, no. 10, pp. 1019-1027, 2006.
- [239] T. J. O'Connor *et al.*, "Evaluation of a manual wheelchair interface to computer games," *Neurorehabilitation and Neural Repair*, vol. 14, no. 1, pp. 21-31, 2000.
- [240] S. G. Fitzgerald, R. A. Cooper, T. Thorman, R. Cooper, S. Guo, and M. L. Boninger, "The GAME (Cycle) exercise system: comparison with standard ergometry," *The Journal of Spinal Cord Medicine*, vol. 27, no. 5, pp. 453-9, 2004.
- [241] S. R. Sharar, G. J. Carrougner, D. Nakamura, H. G. Hoffman, D. K. Blough, and D. R. Patterson, "Factors influencing the efficacy of virtual reality distraction analgesia during postburn physical therapy: preliminary results from 3 ongoing studies," *Archives of Physical Medicine and Rehabilitation*, vol. 88, no. 12, pp. S43-S49, 2007.
- [242] S. J. Brown, D. A. Lieberman, B. Gemeny, Y. C. Fan, D. Wilson, and D. Pasta, "Educational video game for juvenile diabetes: results of a controlled trial," *Medical Informatics*, vol. 22, no. 1, pp. 77-89, 1997.
- [243] D. A. Lieberman, "Management of chronic pediatric diseases with interactive health games: Theory and research findings," *The Journal of Ambulatory Care Management*, vol. 24, no. 1, pp. 26-38, 2001.
- [244] M. D. Hanus and J. Fox, "Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance," *Computers & Education*, vol. 80, pp. 152-161, 2015.
- [245] W. J. Boendermaker, P. J. M. Prins, and R. W. Wiers, "Cognitive Bias Modification for adolescents with substance use problems – Can serious games help?," *Journal of Behavior Therapy and Experimental Psychiatry*, vol. 49, pp. 13-20, 2015/12/01/ 2015.
- [246] K. C. Berridge and M. L. Kringelbach, "Affective neuroscience of pleasure: reward in humans and animals," (in eng), *Psychopharmacology*, vol. 199, no. 3, pp. 457-480, 2008.
- [247] P. Dayan and B. W. Balleine, "Reward, motivation, and reinforcement learning," *Neuron*, vol. 36, no. 2, pp. 285-98, 2002.
- [248] R. M. Ryan and E. L. Deci, "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions," *Contemporary Educational Psychology*, vol. 25, no. 1, pp. 54-67, 2000.
- [249] C. C. Ruff and E. Fehr, "The neurobiology of rewards and values in social decision making," (in eng), *Nature reviews. Neuroscience*, vol. 15, no. 8, pp. 549-562, 2014.
- [250] W. Schultz, "Behavioral theories and the neurophysiology of reward," *Annual review of psychology*, vol. 57, pp. 87-115, 2006.

- [251] H. Wang and C.-T. Sun, "Game reward systems: Gaming experiences and social meanings," in *Proc. of the 2011 DiGRA International Conference: Think Design Play, DiGRA '11*, Utrecht, Netherlands, 2011.
- [252] J. Hamari and V. Eranti, "Framework for Designing and Evaluating Game Achievements," in *Proc. of the 2011 DiGRA International Conference: Think Design Play, DiGRA '11*, Utrecht, Netherlands, 2011.
- [253] A. K. Przybylski, C. S. Rigby, and R. M. Ryan, "A motivational model of video game engagement," *Review of General Psychology*, vol. 14, no. 2, pp. 154-166, 2010.
- [254] H. Braun, I. Kirsch, and K. Yamamoto, "An Experimental Study of the Effects of Monetary Incentives on Performance on the 12th-Grade NAEP Reading Assessment," *Teachers College Record*, vol. 113, no. 11, pp. 2309-2344, 2011.
- [255] G. Kohls, J. Peltzer, B. Herpertz-Dahlmann, and K. Konrad, "Differential effects of social and non-social reward on response inhibition in children and adolescents," *Developmental Science*, vol. 12, no. 4, pp. 614-625, 2009.
- [256] A. D. Stajkovic and F. Luthans, "Differential Effects of Incentive Motivators on Work Performance," *The Academy of Management Journal*, vol. 44, no. 3, pp. 580-590, 2001.
- [257] W.-H. Choi *et al.*, "An fMRI Study Investigating Adolescent Brain Activation by Rewards and Feedback," *Psychiatry Investigation*, vol. 10, no. 1, pp. 47-55, 2013.
- [258] M. J. Koeppe *et al.*, "Evidence for striatal dopamine release during a video game," (in eng), *Nature*, vol. 393, no. 6682, pp. 266-8, May 21 1998.
- [259] N. D. Volkow, J. S. Fowler, G. J. Wang, and J. M. Swanson, "Dopamine in Drug Abuse and Addiction: Results From Imaging Studies and Treatment Implications," *Molecular Psychiatry*, vol. 9, pp. 557-569, 2004.
- [260] P. Siriaraya, V. Visch, A. Vermeeren, and M. Bas, "A cookbook method for Persuasive Game Design," *International Journal of Serious Games*, vol. 5, no. 1, pp. 37-71, 2018.
- [261] G. F. Koob and M. Le Moal, "Drug addiction, dysregulation of reward, and allostasis," *Neuropsychopharmacology*, vol. 24, no. 2, pp. 97-129, 2001.
- [262] J. Reuter, T. Raedler, M. Rose, I. Hand, J. Glascher, and C. Buchel, "Pathological gambling is linked to reduced activation of the mesolimbic reward system," *Nature Neuroscience*, vol. 8, no. 2, pp. 147-148, 2005.
- [263] N. D. Volkow, G.-J. Wang, J. S. Fowler, D. Tomasi, F. Telang, and R. Baler, "Addiction: Decreased reward sensitivity and increased expectation sensitivity conspire to overwhelm the brain's control circuit," *BioEssays : news and reviews in molecular, cellular and developmental biology*, vol. 32, no. 9, pp. 748-755, 2010.
- [264] G. F. Koob and M. Le Moal, "Plasticity of reward neurocircuitry and the 'dark side' of drug addiction," *Nature Neuroscience*, vol. 8, p. 1442, 2005.
- [265] J.-E. Kim *et al.*, "Neural responses to various rewards and feedback in the brains of adolescent Internet addicts detected by functional magnetic resonance imaging," *Psychiatry and Clinical Neurosciences*, vol. 68, no. 6, pp. 463-470, 2014.

