Value in Virtual Reality

The values for Virtual Reality for forensic mental healthcare



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TRANSFORE



Abstract

Introduction: Virtual Reality (VR) is a promising eHealth technology for assessment, treatment and understanding of various disorders in forensic mental healthcare. However, a VR-application that resolves the issues of forensic mental healthcare and as well considers the different forensic patient types and context of forensic mental healthcare does not yet exist. Applying VR applications from other mental healthcare fields will not work well due to the unique patient characteristics, context, and accompanied issues of forensic mental healthcare. This gap can be accounted for by developing a VR technology directly based on stakeholders' values. Since these values of the end-users (patients and therapists) and other stakeholders can widely differ, it is important to consider all values. Therefore this study aims to identify patients', therapists' and other stakeholders' values for VR for forensic mental healthcare, which could become the foundation for the development of a VR application.

Methods: In this study the CeHRes Roadmap is used as a framework, with the emphasis on the Value Specification. First, an existing stakeholder identification was updated using desk-research and open-ended interviews with stakeholders. Second, an online questionnaire was used (19 patients, 89 therapists and 37 other stakeholders), showing six different ideas for potential VR applications, to understand the stakeholders' likes, dislikes and suggestions for VR. This questionnaire measured involvement with and general opinion about these six ideas, measured in Personal Involvement Inventory (PII) scores and grades. These were analyzed using Mann-Whitney, Wilcoxon, and Kruskal-Wallis tests. The open questions were analyzed by multiple researchers using inductive coding. Third, based on the results of the questionnaire, attributes and values were identified. Fourth, based on these values, elements of the six different ideas were merged into one new more tangible idea for a VR application. Fifth, semi-structured scenario based interviews with patients (n=10) and therapists (n=12) were held to check if their values were properly represented within this new more tangible idea for a VR application. These interviews were coded deductively with the previously identified values, and all provided suggestions were summarized.

Results: First, the stakeholder evaluation was updated. Second, the stakeholders graded the six ideas for different VR applications on average at 7.75 out of 10 and gave an average PII score of 5.48 out of 7. The mean grade of idea 3 was significantly lower than those of ideas 2, 4 and 6, with a small difference (maximum of 0.41 α =0.05). No other significant differences were found. The open questions showed several potential advantages, disadvantages and suggestions for VR, related to the treatment/therapist, the patient, the content and to practical matters. Third, based on the 43 identified attributes, 13 values for VR for forensic mental healthcare were constructed: fit the patient; skills training/practice; safety; generalize skills to daily life; bridge between the therapy room and practice; insight into behavior: treatment motivation: unique addition to the current treatment: easy to fit in the current treatment; cooperation of patient and therapist; widely applicable; affordable; and continuously adapt application. Fourth, a more tangible idea for a VR application was created with the aim to give forensic patients skills to deal with difficult daily life situations. Fifth, the stakeholders' feedback indicated that they found the 13 identified values represented within this idea, however they found some areas for further improvement concerning the values: safety, treatment motivation, easy to fit in the current treatment and widely applicable.

Discussion: The results of this study provide insight into values for VR for forensic mental healthcare, which can be the foundation for the development of such a VR application. A more tangible idea for a VR application, based on stakeholder values, was valued positively by the stakeholders. However, further improvement of this application concerning: possible harms, treatment motivation, adoption in practice and usability for all patient types, seems necessary. The results support the usability of the CeHRes Roadmap as a framework for VR development, in particular concerning stakeholder involvement and context-based development.

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1. Introduction

In the multiannual agreement for Dutch forensic mental healthcare, one of the spearpoints is to investigate the opportunities for eHealth to improve the efficiency and effectiveness of forensic mental healthcare [1, 2]. eHealth for mental healthcare (e.g. web-based interventions, apps and wearables), is frequently researched and has in practice shown promising results for improving effectiveness, quality of care and self-management [3-6]. However, the application of eHealth varies in the mental healthcare field, with its use in forensic mental healthcare clearly underdeveloped [7]. Existing eHealth applications within other mental healthcare fields cannot straightforwardly be applied to forensic mental healthcare [1, 8]. Little is known about the true added value of eHealth for forensic mental healthcare. Therefore, to develop a suitable eHealth intervention, first these added values of stakeholders (therapists, patients and other stakeholders) should be identified [9].

Forensic mental healthcare in the Netherlands can be defined as: "all mental healthcare, addiction care and mentally disabled care for adults, where the given care is primarily focused on the prevention of recidivism, both in criminal and psychiatric sense, and decreasing the risk of crime" [1]. As the definition shows, in forensic mental healthcare the protection of society is combined with care for the patients [10]. This is also reflected in the goals of forensic mental healthcare. Just like in other mental healthcare fields there is a care related goal: recovery of the patients. However, in contrast with other mental healthcare fields the main goal is protection related: the prevention of criminal recidivism [11, 12]. Several of the characteristics of patients in forensic mental healthcare may be complicating factors in the forensic treatment. The patients in forensic mental healthcare are characterized by (the risk of) aggressive and/or sexual unacceptable behavior, and suffer from various psychiatric disorders [13], with many having comorbidity between these disorders [14, 15]. Due to these different types of disorders, differences in type of offence, and differences in risk factors, the forensic patient population is heterogeneous [16, 17]. Forensic patients are also often low educated and have low literacy, 15 to 25% of the forensic population is even mildly intellectual disabled [17-20]. This may make it difficult for some patients to grasp all the elements of their treatment [8]. Moreover, most of the forensic population externalizes its' problems, has little or no problem awareness and lacks treatment motivation [8, 17, 21]. This low treatment motivation negatively influences the chance of treatment success [22]. This heterogeneity, low educational level and low-treatment motivation make the forensic patient population complex and diverse [8, 23]. Consequently, a one-size-fits-all treatment does not fit the heterogeneous forensic patient population [24]. Personalizing, adapting the treatment to the individual patient, obtains better outcomes in behavior change of forensic patients [5, 25-28], and prevents the one-size-fits treatment [23]. Therefore, a personalized approach is required for the forensic patient population [23, 24, 27, 28].

In addition, the forensic mental healthcare treatment context has unique characteristics, which may complicate treatment success. Forensic mental healthcare is delivered in several forensic in- and outpatient care facilities in the Netherlands [1]. The treatment is often oneon-one and takes place in an artificial setting such as a therapy room or in a closed environment. In these therapy settings, patients have to develop and train their skills for functioning in society, which might require a lot of imagination since realistic environments and stimuli are missing [8]. This could make it difficult for patients to transfer the acquired skills from the therapy setting to another context such as daily life. In addition, there are limitations for the currently used treatment tools. Conversations contain social desirability, risk-management tools cannot always provide sufficient information about behavior of patients in concrete situations and observing patients' behavior in high risk situations has ethical constraints [8, 29]. These limitations may sometimes make it difficult for therapists to get deep insight in patients' mental disorders, problematic behaviors, or triggers of delinquent behavior [8, 29]. This may cause suboptimal treatment and difficulties in risk assessment. Due to the legal restrictions that require clinical patients to stay in closed settings, it is not possible for patients to move outside of the clinic within society [30]. This complicates certain treatments such as exposure therapy [8]. Furthermore, the forensic treatment is often mandated and studies suggest that mandated treatments have worse outcomes [31].