References

- [266] N. D. Volkow, G. J. Wang, J. S. Fowler, D. Tomasi, and F. Telang, "Addiction: beyond dopamine reward circuitry," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 108, no. 37, pp. 15037-15042, 2011.
- [267] M. Prendergast, D. Podus, J. Finney, L. Greenwell, and J. Roll, "Contingency management for treatment of substance use disorders: a meta-analysis," *Addiction*, vol. 101, no. 11, pp. 1546-1560, 2006.
- [268] S. Shoptaw *et al.*, "Behavioral treatment approaches for methamphetamine dependence and HIV-related sexual risk behaviors among urban gay and bisexual men," *Drug and Alcohol Dependence*, vol. 78, no. 2, pp. 125-134, 2005.
- [269] S. Minozzi, R. Saulle, F. De Crescenzo, and L. Amato, "Psychosocial interventions for psychostimulant misuse," *Cochrane Database of Systematic Reviews*, vol. 9, p. Cd011866, 2016.
- [270] J. P. Lussier, S. H. Heil, J. A. Mongeon, G. J. Badger, and S. T. Higgins, "A meta-analysis of voucher-based reinforcement therapy for substance use disorders," *Addiction*, vol. 101, no. 2, pp. 192-203, 2006.
- [271] W. M. Compton, 3rd, L. B. Cottler, A. Ben Abdallah, D. L. Phelps, E. L. Spitznagel, and J. C. Horton, "Substance dependence and other psychiatric disorders among drug dependent subjects: race and gender correlates," *The American Journal on Addictions*, vol. 9, no. 2, pp. 113-125, 2000.
- [272] S. E. Young, R. P. Corley, M. C. Stallings, S. H. Rhee, T. J. Crowley, and J. K. Hewitt, "Substance use, abuse and dependence in adolescence: prevalence, symptom profiles and correlates," *Drug and Alcohol Dependence*, vol. 68, no. 3, pp. 309-322, 2002.
- [273] S. IVZ. (2016). *Kerncijfers Verslavingszorg 2015. LADIS, Landelijk Alcohol en Drugs Informatie Systeem. Achieved 02-02-2019 from <https://www.ggz nederland.nl/uploads/assets/Werkdocument%20KC%202015%20.pdf>*.
- [274] R. Rigter and P. Blanken, "Kerncijfers Brijder Jeugd 2016.," *Den Haag: Parnassia Addiction Research Centre (PARC), Brijder Verslavingszorg, Parnassia Groep*, 2017.
- [275] Jannet de Jonge, Renske Spijkerman, and M. Müller, *Handleiding CGT-J. Cognitieve gedragstherapeutische behandeling van problematisch middelengebruik, gokken en gamen bij jongeren* Resultaten Scoren & Perspectief Uitgevers 2018.
- [276] M. Ventura, V. Shute, and W. Zhao, "The relationship between video game use and a performance-based measure of persistence," *Computers & Education*, vol. 60, no. 1, pp. 52-58, 2013.
- [277] L. Van Leijenhorst, B. Gunther Moor, Z. A. Op de Macks, S. A. Rombouts, P. M. Westenberg, and E. A. Crone, "Adolescent risky decision-making: neurocognitive development of reward and control regions," *Neuroimage*, vol. 51, no. 1, pp. 345-355, 2010.
- [278] B. R. Braams, A. C. van Duijvenvoorde, J. S. Peper, and E. A. Crone, "Longitudinal changes in adolescent risk-taking: a comprehensive study of neural responses to rewards, pubertal development, and risk-taking behavior," *The Journal of*

- neuroscience : the official journal of the Society for Neuroscience*, vol. 35, no. 18, pp. 7226-7238, May 6 2015.
- [279] A. Galvan *et al.*, "Earlier development of the accumbens relative to orbitofrontal cortex might underlie risk-taking behavior in adolescents," *The Journal of neuroscience : the official journal of the Society for Neuroscience*, vol. 26, no. 25, pp. 6885-92, 2006.
 - [280] N. Shabihi, F. Taghiyareh, and M. H. Abdoli, "Analyzing the effect of game-elements in e-learning environments through MBTI-based personalization," in *Telecommunications (IST), 2016 8th International Symposium on*, 2016, pp. 612-618: IEEE.
 - [281] M. R. Mitchell and M. N. Potenza, "Addictions and Personality Traits: Impulsivity and Related Constructs," *Current Behavioral Neuroscience Reports*, vol. 1, no. 1, pp. 1-12, 2014.
 - [282] G. F. Tondello, R. R. Wehbe, L. Diamond, M. Busch, A. Marczewski, and L. E. Nacke, "The Gamification User Types Hexad Scale," presented at the Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play, Austin, Texas, USA, 2016.
 - [283] R. Kotov, W. Gamez, F. Schmidt, and D. Watson, "Linking "big" personality traits to anxiety, depressive, and substance use disorders: A meta-analysis," *Psychological Bulletin*, vol. 136, no. 5, pp. 768-821, 2010.
 - [284] B. R. Braams, S. Peters, J. S. Peper, B. Guroglu, and E. A. Crone, "Gambling for self, friends, and antagonists: differential contributions of affective and social brain regions on adolescent reward processing," *Neuroimage*, vol. 100, pp. 281-289, 2014.
 - [285] N. Vegt, V. Visch, A. Vermeeren, and H. Ridder, *A Case Study on Gamified Interventions for Team Cohesion in Factory Work*. 2018, pp. 176-208.
 - [286] I. Ajzen, "Perceived Behavioral Control, Self-Efficacy, Locus of Control, and the Theory of Planned Behavior1," *Journal of Applied Social Psychology*, vol. 32, no. 4, pp. 665-683, 2002.
 - [287] S. Gilbert, *Designing Gamified Systems: Meaningful play in interactive entertainment, marketing and education*. Focal Press, 2015.
 - [288] J. Schell, "The art of game design: a book of lenses," ed: San Francisco, Calif.: Morgan Kaufmann; Oxford: Elsevier Science [distributor], 2008.
 - [289] K. Salen and E. Zimmerman, *Rules of Play: Game Design Fundamentals*. MIT press, 2004.
 - [290] T. Hainey, T. Connolly, M. Stansfield, and E. Boyle, "The differences in motivations of online game players and offline game players: A combined analysis of three studies at higher education level," *Computers & Education*, vol. 57, no. 4, pp. 2197-2211, 2011.
 - [291] L. Van Leijenhorst, K. Zanolie, C. S. Van Meel, P. M. Westenberg, S. A. R. B. Rombouts, and E. A. Crone, "What Motivates the Adolescent? Brain Regions Mediating Reward Sensitivity across Adolescence," *Cerebral Cortex*, vol. 20, no. 1, pp. 61-69, 2010.

References

- [292] K. N. Spreckelmeyer *et al.*, "Anticipation of monetary and social reward differently activates mesolimbic brain structures in men and women," *Social cognitive and affective neuroscience*, vol. 4, no. 2, pp. 158-165, 2009.
- [293] B. Knutson, G. W. Fong, C. M. Adams, J. L. Varner, and D. Hommer, "Dissociation of reward anticipation and outcome with event-related fMRI," *Neuroreport*, vol. 12, no. 17, pp. 3683-3687, 2001.
- [294] E. Demurie, H. Roeyers, D. Baeyens, and E. Sonuga-Barke, "Common alterations in sensitivity to type but not amount of reward in ADHD and autism spectrum disorders," *Journal of Child Psychology and Psychiatry*, vol. 52, no. 11, pp. 1164-1173, 2011.
- [295] A. A. Scott-Van Zeeland, M. Dapretto, D. G. Ghahremani, R. A. Poldrack, and S. Y. Bookheimer, "Reward processing in autism," *Autism research : official journal of the International Society for Autism Research*, vol. 3, no. 2, pp. 53-67, 2010.
- [296] J. A. Richey *et al.*, "Common and distinct neural features of social and non-social reward processing in autism and social anxiety disorder," *Social cognitive and affective neuroscience*, vol. 9, no. 3, pp. 367-377, 2014.
- [297] H. Oinas-Kukkonen, "Behavior change support systems: a research model and agenda," in *Proc. of the 5th International Conference on Persuasive Technology, PERSUASIVE 2010*, Copenhagen, Denmark, 2010, pp. 4-14: Springer Berlin Heidelberg.
- [298] M. M. M. v. Dooren, R. Spijkerman, R. H. M. Goossens, V. M. Hendriks, and V. T. Visch, "PLEX as input and evaluation tool in persuasive game design: pilot study," presented at the Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play, Toronto, Ontario, Canada, 2014.
- [299] P. Siriraya, V. T. Valentijn Visch, M. M. M. van Dooren, and R. Spijkerman, "Learnings and challenges in designing gamifications for mental healthcare: the case study of the ReadySetGoals Application," in *10th International Conference on Virtual Worlds and Games for Serious Applications (VS Games 2018)*, 2018: IEEE.
- [300] M. Krank, S. H. Stewart, R. O'Connor, P. B. Woicik, A.-M. Wall, and P. J. Conrod, "Structural, concurrent, and predictive validity of the Substance Use Risk Profile Scale in early adolescence," *Addictive behaviors*, vol. 36, no. 1, pp. 37-46, 2011.
- [301] C. W. Langfred and N. A. Moye, "Effects of task autonomy on performance: an extended model considering motivational, informational, and structural mechanisms," *The Journal of applied psychology*, vol. 89, no. 6, pp. 934-945, 2004.
- [302] H. M. Lau, J. H. Smit, T. M. Fleming, and H. Riper, "Serious Games for Mental Health: Are They Accessible, Feasible, and Effective? A Systematic Review and Meta-analysis," (in eng), *Front Psychiatry*, vol. 7, p. 209, 2016.
- [303] R. C. Kessler, P. Berglund, O. Demler, R. Jin, K. R. Merikangas, and E. E. Walters, "Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication," (in eng), *Arch Gen Psychiatry*, vol. 62, no. 6, pp. 593-602, Jun 2005.
- [304] R. W. Wiers, C. Eberl, M. Rinck, E. S. Becker, and J. Lindenmeyer, "Retraining automatic action tendencies changes alcoholic patients' approach bias for