1.1 Virtual Reality in forensic mental healthcare

The use of eHealth is expected to deliver solutions to overcome the above mentioned challenging patient characteristics, as well as the context bound challenges of forensic mental health problems. eHealth can be defined as "the use of technology to support health, well-being and healthcare" [26]. In a recent review Kip et al categorized the advantages of eHealth for forensic mental healthcare [23]. An eHealth technology that can generate these advantages especially well and that as well meets the needs of the forensic field is Virtual Reality (VR) [8, 23, 32]. VR has been used in mental healthcare for over 20 years [32], where it has proven an effective treatment for anxiety disorders, PTSD, mental disorders such as schizophrenia, and substance related disorders [33-39]. VR can be used to create an interactive computer-generated world, that provides the user the sensation of being in lifesized environments other than their physical location by replacing the real-world senses with digital ones [40, 41]. This allows VR to progress one of the key advantages of eHealth as identified by Kip et al: help overcoming the physical barriers of the closed setting by visiting relevant environments for exposure therapy or skills training [23]. In addition, VR can be automatically tailored to specific patient characteristics, which can make it more personally meaningful for patients than traditional in-person treatment [23]. This is helpful considering the heterogeneous patient population and the accompanying need for a wide range of options making the technology personally meaningful for the individual patient. Patients also find VR fun to use [23], which can help to increase their treatment motivation. This is especially important for the low motivated forensic patient population. In addition, VR can provide unique information, such as insight for the therapist in the behavior of the patient. which is difficult to obtain in traditional in-person treatment [23]. For example, VR environments allow therapists to have control over the environment. This is impossible in the real world, since the environment and possible stimuli that the user undergoes, such as persons, voices and ambient noise, can now be controlled [40, 42]. VR also has low demands for the imagination of the patient and it does not require a high level of literacy [8, 32, 43]. This is useful considering the relatively high level of illiteracy in the forensic population. Due to the above mentioned advantages, eHealth and especially VR is promising for forensic mental healthcare. However, these advantages are not self-evident, the quality of the technology needs to be good and the technology should fit the context [23].

VR can be applied in assessment, treatment and understanding of various mental disorders [40]. For these three applications, some studies are done in the forensic mental healthcare context. VR enables therapists to assess deviant sexual interests [42, 44-46], the assessment can also be conducted in a realistic offence-related context [8, 29, 32, 45]. VR allows forensic patients to practice in a realistic context without endangering others [29, 30, 32, 42, 45, 47-49], in line with the aim treatment. VR also has potential for educational treatment purposes [30, 42], for example for vocational related training. VR can support patients to better understand and reconnect with current society, by allowing patients to observe a more realistic context [8, 30]. VR can also provide another perspective on forensic mental healthcare, and in that way help people understand forensic patients and help patients to understand themselves and others, e.g. provide patients the victim's perspective and provide therapists and significant others the patient's perspective [8, 50]. However, VR usage in forensic mental healthcare is rare [32, 44-46, 50-52]. In addition, most of the limited number of studies applying VR in forensic mental healthcare focus on the assessment of sexual offenders [29, 44-46, 52], while violent offenders are often not the target group in VR research [8, 50]. Therefore, more research is needed that investigates application of VR in forensic mental healthcare from a broader perspective for patients with (the risk of)

aggressive and sexual unacceptable behavior and who often suffer from several psychiatric disorders. In addition, application of VR beyond assessment, e.g. within treatment and understanding, should be further explored to ensure that the full potential of VR for forensic mental healthcare can be reached.

1.2 Virtual Reality development

The World Health Organization identified the mismatch between technology and context as the main reason that up to three quarter of all technology in healthcare fail [53]. Using an unchanged VR application from other mental healthcare fields is impossible, due to the unique patient characteristics, context and accompanied issues of forensic mental healthcare. Therefore, it is important to adjust or to develop a new VR application that provides possible solutions for the issues of the forensic setting, takes the forensic patient population and the unique context into account, and considers the full potential of VR (assessment, treatment and understanding). Most studies focus on effectiveness instead of adjustment or development for VR in forensic mental healthcare [29, 44, 46, 50, 52]. Little attention has been paid to how VR could be adjusted or developed for such a complex health domain and complex population [40, 54]. A mismatch between technology and context can be prevented by developing technologies which take the designated context into account, by involving end-users and other stakeholders in the development process as co-creators [26, 55-57]. eHealth implementation and adoption are often difficult [58], therefore attention should be given to these subjects in the development process.

A way to take the context into account and involve stakeholders is by developing a technology based on values of stakeholders [26, 57, 59]. Values are what the eHealth technology should improve or support and what the technology's main goals should be, according to the stakeholders [26]. In other words: what added value this eHealth should generate. These values are researched before starting the actual technical design, they are mapped and then used as requirements for the design [59]. They are defined by the stakeholders of the forensic setting [9, 26, 59]. The different stakeholders often have different and conflicting values for eHealth. The challenge is therefore to find a balance between those different values [9, 59]. Previous VR studies in forensic mental health mainly considered patients as the end-users of VR for forensic mental healthcare [32, 44, 46, 52]. However, recent research has shown that both patients and therapists in forensic mental healthcare should be targeted as prospective end-users of VR for forensic mental healthcare [8, 60], since they will directly use the technology [61]. In addition to these end-users, other people and organizations may have an important role in and can be affected by this development of VR. They are also considered to be stakeholders [60, 62, 63]. Since involving all important stakeholders will lead to a more successful development and a better fit between context and technology [9, 63, 64], patients, therapists and other stakeholders should be involved in the development of VR for forensic mental healthcare.

1.3 Research questions

The use of VR in forensic mental healthcare is promising. A VR application that helps to resolve forensic mental healthcare issues, considers the different patient types, context of forensic mental healthcare, and the full potential of VR (assessment, treatment and understanding), is still missing. Therefore, it is important to co-create a VR application together with stakeholders, based on the stakeholders' values. Since the values for the end-users (patients and therapists), and other stakeholders can differ, it is important to take all values into account. Therefore, in the central research question of this study is:

What are values for a VR application for forensic mental healthcare, according to patients, therapists and other stakeholders?

The research question is supported by six sub-questions:

- 1. Who are the stakeholders besides patients and therapists for the development of a VR application for forensic mental healthcare?
- 2. What do patients, therapists and other stakeholders like, dislike and suggest for VR applications for forensic mental healthcare?
- 3. Which values for a VR application for forensic mental healthcare can be constructed based on the patients', therapists' and other stakeholders' needs, problems, likes, dislikes and suggestions?
- 4. How can a tangible idea for a VR application for forensic mental healthcare be created, based on the values?
- 5. To what extent are the values of the patients, therapists and other stakeholders represented in the more tangible idea for a VR application for forensic mental healthcare?
- 6. What additions to the more tangible idea are needed to optimize the value of the more tangible idea for a VR application for forensic mental healthcare, according to patients and therapists?

2. Methods

2.1 Background & setting

Transfore, a forensic mental healthcare organization that delivers in- and outpatient care (Appendix 1), started the project 'VooRuit met VR' in 2016 to expand their treatment options with a VR application. The aim of this project is to develop a VR application that fits in the forensic context. The project is led by a multi-disciplinary team, 2 (ex-) patients, 2 ambulant therapists, 1 clinical therapist, 1 policy maker, 2 researchers, and 2 students. The CeHRes Roadmap shown in Figure 1 [65] is used as framework for this project.

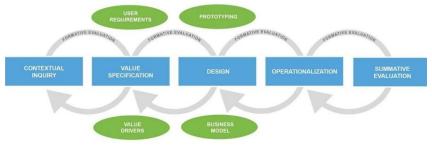


Figure 1 The CeHRes roadmap

The CeHRes roadmap describes five phases:

- 1. Contextual inquiry. This phase aims at identifying the stakeholders' needs and problems, understanding the context of use, defining the end-users and other stakeholders and generating ideas how technology could fulfil the needs of the stakeholders.
- 2. Value Specification. Based on the data of the Contextual Inquiry, values of the stakeholders are determined. These values are ranked to find the best solution, which is most beneficial to and favored by the stakeholders. These broad values are translated into concrete requirements for the design of the technology.
- 3. Design. Prototypes are created based on the requirements defined in the Value Specification and subsequently tested.
- 4. Operationalization. The final version of the technology is implemented in the context and additional resources (e.g. user support) are mobilized.

5. Summative evaluation, the impact and uptake of the technology are assessed [26, 65]. In the past two years, phase 1 'Contextual Inquiry' of the project was conducted [60]. This study builds on those results and emphasizes the first three phases of the project.

The applied methods are depicted in the flowchart below (Figure 2). The stakeholder identification conducted in the Contextual Inquiry was updated in this study (Paragraph 2.2). For the Value Specification, an online questionnaire was used, to understand the stakeholders' likes, dislikes and suggestions for VR for forensic mental healthcare (Paragraph 2.3). Based on the results of this online questionnaire and results of the Contextual Inquiry, values were identified (Paragraph 2.4). These values were transformed into a new more tangible idea for a VR application (start Design phase) (Paragraph 2.5). This was shown to end-users by using a scenario in interviews, to identify to what extent the identified values were represented in the more tangible idea for a VR application and to identify points of improvement (evaluation Value Specification) (Paragraph 2.6). The sections below will elaborate on these research methods.