- alcohol and improves treatment outcome," (in eng), *Psychol Sci*, vol. 22, no. 4, pp. 490-7, Apr 2011.
- [305] S. Nicholson, "A user-centered theoretical framework for meaningful gamification," *Games+ Learning+ Society*, vol. 8, no. 1, pp. 223-230, 2012.
- [306] R. Tate, J. Haritatos, and S. Cole, *HopeLab's Approach to ReMission*. 2009, pp. 29-35.
- [307] D. Thompson, T. Baranowski, and R. Buday, "Conceptual model for the design of a serious video game promoting self-management among youth with type 1 diabetes," *Journal of diabetes science and technology*, vol. 4, no. 3, pp. 744-749, 2010.
- [308] P. Cuijpers, M. Berking, G. Andersson, L. Quigley, A. Kleiboer, and K. S. Dobson, "A meta-analysis of cognitive-behavioural therapy for adult depression, alone and in comparison with other treatments," (in eng), *Can J Psychiatry*, vol. 58, no. 7, pp. 376-85, Jul 2013.
- [309] A. C. Butler, J. E. Chapman, E. M. Forman, and A. T. Beck, "The empirical status of cognitive-behavioral therapy: a review of meta-analyses," *Clinical Psychology Review*, vol. 26, no. 1, pp. 17-31, 2006.
- [310] J. Zimmerman, J. Forlizzi, and S. Evenson, "Research through design as a method for interaction design research in HCI," presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, San Jose, California, USA, 2007.
- [311] W. Gaver, "What should we expect from research through design?," presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Austin, Texas, USA, 2012.
- [312] C. E. Wiers *et al.*, "Effects of cognitive bias modification training on neural alcohol cue reactivity in alcohol dependence," (in eng), *Am J Psychiatry*, vol. 172, no. 4, pp. 335-43, Apr 2015.
- [313] P. J. Conrod and K. Nikolaou, "Annual Research Review: On the developmental neuropsychology of substance use disorders," (in eng), *J Child Psychol Psychiatry*, vol. 57, no. 3, pp. 371-94, Mar 2016.
- [314] M. Malmberg, G. Overbeek, K. Monshouwer, J. Lammers, W. A. Vollebergh, and R. C. Engels, "Substance use risk profiles and associations with early substance use in adolescence," (in eng), *J Behav Med*, vol. 33, no. 6, pp. 474-85, Dec 2010.
- [315] N. Castellanos-Ryan and P. Conrod, "Personality and substance misuse: Evidence for a four-factor model of vulnerability," in *Drug abuse and addiction in medical illness: Causes, consequences and treatment*. New York, NY, US: Springer Science + Business Media, 2012, pp. 47-62.
- [316] P. A. Woicik, S. H. Stewart, R. O. Pihl, and P. J. Conrod, "The substance use risk profile scale: A scale measuring traits linked to reinforcement-specific substance use profiles," *Addictive behaviors*, vol. 34, no. 12, pp. 1042-1055, 2009.
- [317] M. Zuckerman, "Sensation Seeking and Substance Use and Abuse: Smoking, Drinking, and Drugs," in *Sensation seeking and risky behavior*. Washington, DC, US: American Psychological Association, 2007, pp. 107-143.

References

- [318] M. M. van Dooren, V. T. Visch, and R. Spijkerman, "The Design and Application of Game Rewards in Youth Addiction Care," *Information*, vol. 10, no. 4, p. 126, 2019.
- [319] Y. Francillette, A. Gouaïch, N. Hocine, and J. Pons, "A gameplay loops formal language," in *2012 17th International Conference on Computer Games (CGAMES)*, 2012, pp. 94-101.
- [320] L. Andreas, M. Max, and M. Andreea Catalina, "Deep and Shallow Gamification in Marketing: Thin Evidence and the Forgotten Powers of Really Good Games," in *Engaging Consumers through Branded Entertainment and Convergent Media* Hershey, PA, USA: IGI Global, 2015, pp. 110-126.
- [321] W. IJsselsteijn, Y. De Kort, and K. Poels, "{The Game Experience Questionnaire: Development of a self-report measure to assess the psychological impact of digital games. Manuscript in Preparation}," 2013.
- [322] N. Gillet, R. J. Vallerand, and M.-A. K. Lafrenière, "Intrinsic and extrinsic school motivation as a function of age: the mediating role of autonomy support," *Social Psychology of Education*, vol. 15, no. 1, pp. 77-95, 2012/03/01 2012.
- [323] T. M. Kelly and D. C. Daley, "Integrated treatment of substance use and psychiatric disorders," *Social work in public health*, vol. 28, no. 3-4, pp. 388-406, 2013.
- [324] P. J. Prins, D. S. D. Ponsioen, A. Ten Brink, E., & Van der Oord, S., "Does computerized working memory training with game elements enhance motivation and training efficacy in children with ADHD?," *Cyberpsychology, behavior, and social networking*, vol. 14, no. 3, pp. 115-122, 2011.
- [325] S. D. S. Van der Oord, R. W. Wiers, and P. J. Prins, "Can motivation normalize working memory and task persistence in children with attention-deficit/hyperactivity disorder? The effects of money and computer-gaming," (in eng), *J Abnorm Child Psychol*, vol. 40, no. 5, pp. 669-81, Jul 2012.
- [326] A. Sung *et al.*, "From the small screen to the big world: mobile apps for teaching real-world face recognition to children with autism," *Advanced Health Care Technologies*, vol. 1, pp. 37-45, 2015.
- [327] K. M. Carroll *et al.*, "Motivational interviewing to improve treatment engagement and outcome in individuals seeking treatment for substance abuse: a multisite effectiveness study," *Drug and alcohol dependence*, vol. 81, no. 3, pp. 301-312, 2006.
- [328] T. Susi, M. Johannesson, and P. Backlund, "Serious games: An overview," ed: Institutionen för kommunikation och information, 2007.
- [329] R. M. Entman, "Framing: Toward Clarification of a Fractured Paradigm," *Journal of Communication*, vol. 43, no. 4, pp. 51-58, 1993.
- [330] J. Juul, "The Open and the Closed: Game of emergence and games of progression," in *Computer Games and Digital Cultures Conference Proceedings*, Tampere University Press, 2002, pp. 323-329: Tampere.
- [331] E. Adams and J. Dormans, *Game Mechanics: Advanced Game Design*. New Riders Publishing, 2012, p. 360.

- [332] S. Göbel, V. Wendel, C. Ritter, and R. Steinmetz, "Personalized, Adaptive Digital Educational Games Using Narrative Game-Based Learning Objects," Berlin, Heidelberg, 2010, pp. 438-445: Springer Berlin Heidelberg.
- [333] G. Andrade, G. Ramalho, H. Santana, and V. Corruble, "Automatic computer game balancing: a reinforcement learning approach," presented at the Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems, The Netherlands, 2005.
- [334] K. van der Kooij, E. Hoogendoorn, R. Spijkerman, and V. Visch, "Validation of serious games," *International Journal of Serious Games*, vol. 2, no. 3, 2015.
- [335] J. E. Van Gemert-Pijnen, S. M. Kelders, and E. T. Bohlmeijer, "Understanding the Usage of Content in a Mental Health Intervention for Depression: An Analysis of Log Data," (in English), *J Med Internet Res*, Original Paper vol. 16, no. 1, p. e27, 2014.
- [336] C. Granja, W. Janssen, and M. A. Johansen, "Factors Determining the Success and Failure of eHealth Interventions: Systematic Review of the Literature," (in eng), *Journal of medical Internet research*, vol. 20, no. 5, pp. e10235-e10235, 2018.
- [337] R. Orji, G. F. Tondello, and L. E. Nacke, "Personalizing persuasive strategies in gameful systems to gamification user types," in *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 2018, p. 435: ACM.
- [338] A. Cadamuro and V. Visch, "'What Remains?': A Persuasive Story Telling Game," in *Games for Health*, B. Schouten, S. Fedtke, T. Bekker, M. Schijven, and A. Gekker, Eds.: Springer Fachmedien Wiesbaden, 2013, pp. 153-160.
- [339] G. Dunn *et al.*, "Effective elements of cognitive behaviour therapy for psychosis: results of a novel type of subgroup analysis based on principal stratification," (in eng), *Psychological medicine*, vol. 42, no. 5, pp. 1057-1068, 2012.
- [340] M. Y. Ng and J. R. Weisz, "Building a science of personalized intervention for youth mental health," *Journal of child psychology and psychiatry, and allied disciplines*, vol. 57, no. 3, pp. 216-236, 10/15 2016.
- [341] A. Ghaderi, "Does individualization matter? A randomized trial of standardized (focused) versus individualized (broad) cognitive behavior therapy for bulimia nervosa," *Behaviour Research and Therapy*, vol. 44, no. 2, pp. 273-288, 2006.
- [342] K. Vernmark, Lenndin, J., Bjärehed, J., Carlsson, M., Karlsson, J., Öberg, J., ... & Andersson, G., "Internet administered guided self-help versus individualized e-mail therapy: A randomized trial of two versions of CBT for major depression," *Behaviour research and therapy*, vol. 48, no. 5, pp. 368-376, 2010.
- [343] J. L. Hudson *et al.*, "Child involvement, alliance, and therapist flexibility: process variables in cognitive-behavioural therapy for anxiety disorders in childhood," (in eng), *Behav Res Ther*, vol. 52, pp. 1-8, Jan 2014.
- [344] S. E. Knowles *et al.*, "Qualitative meta-synthesis of user experience of computerised therapy for depression and anxiety," (in eng), *PloS one*, vol. 9, no. 1, pp. e84323-e84323, 2014.
- [345] W. Tang and D. Kreindler, "Supporting Homework Compliance in Cognitive Behavioural Therapy: Essential Features of Mobile Apps," (in eng), *JMIR Ment Health*, vol. 4, no. 2, p. e20, Jun 8 2017.

References

- [346] K. D. Ersche, A. J. Turton, S. Pradhan, E. T. Bullmore, and T. W. Robbins, "Drug Addiction Endophenotypes: Impulsive Versus Sensation-Seeking Personality Traits," *Biological Psychiatry*, vol. 68, no. 8, pp. 770-773, 2010/10/15/ 2010.
- [347] R. Orji, L. E. Nacke, and C. D. Marco, "Towards Personality-driven Persuasive Health Games and Gamified Systems," presented at the Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado, USA, 2017.
- [348] E. Murray *et al.*, "Evaluating Digital Health Interventions: Key Questions and Approaches," (in eng), *Am J Prev Med*, vol. 51, no. 5, pp. 843-851, Nov 2016.
- [349] C. W. Langfred and N. A. Moye, " Effects of task autonomy on performance: An extended model considering motivational, informational, and structural mechanisms," *Journal of Applied Psychology*, 89, pp. 934-945, 2004.
- [350] L. R. Martin, S. L. Williams, K. B. Haskard, and M. R. DiMatteo, "The challenge of patient adherence," *Therapeutics and Clinical Risk Management*, vol. 1, no. 3, pp. 189-199, 09/ 2005.
- [351] A. Loh, R. Leonhart, C. E. Wills, D. Simon, and M. Harter, "The impact of patient participation on adherence and clinical outcome in primary care of depression," (in eng), *Patient Education and Counseling*, vol. 65, no. 1, pp. 69-78, Jan 2007.
- [352] K. Ryan, S. Dockray, and C. Linehan, "A systematic review of tailored eHealth interventions for weight loss," (in eng), *Digital health*, vol. 5, pp. 2055207619826685-2055207619826685, 2019.
- [353] A. J. Linn, M. Vervloet, L. van Dijk, E. G. Smit, and J. C. Van Weert, "Effects of eHealth Interventions on Medication Adherence: A Systematic Review of the Literature," (in English), *J Med Internet Res*, Review vol. 13, no. 4, p. e103, 2011.
- [354] B. K. Campbell, J. Guydish, T. Le, E. A. Wells, and D. McCarty, "The relationship of therapeutic alliance and treatment delivery fidelity with treatment retention in a multisite trial of twelve-step facilitation," (in eng), *Psychology of addictive behaviors : journal of the Society of Psychologists in Addictive Behaviors*, vol. 29, no. 1, pp. 106-113, 2015.
- [355] M. K. Nock, B. D. Michel, and V. I. Photos, "Single-case research designs," *Handbook of research methods in abnormal and clinical psychology*, pp. 337-350, 2007.
- [356] H. Ossebaard, L. van Gemert-Pijnen, A. de Bruijn, and R. Geertsma, "Magnitude of ehealth technology risks largely unknown," *Int J Adv Syst Meas*, vol. 6, no. 1, pp. 57-71, 2013.
- [357] C. Hallensleben, S. van Luenen, E. Rolink, H. Ossebaard, and N. Chavannes, "eHealth for people with COPD in the Netherlands: a scoping review," *International Journal of Chronic Obstructive Pulmonary Disease*, vol. Volume 14, pp. 1681-1690, 07/01 2019.