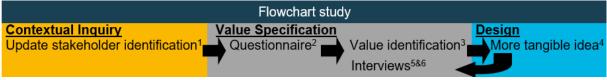


Figure 2 Flowchart of the methods used in this study and numbers of the research question investigated by each method

2.2 Update stakeholder identification

To ensure participation of all the important stakeholders concerning VR development for forensic mental healthcare during this study, the stakeholder identification made in the Contextual Inquiry was evaluated and updated. This was done by performing desk research and informal open-ended interviews with important stakeholders, in line with the guideline of Van Woezik et al [66]. Missing stakeholders and stakeholder groups were added, and existing stakeholder groups were altered.

2.3 Online questionnaire

An online questionnaire was used to find out the stakeholders' preferences concerning six ideas for VR applications for forensic mental healthcare and understand stakeholders' likes, dislikes and suggestions for VR for forensic mental healthcare.

Participants

This questionnaire was meant for all stakeholders of VR for forensic mental healthcare, identified in the stakeholder identification. Participants were included if they were a patient/ ex-patient of forensic mental healthcare, a therapist of forensic mental healthcare or an other stakeholder of VR for forensic mental healthcare. During analysis one participant was excluded since he had no relation with VR for forensic mental healthcare.

Participants were selected by means of convenience sampling, with various recruitment methods within Transfore and on a national level. Posters and flyers were placed in common areas of the various locations of Transfore. Two messages were sent within Transfore's internal communication system to inform therapists about the questionnaire. In addition, project team members visited the common areas of the inpatient and outpatient facilities to encourage patients and therapists to fill in the questionnaire. Furthermore, an advertisement was placed with the national umbrella organization of Dutch mental healthcare and team members were present at a national conference. Five VR glasses were randomly allocated to the participants to motivate people to fill in the questionnaire.

The answers of 145 participants were used for analysis: 19 (ex-)patients, 89 therapists, 37 other stakeholders (Table 1). Of the 108 therapists and (ex-)patients, 37 worked or were treated in inpatient facilities, 41 in outpatient facilities and 14 in both (16 unspecified). The main treatment focus of (ex-)patients and therapists, was aggressive (33), sexual (11) unacceptable behavior or both (43) (54 unspecified). The other stakeholders belonged to: Transfore, forensic mental healthcare organizations, other care organizations, knowledge institutes, government & society, and VR developers (Appendix 2). 74 participants filled in the questionnaire completely (51%), the others only partly. The average time to fill in the questionnaire was 21 minutes, 53 minutes for filling in the questionnaire completely. Table 1 Characteristics participants guestionnaire

Characteristics	Total	Therapist	(Ex-)patier	nt Other
Participants (% of total)	145	89 (61%)	19 (13%)	37 (26%)
Mean age (SD)	41.1 (11.6)	39.2 (11.8)	41.6 (7.2)	45.5 (12.0)
Gender male (% Male)	55 (37%)	27 (30%)	17 (90%)	12 (35%)

Materials & procedure

Based on the results of the Contextual Inquiry [60] the project team created six ideas for possible VR applications with the themes: Triggers & helpers, Observing and interpreting body language, Body language and effect on others, Role playing in context, Moments of choice and Crime scenarios. A description of these ideas can be found in Appendix 3.

After consent by the ethical committee the online questionnaire was send out to present these ideas to the stakeholders. The participants could fill in the questionnaire at any location

they preferred. The questionnaire (Appendix 4) started with an explanation of the project and the questionnaire, followed by an informed consent. The participants were subsequently asked questions about their demographics, their relationship with forensic mental healthcare (patient/ex-patient, therapist or other), and about their experiences with VR.

The next section of the questionnaire focused on the different VR ideas. First, the participants watched a video about an idea for a possible application for VR. These videos presented the aim, possible application and desired outcome, for each of the six ideas. They were simple in a technical sense, short (1-2 minutes) and the visualization was conducted in several different ways (animated film, human acting and clay figures). To identify to what extent the ideas were personally relevant to the participants, questions that measured their involvement followed. Involvement can be defined as a persons perceived relevance of a product, based on their needs, believes and interests [67, 68]. Similar to the study of Kelders [69], involvement was measured using the Personal Involvement Inventory (PII). The PII consists of 10-word pairs, for example worthless-valuable on a 7 point Likert scale [68]. A Dutch version of the PII [69] was used (Appendix 5). The study of Brüninghoff showed a good reliability of the PII in this questionnaire with Cronbach's alpha with an α of 0.94 [70]. The PII was followed by three open questions about the ideas: positive aspects, negative aspects and suggestions to improve the idea. Finally, the participants were asked to grade the idea represented in the video (1=very bad to 10=excellent). The PII, open questions and grades were asked for all six ideas. The ideas were presented to the participants in a random order, to ensure a similar number of participants for each idea.

After answering the questions about all six ideas for VR applications, participants were asked which of the 6 ideas they preferred. In addition, their argumentation for choosing these ideas was requested in an additional open question. The final question was also open-ended and it requested an explanation about which aspects of VR in general they were most enthusiastic.

Data analysis

The quantitative data were analyzed using IMB SPSS Statistics 25. The demographics of the participants were investigated using descriptive statistics. The mean of the grades and PII scores of the six ideas were calculated and the number of times an idea was chosen as favorite was counted. The Shapiro-Wilk Test showed that the grades and PII scores were not normally distributed, therefore non-parametric tests were applied with α =0.05. For testing the differences between the PII scores and grades of the six ideas, Wilcoxon rank tests were performed. To test the differences between the groups (therapists, patients and other stakeholders), Kruskal Wallis and Mann-Whitney tests were used, comparing the mean grades and mean PII scores of the six ideas for each participant.

The gualitative data was analyzed using Atlas.ti 8. The answers to the three open guestions were coded inductively, deriving the codes from the content of the raw data [71]. During the whole process codes were added and altered until researchers reached consensus. Three code schemes were created matching the open questions (positive, negative and suggestion), however the codes were not bound to the questions. For example, if a participant mentioned a suggestion as an answer to: "What do you find negative about this idea?", this was coded as a suggestion. First, two researchers (IB, AK) wrote down possible codes, compared the codes and coded the answers on one idea together. This resulted in a first version of the code scheme. With this scheme the two researchers coded a second idea individually. The first version of the code scheme, codes per answer and the additions found during the coding, were discussed by three researchers (IB, HK, AK), resulting in a second code scheme. Two of the researchers (IB, AK) used this second version to code the answers on all the ideas. Afterwards three researchers (IB, HK, AK) discussed the code scheme and possible adaptions. Based on this the final code scheme was created. With this final code scheme one researcher coded the answers on all the ideas (AK). Finally, two researchers (IB, AK), discussed the codes used to ensure consensus. One researcher (AK), coded the

answers on the two final open questions (argumentation of choosing favorite ideas and what makes them most enthusiastic) deductively, with the codes from the other open questions.

2.4 Value identification

The codes derived from the qualitative data from the questionnaire and data from the Contextual Inquiry [8] were used to identify the attributes, a summary of the needs or wishes told by stakeholders [57], and values for a VR application for forensic mental healthcare. This was done based on the methods of Van Velsen et al [57]. Two researchers (HK, AK) independently wrote down attributes based on the codes of the Contextual Inquiry and questionnaire. They subsequently compared the attributes. If the content of the attributes of the two researchers overlapped, then these were combined into one attribute. If only one researcher had written down an attribute, then this attribute was also included. These attributes were used to identify the values. First the attributes were grouped, based on similarity. Then the two researchers (HK, AK) translated these attribute groups into values, that connected the attributes in each group. These values were discussed with a third researcher (SK), and adjusted based on her feedback. This resulted in the final list of values.