SUMMARY

This dissertation focused on the added value of personalized gamification as a factor to enhance implementation potential of eHealth interventions in youth mental healthcare. Mental health disorders are the leading cause of disability in adolescents. It is important for these adolescents to go into therapy, as adolescence is a period in life in which essential developments occur on which mental health disorders have a negative impact. Although psychosocial therapies are effective in reducing psychiatric symptoms in adolescents with mental disorders, there is still room for improvement. For example, because of premature termination of treatment, poor attendance of treatment-sessions and a low or non-adherence to homework assignments.

One way of improving psychological treatment is the use of the use of Information and Communication Technologies combined with face-to-face therapy (also called “blended eHealth”). It can extend the reach of psychological therapy beyond the clinical setting, as technologies can be used anytime and anywhere. It is especially suitable for adolescents, as a majority owns a smartphone.

Current eHealth interventions in mental healthcare are often focused on the therapeutic content and provide limited interaction motivation for the users, causing a high drop-out rate. Users of therapeutic eHealth should thus be motivated to start and continue to use the online modules for therapy-related activities, especially when they have to perform these online modules in their own environment and time.

Gamification seems a suitable design technique to enhance this motivation within eHealth interventions. It aims to change the behavior of a user in the real world (this change is also called the (health related) transfer effect) by creating a game world experience that is more engaging, free and enjoyable compared to a real world experience, by using game-elements in a non-game context. However, some game-elements can be more motivating for specific individuals than others and should therefore be personalized.

We first conducted a literature study that focused on how personalization is applied in game design for healthcare and how these games influenced health related outcomes (**Chapter 2**). This was followed by a focus group study that focused on the therapeutic practice of personalization in youth mental healthcare (**Chapter 3**) and experiments that focused on the game design relevance of personalization in youth mental healthcare (**Chapter 4**). Based on this information, we designed an eHealth application for youth mental healthcare and implemented gamification and personalization in the design and explain this process in **Chapter 5**. Concluding, the aim of the study in this dissertation was to study the added value of personalized gamification to enhance implementation potential of eHealth interventions in youth mental healthcare.

Since personalization in gamification had never been systematically studied, I executed a literature study and developed a model to study the effects of personalization in game design for healthcare (**Chapter 2**). Based on the literature we proposed a model for different types of personalization in eHealth development and design. We defined 'personalization' as the involvement of stakeholders across Problem Definition, Product Design and Tailoring (the Personalized Design Process (PDP) phases). In the first phase, information is generated to identify, establish and analyze the problem and generate related ideas. In the next Product Design phase, possible solutions are produced, resulting in product ideas or design proposal(s) that are tested and evaluated by users, and further improved through iterations. In the last Tailoring phase, the final product can be tailored to the needs of individual end-users. The studies generally found positive effects on interaction experience, interaction behavior and health related transfer effects. However, since a majority of the studies were of low methodological quality, we could only suggest that it is important to involve stakeholders across the PDP-phases. It will limit the amount of iterations needed, as the chance is increased that the eHealth intervention is aligned to the users. Consequently, the users will potentially use the product to its full extend which will positively influence the health related transfer effect.

Personalization is not only often applied in game design for healthcare, but also in a therapeutic process. Therapists and patients often adapt therapy protocols, to align it to their personal preferences and situation. If designers of eHealth for mental healthcare do not take this into account it is more likely that the final eHealth design does not suit the therapeutic practice. This will in turn negatively influence the implementation. We conducted focus-group discussions with patients and therapists in youth addiction care on therapy protocol application and personalization (**Chapter 3**) and generated recommendations for eHealth designers to enhance alignment of eHealth to the therapeutic practice and implementation: a) study and copy at least the actual applied parts of a therapy protocol in eHealth, b) co-design eHealth in such a way that both therapists and patients can personalize specific parts of the final eHealth design, and c) investigate if parts of the therapy protocol that are not presently applied by therapists or patients should be part of the eHealth application.

Even when an eHealth product is aligned to therapeutic practice, it is important to enhance the motivation of patients to use eHealth and to facilitate the achievement of aimed-for real-world goals such as behavioral change. This can be done by making it more appealing by applying gamification design. We first used a design method with the often used PLEX cards that represent 22 playful experiences that can motivate users to (continue) to play a game. We wanted to examine whether the input of playful experiences was also experienced by other end-users from the same context in the actual design itself (**Chapter 4A**). However the experiences that were used in the design of the prototype did not correspond one-on-one with the experiences that were reported by other users who played the prototype. To ensure that the product is still aligned to preferred experiences and limit possible individual preferences of stakeholder types that cannot be generalizable to the specific stakeholder type, it is important to involve stakeholders in multiple moments and phases of a PDP, and not only in one. Next to the specific design method, we also wanted to study the effect of a specific design element in a youth mental healthcare context. Rewards are the most typically used game-elements to foster motivation in entertainment gaming. However, it is unclear whether game-rewards are also effective in a

healthcare context. For example, patients with substance-related disorders may be less sensitive to non-drug-related rewards compared to patients without a substance use disorder. Results of our study (**Chapter 4B**) showed that, in contrast to our expectations, substance dependent participants were more motivated by the types of rewards compared to non-substance dependent participants.

The previous chapters provided argumentation for personalization to enhance implementation of gamified eHealth. This was taken into account in the design process of an eHealth application for youth mental healthcare (**Chapter 5**). We wanted to test the general effect of the gamification, by conducting a non-randomized pre-post (eight weeks) study. In this study we contrasted two conditions: one eHealth intervention that was gamified and one that was not gamified. However, the inflow of patients in the Luca study was low, and at the time of writing it was uncertain whether the study could be finalized as planned according to our protocol. The main reason was that the study set-up was not in line with the current therapeutic practice, which was a reason for therapists and patients to not be fully willing to participate in the experiment. Thus, even when eHealth is personalized and gamified, implementation can still be influenced by negative expectations about the effect, a limited integration within current therapy.

Concluding, when stakeholders are more actively involved in the design phases of a gamification, the motivational effect of the gamification can be enhanced. It is important to align an eHealth product to the context of application and to align the design to the preferred experience, capacity and context of a user, to enhance the implementation potential. Secondly, the set-up of effect-studies should be adapted to the context of application to limit invasiveness in therapeutic practice and to enhance the feasibility of the study. If a study set-up is not in line with the current therapeutic practice, therapists and patients may thus not be fully willing to participate in an experiment. This would make it difficult or impossible to test the effect of personalized gamification in eHealth, which is useful information for future eHealth designs and studies to enhance implementation potential.

SAMENVATTING

Dit proefschrift richtte zich op de toegevoegde waarde van gepersonaliseerde gamificatie als een factor om de implementatie van eHealth interventies in de jeugd geestelijke gezondheidszorg (jeugd-GGZ) te vergroten. Psychische stoornissen zijn de grootste oorzaak van belemmeringen in de adolescentie. Voor deze adolescenten is het belangrijk om in behandeling te gaan, omdat de adolescentie een periode in het leven is waarbinnen essentiële ontwikkelingen plaatsvinden waar psychische stoornissen een negatieve impact op hebben. Ondanks effectieve psychosociale behandelingen om symptomen bij adolescenten met psychische stoornissen te verminderen, is er nog steeds ruimte voor verbetering. Bijvoorbeeld, omdat veel behandelingen vroegtijdig stoppen, men vaak niet aanwezig is op behandelsessies, en behandel opdrachten vaak niet of niet volledig worden uitgevoerd.

Een mogelijkheid om psychologische behandeling te verbeteren, is het gebruik van Informatie en Communicatie Technologieën in combinatie met face-to-face therapie (ook “blended behandeling” genoemd). Het kan zorgen voor een groter bereik van de face-to-face behandeling dan alleen binnen de klinische setting, omdat dergelijke technologieën altijd en overal gebruikt kan worden. Daarbij is het vooral geschikt voor adolescenten, omdat een meerderheid van hen in het bezit is van een smartphone.

Huidige eHealth interventies in de GGZ zijn vaak gericht op de therapeutische inhoud en zorgen voor een beperkte interactie motivatie voor de gebruikers, wat voor veel uitval in gebruik zorgt. Gebruikers van therapeutische eHealth moeten dus gemotiveerd worden om de online modules te gebruiken en blijven te gebruiken voor therapeutische-gerelateerde activiteiten, vooral als dit moet gebeuren in hun eigen omgeving en tijd.

Gamificatie lijkt een gepaste ontwerptechniek om deze motivatie binnen eHealth interventies te verhogen. Het heeft als doel het gedrag van de gebruiker in zijn of haar dagelijkse leven te veranderen, door een spel-wereld-ervaring te creëren die aantrekkelijker, vrijer, en leuker is dan de ervaringen in de echte wereld, door het gebruik van spelelementen in een niet-spel context. Maar sommige spelelementen kunnen motiverender zijn voor

specifieke individuen dan anderen en zouden daarom gepersonaliseerd moeten worden.

Ik heb eerst een literatuur onderzoek uitgevoerd, waarbij gekeken werd hoe personalisatie is toegepast in game ontwerp voor de gezondheidszorg en hoe deze games gezondheids-gerelateerde uitkomsten beïnvloedde (**Hoofdstuk 2**). Dit werd vervolgd door een focusgroep onderzoek, dat zich richtte op de therapeutische praktijk van personalisatie in de GGZ voor adolescenten (**Hoofdstuk 3**) en experimenten die zich richtten op de game ontwerp relevantie van personalisatie in de GGZ voor adolescenten (**Hoofdstuk 4**). Gebaseerd op deze informatie, hebben we een eHealth applicatie ontwikkeld voor de jeugd-GGZ, waarbij gamificatie en personalisatie in het ontwerp betrokken werd. Dit proces wordt uitgelegd in **Hoofdstuk 5**. Concluderend, was het doel van de onderzoeken in deze dissertatie om de toegevoegde waarde van gepersonaliseerde gamificatie te onderzoeken om de implementatie potentieel van eHealth in de jeugd-GGZ te verhogen.

Omdat personalisatie in gamificatie nooit systematisch onderzocht was, werd er een literatuur onderzoek uitgevoerd en een model ontwikkeld om de effecten van personalisatie in game ontwerp voor gezondheidszorg te onderzoeken (**Hoofdstuk 2**). We definieerden 'personalisatie' als het betrekken van stakeholders in de Probleem Definitie, Product Ontwerp, en Tailoring (de Personalized Design Proces (PDP)-fases). In de eerst fase, wordt er informatie gegenereerd om het probleem te identificeren en te analyseren en door ideeën te genereren. In de volgende product ontwerp fase worden er mogelijke oplossingen geproduceerd, welke resulteren in product ideeën of ontwerp voorstellen die getest en geëvalueerd worden door de gebruikers en verder ontwikkeld worden door iteraties. In de laatste Tailoring fase, kan het uiteindelijke product aangepast worden naar de behoeftes van de individuele gebruikers. De onderzoeken vonden in het algemeen positieve effecten op ervaringen, interactie gedrag en gezondheid-gerelateerde effecten. Echter, omdat een meerderheid van de onderzoeken een lage methodologische kwaliteit had, kunnen we alleen suggereren dat het belangrijk is om stakeholders in de PDP-fases te betrekken. Dit zal naar verwachting de hoeveelheid iteraties die nodig zijn beperken omdat de eHealth interventies

naar verwachting meer in lijn liggen met de gebruikers. Als gevolg, zullen de gebruikers het product volledig benutten wat weer een positief effect zal hebben op gezondheid-gerelateerde uitkomsten die men wil beïnvloeden.