2.5 Construction more tangible idea

The results of the Contextual Inquiry and questionnaire were discussed with the project team, which resulted in a broad idea for a possible VR application. To make this idea more tangible 4 team members (2 (ex-)patients and 2 researchers AK, HK) held 2 meetings to develop this idea. Elements of the six different ideas were merged into one new more tangible idea for a VR application. The values and attributes were kept in mind, to make an idea for a VR application that suits the values. This more tangible idea was presented to the project team for feedback, which was incorporated into the idea afterwards.

2.6 Interviews

Interviews were held with patients and therapists to check if the previously identified values were adequately represented in the new more tangible idea for a VR application.

Participants

Participants were included when they were working as a therapist at or treated as a patient at Transfore. Participants were selected by means of convenience sampling [72]. An e-mail was sent to the managers of 5 treatment facilities of Transfore. These facilities provide inpatient or outpatient care and vary in security level (0 to 3). Where outpatient care is the lowest in security (0) and FPK (English=Forensic Psychiatric Clinic), a closed ward where patients stay for a longer period, has the highest security level within Transfore (3) [73]. Inpatient care with the highest Dutch security level (4) is not provided within Transfore and thus excluded from this study [73]. In agreement with the managers of each facility the different participants were approached, which resulted in three ways subjects participated: 7 patients and therapists were asked to participate in a common area of their facility, 8 therapists were approached via e-mail, and 7 patients were asked to participate by their therapist. The overall sample consisted of 10 patients and 12 therapists (Table 2).

Table 2 Characteristics of the participants of the interviews therapists (n=12) and patients (n=10)

Characteristics	Total	Therapist	Patient
Gender male (% male)	15 (83%)	5 (42%)	10 (100%)
Inpatient care	13	8	5
Security level 1	5	2	0
Security level 2	6	4	2
Security level 3	2	2	3
Outpatient care	9	4	5

Materials & procedure

The opinions of patients and therapists about the more tangible idea for a VR application were asked by means of interviews, individual or in a group. The interviews took on average 21 minutes, the shortest was 11 minutes and the longest lasted 31 minutes. These interviews consisted of three parts. In part one the more tangible idea was explained, in part two the opinions of the stakeholders about the general idea were asked, and in part three improvements for the personalization options of the idea were discussed (Appendix 6 & 7).

In the first part, a scenario was used to explain the idea as clearly as possible. A scenario is a concise description of a persona using the technology to achieve his goal [74]. Where a persona is defined as a fictitious person whose characteristics resemble the average of an end-user group [74, 75]. This scenario explained how a patient (the persona) and his therapist could use the VR application (Appendix 6 & 7). At first the background and underlying principles of the idea were explained, then the content and possible usage of the VR application were presented.

In the second part, the stakeholders were asked to provide their opinion about the more tangible idea, by asking about their possible adoption and acceptance of the more tangible idea using an adapted version of the Technology Acceptance Model (TAM) [76, 77]. This model has been used to measure these factors for new eHealth technologies [78-80] and Davis et al advise to use this model for evaluating highly developed prototypes [77]. Nevertheless, there are some changes of the model needed, to fit this study's more tangible idea instead of a highly developed prototype. Therefore, an adapted TAM was used, where acceptance of the idea is the outcome and the other factors are transferred to a potential state (perceived potential usefulness, perceived potential ease of use, attitude toward potential using, behavioral intention to potential use) (Appendix 8). Previous studies also used an adapted version on the TAM [81, 82], which shows it may be possible to use an adapted TAM. The TAM has some limitations [83], but seems to be a good tool to obtain insight in the different aspects of the stakeholders' opinions.

In the third and final part, questions regarding the personalization options of the more tangible idea for a VR application were asked. In the VR application the environment, persons, and stimuli, can be personalized, to build a relevant VR-environment for an individual patient. To ensure that the important personalization options are included, the most important and missing options were asked. All participants filled in an informed consent form prior to the interviews and all interviews were recorded.

Analysis

The recordings of the interviews were transcribed. These transcripts were analyzed with the program Atlas.ti 8. Answers that reflected the research questions were fragmented and coded. One researcher coded all the transcripts (AK) and discussed the codes that she was uncertain about with the second researcher (HK), until consensus was reached. First the fragments corresponding to the TAM were coded deductively in agreement or in disagreement with the factors of the adapted TAM. Secondly, the fragments related to the values were coded deductively to their corresponding values. When the answer of a participant showed that one of the identified values was achieved by or represented in the idea for a VR application, this was coded as possible added value. In the case that the answer showed that a value was not achieved, or the opposite would be achieved with the tangible idea for a VR application, then this was coded as a possible point for improvement. When a value was mentioned but did not correspond with one of the previous values, a new code was created. In this way it was possible to identify if the values were adequately represented in this idea or if some values were not represented and what should be added. Suggestions for improvements of the general idea were summarized, and excluded from the coding, since a suggestion is not a verdict on the quality of the idea. The additions to the personalization options mentioned by the patients and therapists were summarized.

3. Results

In this section the results of this study will be described. Starting with the results of the stakeholder identification, followed by the results of the questionnaire, the attributes and values, the more tangible idea for a VR application, and lastly results of the interviews.

3.1 Update stakeholder identification

The results of the update of the stakeholder identification are mapped in Figure 3.

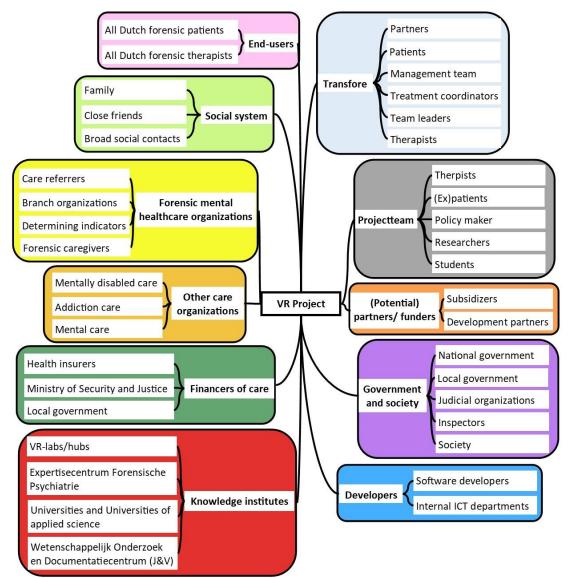


Figure 3 Stakeholder map concerning stakeholders of VR for forensic mental healthcare

The stakeholder groups are:

- Project team: multidisciplinary group of people responsible for the progression of the 'VooRuit met VR' project and decision makers about the content of the VR application.
- End users: the prospective users of the to-be-developed VR application, patients and therapists of forensic mental healthcare.
- (Potential) partners/funders: organizations that cooperate with the project team to develop an VR application for example financing the project.
- Transfore: management, supporting staff, therapists and patients of the in-& outpatient forensic mental healthcare organization where this VR application is developed.

- Forensic mental healthcare organizations: organizations that specialize in forensic mental healthcare in the Netherlands. This can be in the care delivery but also branch organizations, care referees and determining indicators.
- Knowledge institutes: people or organizations that specialize in knowledge development and research concerning VR-technology and/or forensic mental healthcare (e.g. VR labs, universities, research committees).
- VR developers: organizations or people that can develop VR applications for forensic mental healthcare.
- Other care organizations: healthcare organizations that cooperate with forensic mental healthcare yet are not specialized in forensic mental healthcare such as mentally disabled care, addiction care, and mental healthcare.
- Financers of care: the organizations that fund mandated (ministry of Security and Justice) and not-mandated (health insurers and local government) forensic mental healthcare.
- Social system: the social networks of the patients (e.g. family, close friends and broad social contacts).
- Government & society: the Dutch population and Dutch local and national government organizations, which are health and security related. They issue rules and regulations for forensic mental healthcare.

This stakeholder identification differs on various points from the previously made stakeholder identification during the Contextual Inquiry. The project team and potential partners/funders are split in two groups, instead of the previous single group 'decision makers content'. The previous group 'decision makers process' is renamed to the organization Transfore and people working in Transfore beside the management were included as well. Forensic mental healthcare organizations and other care organizations were split in two groups. In this new version other care organizations also include addiction care and mentally disabled care. Two institutes that specialize in forensic research were added to the group knowledge institutes. Internal ICT departments were added to the group of VR developers. The social system of the patients, close friends and broad social contacts were added. Lastly the group Government and society was added.

3.2 Online questionnaire

3.2.1 Quantitative data questionnaire

A description of the quantitative data is shown in Table 3. Here the number of participants that filled in the questions concerning an idea (N), the mean and standard deviation (SD) of the grades and the PII scores per idea and the number of times an idea was chosen as a favorite by the stakeholders (n), are shown.

 Table 3 participants per idea=N, mean grades, mean PII scores and frequency idea is chosen as favorite

Idea	Ν	Grade		PII sco	ore	Favorite
		Mean	SD	Mean	SD	Ν
Idea 1: Triggers & helpers	81	7.75	1.37	5.40	1.09	46
Idea 2: Observing and interpreting body language	82	7.83	1.09	5.48	0.95	32
Idea 3: Body language and the effect on others	79	7.54	1.14	5.42	0.97	35
Idea 4: Roleplaying in context	84	7.77	1.25	5.52	1.04	38
Idea 5: Moments of choice	83	7.66	1.16	5.40	1.07	33
Idea 6: Crime scenario	78	7.95	1.28	5.67	1.02	44
Mean	-	7.75	-	5.48	-	-

The grades and PII scores of the six different ideas came out close together. The largest difference between the mean grades of two ideas is 0.41 point out of 10 and between the mean PII scores 0.27 point out of 7. The most favorite idea (idea 1) was chosen 14 times more often than the least favorite (idea 2).

Grades

Table 4 shows the mean grades given per idea, split by therapists, patients and other stakeholders. What stands out is that the mean grades per stakeholder group (therapists, patients, other) are close together, with a maximum difference of 0.38 points out of 10. Table 4 Grades given to 6 ideas for VR applications by therapists, patients and other stakeholders

Idea	dea Total grade				therap	oists	Grade patients			Grade	Grade other		
	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Ν	
Idea 1	7.75	1.37	81	7.81	1.25	52	7.23	1.42	13	8.00	1.63	16	
ldea 2	7.83	1.09	82	7.81	1.01	52	7.73	1.53	15	8.00	0.85	15	
ldea 3	7.54	1.14	79	7.73	1.04	51	7.07	1.61	13	7.67	0.98	15	
Idea 4	7.77	1.26	84	7.84	1.15	55	7.54	1.56	13	7.75	1.39	16	
ldea 5	7.66	1.16	83	7.79	1.13	52	7.31	1.49	13	7.56	0.98	18	
ldea 6	7.95	1.28	78	8.09	1.25	51	7.92	1.50	13	7.50	1.16	14	
Mean	7.75	-	-	7.85	-	-	7.47	-	-	7.75	-	-	

The stakeholders gave the ideas an average grade of 7.75 out of 10. The Wilcoxon tests showed that idea 3 (mean=7.54 SD=1.14) was significantly lower than three other ideas: idea 2 (Z=-2.51, p=.012), idea 4 (Z=-2.28, p=.023) and idea 6 (Z=-2.29, p=.022) with an α of 0.05. With a Kruskal-Wallis testing for differences between the three groups (patient, therapists and other) and a Mann-Whitney test for differences between two groups (patient and other, other and therapist, therapist and patient), no significant differences between the grades of the three groups were found (Appendix 9).

PII scores

Table 5 shows the mean PII scores given to each idea by the therapists, patients, and other stakeholders. The mean scores per stakeholder group are again close together, maximum difference 0.65 out of 7 points. - VD employetions by thorapiete

l able 5	PII SCO	'es givei	1 to 6 ide	as for v	к аррііс	ations by	therapi	ists, pati	ents and	d other s	takeholo	lers
Idea	Total F	PII-scor	е	PII the	rapists		PII pa	tients		Pll oth	ers	
	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Ν	Mean	SD	Ν
Idea 1	5.40	1.09	81	5.51	1.02	52	4.66	1.22	13	5.67	0.99	16
ldea 2	5.48	0.95	82	5.61	0.86	52	4.95	1.45	15	5.56	0.91	15
Idea 3	5.42	0.97	79	5.56	0.84	51	4.97	1.34	13	5.31	0.95	15
Idea 4	5.52	1.04	84	5.57	1.02	55	5.20	1.24	13	5.59	0.97	16
Idea 5	5.40	1.07	83	5.58	0.96	52	4.72	1.23	13	5.36	1.11	18
ldea 6	5.67	1.02	78	5.81	0.92	51	5.32	1.34	13	5.49	0.98	14
Mean	5.52	-	-	5.62	-	-	4.97	-	-	5.50		-

On average the stakeholders gave the ideas a PII score of 5.52 out of 7. No significant differences between the ideas were found with α =0.05 (Appendix 9). The Kruskal-Wallis test and Mann-Whitney tests showed no significant differences between the PII scores of the groups (therapists, patients and other stakeholders) (Appendix 9).

Favorite ideas

Table 6 shows the number of times an idea was chosen as favorite by all the stakeholders, therapists, patients and other stakeholders. Table 6 frequency favorite idea for a VR application of therapists, patients and other stakeholders

l able 6 freque	ency favorite idea	a for a VR application of	therapists, patients	and other stakehold
Idea	Total favorite	Therapists' favorite	Patients' favorite	Others' favorite
Idea 1	46*	25	8*	13*
ldea 2	32	19	7	6
ldea 3	35	21	7	7
Idea 4	38	24	5	9
Idea 5	33	19	5	9
ldea 6	44	28*	8*	8
n per group	74	47	13	14

*most often chosen by stakeholder group

When looking at the favorite ideas, idea 1 was chosen the most often (n=46) and idea 2 the least (n=32), with a difference of fourteen. There are also differences between the favorite ideas for a VR application for forensic mental healthcare for each of the stakeholder groups (Table 6). The therapists most often choose idea 6 as their favorite idea (n=28). Patients most often chose idea 1 and idea 6 as their favorite ideas (n=8 for both). Idea 1 was also chosen most often by the other stakeholders as their favorite idea (n=13).

There were no large differences found between the ideas, based on the quantitative data of the questionnaire. The only significant result is that idea 3 was graded significantly lower by the stakeholders than three other ideas. However, the differences between the grades are small, at maximum 0.41 point. In addition, the low score of idea 3 is not supported by the PII scores and it was chosen 35 times as a favorite, making this idea the fourth favorite of the stakeholders. No significant differences between the different groups of patients, therapists and other stakeholders were found.

3.2.2 Qualitative data questionnaire

The qualitative data provided some insights into the positive aspects, negative aspects and suggestions for improvement that patients, therapists and other stakeholders had noticed concerning the six ideas for VR for forensic mental healthcare. The codes were categorized based on the open-questions (positive, negative and suggestion). For each code-scheme five main codes were used:

- Treatment/Therapist: the aspects concerning the therapy and/or the therapist.
- Patient: the aspects concerning the patient population, patient behavior and patient outcomes.
- Concept: the aspects concerning the concept presented in one of the six ideas for VR applications and the operationalization of the VR application.
- Practical: the aspects of the six ideas for VR applications concerning the technology, the use of VR and required means.
- Non-supported judgement: the positive or negative evaluations of the six ideas for VR applications that are not supported by further explanation.

Potential advantages

The therapists (Ther.), patients (Pat.), and other stakeholders (Other) mentioned various potential advantages for the use of the six ideas VR applications (Table 7).

Main and sub codes	Definition of code	Total n=145	Ther. n=89	Pat. n=19	Other n=37
Treatment/ Therapist					
Good way to practice	VR is a good way to practice with behavior in a realistic way	63	45 (71%)	4 (6%)	14 (22%)
Addition to treatment	VR offers new possibilities for treatment	48	33 (69%)	3	12 (25%)
Fit current treatment	VR can be well used within the current way of treating patients	38	28 (74%)	3	7 (18%)
Practicing in a safe way	Patients can practice in VR without harming themselves or their environment	27	13 (48%)	Ò	14 (52%)
Insight into behavior patient	The therapist gains new insights into the patient by observing his behavior in VR	26	19 (73%)	1	6 (23%)
Input for conversation	VR use can become topics of treatment	24	21 (88%)	0 (0%)	3 (13%)
Patient					
Insight into own behavior	The patient is more aware of his own behavior and its consequences, by VR use		50 (76%)	11 (15%)	14 (19%)
Improvement future behavior	The use of VR leads to a positive change in the future behavior of the patient	27	17 (63%)	6 (22%)	4 (15%)

 Table 7 Potential advantages of the use of the six ideas for VR applications for forensic mental healthcare according to therapists, patients and other stakeholders

Table 7 (continued)					
Suitable for specific	VR can be used well for specific types of	27	19	2	6
target groups	patients		(70%)	(7%)	(22%)
Insight into other's	The patient learns to better understand and	17	8	5	4
behavior	interpret the behavior of others, by VR use		(47%)	(29%)	(24%)
Support in reliving	VR can be used to help a patient re-experience	15	11	2	2
situations	a specific offense-related scenario		(73%)	(13%)	(13%)
Treatment motivation	The motivation to actively participate in	12	6	3	3
	treatment increases because of the use of VR		(50%)	(25%)	(25%)
Content					
Adaptation of	The content of virtual scenarios can be adapted	45	31	5	9
scenarios	to the needs of an individual patient		(69%)	(11%)	(20%)
Adaptation of	The design of virtual environments can be	40	27	4	9
environments	adapted to the needs of an individual patient		(68%)	(10%)	(23%)
Adaptation of persons	The appearance of virtual people can be	29	17	4	8
	adapted to the needs of an individual patient		· ,	(14%)	(28%)
Realism of behavior	Behavior of and interaction between virtual	27	22	1	4
	people seems realistic to the user		(81%)	(4%)	(15%)
Practical					
Visual realism	Environments and people in VR look similar to	35	28	1	6
	real life		(80%)	. ,	(17%)
New technology	VR is innovative and a possibility to use	19	9	8	2
	technology within treatment		(47%)	(42%)	(11%)
Unsupported remarks					
Positive judgement	A positive comment about VR or an VR	58	31	15	12
without support	application without any further explanation		(53%)	. ,	
Total	Total amount of positive codes used	652	435	78	139
			(67%)	(12%)	(21%)

Therapy/Therapist

The participants found it positive that the six ideas for VR applications could fit within the current treatment of forensic mental healthcare and could add value to the current way of treating forensic patients. Since VR is more visual and experience based, it may work better for some patients than current treatment options, which are often conversation based and require a higher degree of imagination. The participants thought that the ideas for VR applications can also be input for conversations between patients and therapists. VR may make it easier for patients to verbalize their thoughts and for therapists to explain something, since they can refer to the patients' behavior and experiences in VR, for example this social worker:

"The visualization of events makes it possible to discuss matters easier. I think it's a convenient instrument when discussing boundaries and risks." Other stakeholder, social worker (idea 6)

Another advantage participants identified is that therapists can observe patients' behavior in VR, which gives them insight in the patients' behavior in the real world. They also mentioned the presented ideas for VR applications as a tool for patients to practice in a realistic context. An accompanied advantage is that VR can be a safe way to practice, harmless for the patient and their environment. This therapist explained this advantage:

""I think it's valuable that one can first practice before directly being thrown in at the deep end. Sometimes 'practicing' in real life can for example lead to an enormous relapse. In this way, the patient/client can practice and make mistakes under supervision, without serious consequences. First practice in the paddling pool before the big leap to the deep swimming pool." Therapist (idea 1).

Patient

The participants also mentioned patient related advantages. Several patient groups were mentioned for whom certain ideas for VR applications may be extra helpful (e.g. mildly mentally disabled, autism). Participants also thought that the ideas for VR applications can

give patients insight into their own behavior and into the behavior of others, for example this patient:

"That you can gain new insights into yourself by means of different videos. And that like that, you can look at yourself from a distance." Patient (idea 2)

VR is seen by the participants as a potential mean to help patients relive a crime related situation in a safe way, which helps patients and therapists to acquire insight into the crime. The participants also thought that when patients use the VR applications presented in the ideas, it can help them to improve their behavior in the future. For instance, learn skills for daily life and risk situations. VR was seen as a fun way to practice. Participants, such as this patient, stated that VR may help patients to increase their treatment motivation.

"it is a new platform and because of its nature/method it's motivating to work with" Patient (idea 6)

Content

Participants did also foresee advantages regarding the content of the ideas. Participants appreciated that VR can portray realistic situations, where the interactions with and behavior of virtual people are similar to the real world. Participants found it positive when the ideas presented that virtual people, virtual environments and situations, can be adapted within VR applications. Like this patient says, this helps to make VR relevant for the individual patient.

"That you can practice in multiple ways and that there are multiple options from which you can choose. And that you receive a tailored, personal exercise." Patient (idea 4) Practical

Lastly, the participants saw some prospective practical advantages of VR use. Stakeholders mentioned that the visually realistic environment VR creates, improves the possibilities to practice skills. Thereby participants liked the innovative aspect of VR.

Some differences are visible in the answers provided by patients, therapists, and other stakeholders. All three groups acknowledged the advantages of practicing in VR. The advantage of practicing in a safe way was also mentioned by therapists and other stakeholders, but not by patients. Providing the patients insight in their own behavior and in the behavior of others was mentioned by all three groups. Providing the therapist insight into patients' behavior was often brought forward by therapists and other stakeholders, however only once by a patient. Lastly, relatively many patients mentioned that VR use can lead to higher treatment motivation and that VR is a something new for the forensic treatment.

Potential disadvantages

Table 8 shows the potential disadvantages of using VR in forensic mental healthcare.

Main and sub codes	Definition of code	Total n=145	Ther. n=89	Pat. n=19	Other n=37
Treatment/ Therapis	st				
No fit with current treatment	A VR application cannot be used within the current way of treating patients	15	14 (93%)	0 (0%)	1 (7%)
No new addition to current treatment	A VR application does not have any added value for the current situation	15	10 (67%)	2 (13%)	3) (20%
VR not necessary	Instead of VR, other in person activities or technologies can be used to reach a goal	10	5 (50%)	1 (10%)	4) (40%)
Patient			•		
Not suitable for specific target groups	VR cannot be used for some types of patients	23	17 (74%)	5 (22%)	1) (44%)
Elicitation negative feelings	The use of VR is accompanied by unnecessary negative emotions in a patient	17	9 (53%)	6 (35%)	2) (12%
No effect	A VR scenario does not elicit the intended emotions, cognitions and behavior in a patient	11	8 (73%)	2 (18%)	1) (9%)

 Table 8 Potential disadvantages of the use of the six ideas for VR applications for forensic mental healthcare according to therapists, patients and other stakeholders

Table 8 (continued)					
Dishonesty about own history	Patients do not give honest personal information to build a relevant VR environment	7	6 (86%)	0 (0%)	1 (14%)
Dishonesty about	Patients are not honest about the feelings and	2	1	1	0
effect	thoughts that are elicited by a VR application		(50%)	(50%)	(0%)
Content	· · · · · · · · · · · · · · · ·				. ,
Not generalizable to daily life	The skills learned in VR cannot be transferred to daily life	18	12 (67%)	3 (17%)	3 (17%)
No realism of	The behavior of and interaction between persons	16	8	3	5
behavior	in the VR application is not perceived as realistic by the user		(50%)	(19%)	(30%)
Important element missing	The VR application does not consider an important treatment element	5	3 (60%)	1 (20%)	1 (20%)
Practical			()	(,	(/
No visual realism	The visuals of VR do not resemble the real world enough	30	18 (60%)	0 (0%)	12 (40%)
Difficult to use	Using the VR application is hard for therapists and patients	13	6 (46%)	6 (46%)	1 (8%)
	VR might offer not enough ways of adapting	9	3	1	5
adaptation of scenario	scenarios to fit the needs of an individual patient		(33%)	(11%)	(56%)
Too little options for adaptation of environment	VR might offer not enough ways of adapting environments to fit the needs of an individual patient	8	2 (25%)	1 (13%)	5 (63%)
Too little options for	VR might offer not enough ways of adapting	7	2	1	4
adaptation of persons	persons to fit the needs of an individual patient		(29%)	(14%)	(57%)
Time to use in treatment	Using VR within treatment costs too much time	6	5 (83%)	1 (17%)	0 (0%)
Costs	The VR technology and applications are too expensive	6	6 (100%)	0 (0%)	0 (0%)
Learning to use VR	Learning to use VR will cost too much time and effort from therapists	3	2 (67%)	1 (33%)	0 (0%)
Unsupported remark					
	A negative comment about VR or an VR	1	1	0	0
without support	application without any further explanation		(100%)		(0%)
Total	Total amount of negative codes used	222	138 (62%)	35 (16%)	49 (22%)

Therapy/Therapist

Participants also mentioned disadvantages of the ideas for VR applications related to the therapy/therapist. Some participants thought that certain ideas will be hard to fit into the current treatment approach. Participants also thought that some ideas for VR applications would not have an added value, since the same is already done in current treatments. Participants, such as this prohibition officer, also found that VR is sometimes not the right means to achieve a certain goal:

"There is no need to do this with VR. It is easier to do with regular videos, photos and real-life situations" Other stakeholder, probation officer (idea 2)

Patient

The participants also saw potential disadvantages related to patients. They feared that patients will be dishonest about the effect VR use has on them, or dishonest about their input required to build a VR environment as this therapist explained:

"Furthermore, I wonder if the target group will work on this scenario actively and honestly, or if they for example make it seem that it is less severe than it actually was. Because then you don't have a realistically recreated scenario." Therapist (idea 6)

Some participants indicated that the ideas for VR applications may not be suitable for certain target groups. They expected problems for patients with certain psychiatric disorders, sexual offenders, and mildly mentally disabled patients, for example this therapist:

"Clients with mild mental disabilities are staying in [name or organization]. Perhaps these situations are too difficult and it is hard to practice hands-on." Therapist (idea 2) Several participants expected that certain ideas for VR applications will not have the desired effect on patients. They fear that the intended behavior, cognitions and emotions, will not be achieved, with the result that the goals of the VR application will not be reached. The participants also feared that using VR can lead to undesired negative feelings for patients.

Content

Concerning the content, participants feared that VR will not portray behavior, such as interactions with virtual people, in a realistic way. In addition, they feared that patients will not be able to apply the lessons learned in VR in the real world, because the real world is more complex than a VR world or because patients know the VR environment is not real, as this therapist explained:

"It has something artificial, a trick that you are learning. That can mean that something new will be rejected or neglected directly once treatment is terminated." Therapist (idea 1)

Some participants missed a treatment element in the description of a specific idea for a VR application (e.g. insight on consequences and risk factors).

Practical

Many potential practical disadvantages were mentioned by participants. Participants thought that the ideas for VR application may have too little adaption options concerning the virtual people, the environment and the scenarios, making it impossible to create a relevant experience for every patient. Participants also feared that VR will be too complicated to use for patients and therapists. They expected that learning to use the VR applications presented in the ideas and using the applications in treatment will cost too much time and effort. Lastly, participants feared that buying and using the VR applications will cost too much money.

The therapists, patients and other stakeholders also differ in what disadvantages they mentioned most. Therapists mentioned more often that VR will not fit in the current treatment, dishonesty of patients, costs of VR, time to use VR, and time to learn to use VR, than the other two groups. All three groups mentioned the lack of realism of behavior. Therapists and other stakeholders also frequently mentioned the lack of visual realism, but this was not mentioned by patients. Patients mentioned the elicitation of negative feelings and difficulty of use relatively more often than the other two groups. Lastly the group other stakeholders mentioned the lack of adaption options most often, while this was a less common topic for patients and therapists.

Suggestions

The suggestions that the participants gave regarding the ideas for VR applications are shown in Table 9.

Main and sub codes	Definition of code	Total	Ther.	Pat.	Other
		n=145	n=89	n=19	n=37
Treatment/ Therapist					
Implement for specific treatment	Use VR for a current treatment option that it suits well	16	11 (69%)	0 (0%)	5 (31%)
Prepare input VR	Therapists should prepare their contribution for the content of the VR and the technical abilities before the use	7	5 (71%)	0 (0%)	2 (29%)
Train the therapists	Teach the therapists how to use the content and technical aspects of VR	1	1 (100%)	0)(0%)	0 (0%)
Patient					
Check if suitable for patient	Make sure that using VR is appropriate for the individual patient	10	7 (70%)	2 (20%	1)(10%)

Table 9 Suggestions for the use of the six ideas for VR applications for forensic mental healthcare according to therapists, patients and other stakeholders

Table 9 (continued)					
Co-creation with patient	The patient should be an active participant in the creation of the VR scenario and environment and make his own additions	8	4 (50%)	2 (25%)	2)(25%)
Use for specific target groups	VR should be used for certain types of patients	5	3 (60%)	0 (0%)	2 (40%)
Content			(/	()	(,
Modification in the VR application	Change a specific thing or add something to the idea for a VR application	36	26 (72%)	4 (11%)	6)(17(%)
Use realistic situations	that matches the real world	6	5 (83%)	0 (0%)	1 (17%)
Merge ideas	Combine the ideas of two of the mentioned VR applications	2	1 (50%)	0 (0%)	1 (50%)
Practical					
Improve visual realism	Make the depictions of persons and environments a better representation of the real world	20	12 (60%)	0 (0%)	8 (40%)
Offer enough options for adaptation of environment	VR must offer enough ways of adapting environments to fit the needs of an individual patient	19	13 (68%)	3 (16%)	3)(16%)
Offer enough options for adaptation of persons	VR must offer enough ways of adapting persons to fit the needs of an individual patient	17	13 (76%)	1 (6%)	3 (18%)
Context VR usage	Use VR in specific circumstances	16	12 (75%)	1 (6%)	3 (19%)
Offer enough options for adaptation of scenario	VR must offer enough ways of adapting scenarios to fit the needs of an individual patient	15	12 (80%)	1	2
Connect to other technologies	Combine VR with other technical interventions	13	8 (62%)	2 (15%)	3)(23%)
Continue to develop	Constantly develop the content and technology of VR	8	6 (75%)	0 (0%)	2 (25%)
Posture VR usage	Use VR while your body is in a specific position	3	0 (0%)	1 (33%)	2)(67%)
Unsupported judgement					
Implement	Develop and use a VR application in practice	3	1 (33%)	2 (67%)	0)(0%)
Do not implement	Do not develop and implement a VR application in practice	3	2 (67%)	0 (0%)	1 (33%)
Total	Total amount a suggestion code was used	208	142 (68%)	19 (9%)	47 (23%)

Therapy/Therapist

The participants also gave suggestions regarding the treatment/therapist. They advised to train therapists in using VR. They recommended that therapist should prepare the VR sessions, concerning their input for the VR application, the technical aspects, and the story of the patient. They also advised to use a VR application for a specific currently used treatment (e.g. dramatherapy, eHealth treatments, psychoeducation), For example, this therapist:

"It would work well with specific patients to connect it to the signaling plan or risk management plan. If it for example already says that someone must avoid busy places or for example avoid places where a lot of drugs are available, you can already practice in the ward." Therapist (idea 3).

Patient

Participants also mentioned some suggestions related to the patients. Participants suggested verifying if VR is appropriate for the individual patient before they use it. Like this therapist.

"I think a good estimation should be made of the patient's capabilities and at what phase in the treatment this should be used." Therapist (idea 6) Some participants advised to build the VR application to fit certain patient types (e.g. sexual offenders, inpatient care, mildly mentally disabled). Another suggestion was to make patients active participants in building the VR environments and scenarios, such as this VR therapist:

"Also give the client the possibility to come up with another solution and to try it out." Other stakeholder, therapist VR (idea 5)

Content

Regarding the content, the participants advised to have realistic situations that resemble the real world included in the VR application. For example, incorporate surprising elements and making the behavior and ambiance of VR realistic, such as this manager:

"In my opinion, these situations should be close to reality to bring the patient in the moment. I can imagine that with regard to football hooliganism and everything related to that, the ambiance in a station should really be reflected" Other stakeholder, manager (idea 5)

Some participants also suggested to merge ideas or had suggestions for modifications of the original six ideas for VR applications (Appendix 10).

Practical

Lastly the participants had several suggestions concerning the practical side of VR. They suggested that the VR application should be adapted to the individual patient. Participants also provided some suggestions to use other technologies in combination with VR (e.g. a voice modulator, idea camera or sensors), for example this patient:

"VR in combination with measuring bodily functions. For example, registering heartbeat, breathing, muscle tension, brain activity, etc. VR could then perhaps be used as an (additional) diagnostic instrument to determine how high the chance on recidivism is." Patient (idea 2)

In addition, participants had some suggestions about the posture of the person that uses VR, for example standing, sitting or lying down, during VR usage. Participants also had suggestions for the context of VR, e.g. the location the VR usage takes place and the number of patients that simultaneously use VR. Finally, participants suggested continuing improving the content and technology of the VR application, like this therapist explained.

"Keep improving and adding: in particular non-verbal and stimuli/signals from the VR characters in the VR experience: to make the communication between people as realistic as possible" Therapist (idea 6)

For the suggestions some differences between therapists, patients and other stakeholders are also noticeable. The patients did not have suggestions concerning the therapy. The therapist and other stakeholders gave suggestions on improving the visual reality and reality of behaviors; however this is not mentioned by patients. While co-creation is mentioned twice by patients, this is not frequently mentioned by therapists and other stakeholders.

Preferences for VR

he participants mentioned various reasons for preferring certain ideas for VR, as well as what aspects of VR in general makes them most enthusiastic (Appendix 11). Some participants had replies related to the negative codes or the suggestions. However, most replies were related to positive codes. Visual realism was most often mentioned related to the positive practical aspects of the ideas for VR applications. Concerning the treatment, participants mentioned most often that the ideas for VR applications can be an addition to the current treatment. The participants also frequently mentioned that the VR application fits with current treatment and enables patients to practice in a safe way. In relation to the patient, participants mostly mentioned that the ideas for VR applications provide the patient insight into their own behavior. Three other frequently mentioned codes are that the ideas for VR applications are suitable for specific target groups, that they can help improve future behavior of the patients, and that they give the patients insight into the behavior of others. For the content of the ideas for VR applications the participants mentioned adaption of scenarios, environments and persons most often. This was closely followed by realism of behavior.

3.3 Attributes and values

Based on the qualitative data of the questionnaire and the results of the Contextual Inquiry (e.g. focus groups, interviews, project team meetings) [8, 60], 43 attributes were created (Appendix 12). These attributes are summaries of the needs or wishes expressed by the stakeholders. After grouping the attributes, they were translated in 13 values. The values describe on a more abstract level what the VR application should improve or support and what the VR applications' main goals should be, according to the stakeholders. How the data of the interviews, questionnaire and the attributes were translated into these 13 values is illustrated in Table 10, with two examples of values: skills training/practice and cooperation of patient and therapist.

Table 10 Data analysis table for defining attributes and values for VR, based on the results of the Contextual Inquiry and the questionnaire

Codes	Sample quotes	Attributes	Values
Contextual Inquiry -Return to society (skills) -Return to society (emotions and cognitions) -Skills training in context -Training daily living skills -Training social skills -Training emotion regulation skills Questionnaire -Good way to practice -Practicing in a safe way -Realism of behavior -No realism of behavior -Use realistic situations -Modification in VR application	"People who keep on finding it difficult, who have been incarcerated for a long time or don't have good social skills anyway. Then you'll say: hey, practice! Some things are already being done with eMental health, but I think that you cannot learn social skills from a screen: you have to experience and do." "I think it is really good to practice skills in this way and learn what can be helpful"	 Interaction with a virtual other, played by the therapist is possible in the VR application. The behavior of virtual persons feels as realistic as possible. The patient can learn skills for daily life in the VR application. The patient can learn social skills in the VR application. The patient can learn emotion regulation skills in the VR application. 	Skills training/ practice
Questionnaire -Co-creation with patient -Modification in VR application (let patients make their own videos)	"That the patient himself is allowed to think independently and can take responsibility." "Create their own videos and discuss those with the therapist"	 -VR scenarios and environments can be built in cooperation of the patient and the therapist (cocreation) -Sufficient time will be spent on building the scenarios for an individual patient. 	Cooperation of patient and therapist

The 13 values can be sorted into three groups, based on the type of goal they describe (aim application, embedding in treatment and practical use of the application). The values and corresponding definitions are shown in Table 11.

Table 11 Values and value definitions

Values	Definition of value
Aim application	
1. Fit with the patient	The VR application should suit the forensic patient population, should be adaptable to the individual patient and the VR application is not used for patient groups it is unsuited for.
2. Skills training/practice	The VR application should be interactive, so the patient can practice, and train skills in VR.
3. Safety	Patients should be able to use the VR application without causing harm to themselves or their environment.
4. Generalize skills to daily life	Patients can use the skills they learn in the VR application to improve their behavior in daily life.
 Bridge between therapy room and practice 	The VR application should make the step from the therapy room to the real world smaller for patients.
6. Insight into behavior	The VR application should create insight for the therapist in the patient's behavior, for the patient in his own behavior and for the patient in the behavior of others.
7. Treatment motivation	The VR application should be motivating for patients to use and increase the motivation of patients to participate in their treatment.
Embedding in treatment	
8. Unique addition to current	The VR application should not do something that is already done in
treatment	treatment or could be done in treatment without VR.
Easy to fit in the current treatment	The VR application should be easy to use, not cost too much time and be in line with the current way of treating forensic patients.
10. Cooperation of patient and	The patient and therapist should both be active participants in making
therapist	the VR environments and scenarios.
Practical use of the application	n
11. Widely applicable	The VR application should be usable for a wide range of patient
	types: for patients with (the risk of) sexual and aggressive undesirable
	behavior and for inpatients and outpatients.
12. Affordable	Developing and using the VR application should fit in the budgets of
	the forensic mental healthcare organization(s) that develop and use it.
13. Continuously adapt	During the development and after the implementation of the VR
application	application, the application should be continuously improved to keep the technology and the content of the VR application up-to-date.

3.4 More tangible idea for a Virtual Reality application

Since there is no significant preference of the stakeholders for any of the ideas for a VR application, elements of the six ideas were used as the basis to generate a new more tangible idea for a VR application (Appendix 13). The aim of this new more tangible idea is to provide forensic patients more skills to deal with difficult daily life situations. The application does this by supporting therapists and patients in finding the patients' triggers and helpers in a realistic context. Triggers are stimuli that awaken unwanted feelings, thoughts and behavior. Helpers support the patient in dealing with these triggers. In the new more tangible idea patients and therapists co-create a relevant VR world for the individual patient by using a dashboard (Figure 4). In this dashboard generic blocks can be chosen and combined to create a personalized world. After developing this world, a patient can practice his skills in coping with triggers in this realistic personalized context. The therapist can see what the patient does in VR by looking on a screen, interact with the patient via an avatar, and talk with the patient via a voice modulator microphone. The VR application can be paused to give the patient and therapist a moment to reflect on what happened in the VR world and think about consequences and possible changes for the VR world. The VR world and the exercise

can be adapted based on the needs of the patient, for example to practice in an increasingly difficult situation. The use of the VR application will be structured by a protocol.

1. Environment				2. Virtual avatar o	3. Stimuli to a	3. Stimuli to add to scenario		
1.1 Type of environment	1.2 Background noise (constantly present)	1.3 Extra(s)	2.1 Basic appearance	2.2 Physical appearance	2.3 Facial expression*	2.4 Posture and gestures	3.1 Auditive stimuli	3.2 Visual stimuli
Pedestrian street during night-time	Buzzing of people	bag		Length (enlarging/ reducing) *		Punching gesture	Ringing phone	Game on own phone
Pedestrian street during daytime	Loud talking	Large crowd of people (>10)	Age (6-80)*	Physique skinny built/ broadly built *		Stopping gesture (hands forward)		Bottles of alcohol/beer
Train	Noise of playing children	Loitering adolescents		Ethnicity (white/north- African/African)	Neutral*	Arms crossed	Music by own choice	One building that can be changed into coffeeshop, liquor store, brothel or pharmacy
Living room	