Voor ontwerpers van eHealth is het belangrijk om te weten wat er gepersonaliseerd is in de therapeutische praktijk, omdat het product moet passen in de context waarin het gebruikt gaat worden. Behandelaren en cliënten personaliseren vaak therapie protocollen, zodat deze passen in hun persoonlijke voorkeuren en situaties. Als ontwerpers van eHealth voor de GGZ dit niet meenemen, is het waarschijnlijker dat het uiteindelijke eHealth product niet past binnen de therapeutische praktijk. Dit heeft weer een negatief effect op de implementatie en ook op het uiteindelijk gebruik. Wij voerden focus-groep discussies met behandelaren en cliënten in de jeugd-GGZ over protocol toepassing en personalisatie **(Hoofdstuk 3)**. Op basis hiervan kwamen we met aanbevelingen voor eHealth ontwerpers om zo eHealth meer op een lijn te brengen met de therapeutische praktijk en daarmee de implementatie kans te verhogen: a) onderzoek en kopieer in ieder geval de toegepaste onderdelen van een behandelprotocol in eHealth, b) co-design eHealth op zo'n manier dat zowel behandelaren en cliënten specifieke onderdelen van het uiteindelijke eHealth ontwerp kunnen personaliseren, en c) onderzoek of er delen van het therapie protocol nu niet worden toegepast door behandelaren en cliënten maar die wel onderdeel zouden moeten zijn van de eHealth applicatie.

Zelfs als een eHealth product aangepast is naar de therapeutische praktijk, is het belangrijk om de motivatie van cliënten om eHealth te gebruiken te vergroten. Dit kan gedaan worden door het ontwerp aantrekkelijker te maken, door het toepassen van gamificatie. We hebben eerst een specifieke ontwerp methode, de gebruikte PLEX kaarten, onderzocht. PLEX kaarten bevatten 22 speelse ervaringen, die gebruikers kunnen motiveren om een spel te (blijven) spelen. Hierbij hebben we onderzocht of de input van speelse ervaringen ook ervaren werd door andere eindgebruikers van dezelfde context in het uiteindelijke ontwerp zelf **(Hoofdstuk 4A)**. Resultaten lieten zien dat de ervaringen die gebruikt werden voor het ontwerp van de prototypen niet overeen kwamen met de ervaringen die gerapporteerd werden door andere

gebruikers die het prototype speelden. Om te verzekeren dat het product nog steeds in lijn ligt met specifieke ervaringen, en mogelijke individuele voorkeuren van stakeholder types die niet te veralgemenen zijn naar de grotere groep te beperken, is het belangrijk om stakeholders op meerdere momenten en fases van een PDP te betrekken, en niet alleen in een fase of moment. Naast de specifieke ontwerp methode, wilden we ook een specifiek ontwerp element onderzoeken in de jeugd-GGZ. Beloningen zijn de meest gebruikte game-elementen om motivatie te bevorderen in entertainment games. Maar het kan ook zo zijn dat spelelementen niet geschikt zijn voor alle contexten. Bijvoorbeeld, cliënten met middelen-gerelateerde stoornissen kunnen minder gevoelig zijn voor niet-drugs-gerelateerde beloningen (de meest toegepaste motivator) dan cliënten zonder een middelen stoornis. Resultaten van ons onderzoek (**Hoofdstuk 4B**) lieten zien dat, in tegenstelling tot onze verwachtingen, middelen-afhankelijke deelnemers niet minder gemotiveerd waren door de beloningen dan niet-middelen afhankelijke deelnemers en zelfs meer gemotiveerd waren door geld als beloning.

De voorgaande hoofdstukken zorgden voor argumentatie voor de toepassing van personalisatie om implementatie van gegamificeerde eHealth te vergroten. Dit werd meegenomen in het ontwerp proces van een eHealth applicatie – de Luca-app – voor de jeugd-verslavingszorg (**Hoofdstuk 5**). We wilden het algemene effect van gamificatie onderzoeken, door een niet-gerandomiseerd onderzoek (acht weken) met een voor en nameting uit te voeren. In dit onderzoek contrasteerden we twee condities: een eHealth interventie die gegamificeerd was en een die niet gegamificeerd was. De instroom van patiënten in het Luca onderzoek was echter laag, en ten tijde van dit schrijven was het onzeker of het onderzoek volgende de planning in ons protocol afgerond zou kunnen worden. De voornaamste reden was dat de opzet van het onderzoek niet in lijn lag met de huidige therapeutische praktijk, wat een reden voor behandelaars en cliënten was om niet (volledig) deel te nemen aan het experiment. Dus zelfs als eHealth gepersonaliseerd en gegamificeerd is, kan implementatie nog steeds beïnvloed worden door negatieve verwachtingen over het effect en een beperkte integratie binnen de huidige therapie.

Concluderend, als stakeholders meer actief betrokken zijn in het ontwerp proces van een gegamificeerde interventie, kan het motiverende effect van gamificatie vergroot worden. Het is belangrijk om een eHealth product in lijn te brengen met de context van toepassing en met de geprefereerde ervaringen, capaciteit en context van een gebruiker om implementatie te vergroten. Daarnaast moet de opzet van onderzoeken aangepast worden naar de context van toepassing om de storing binnen de therapeutische praktijk te beperken en haalbaarheid van het onderzoek te vergroten. Als de opzet van een onderzoek niet in lijn ligt met de therapeutische praktijk, zullen behandelaren en cliënten niet (volledig) willen meewerken aan een experiment wat het moeilijk of onmogelijk maakt om het effect van gepersonaliseerde gamificatie binnen eHealth te onderzoeken. Dit is bruikbare informatie voor toekomstige eHealth ontwerpen en onderzoeken om implementatie te vergroten.

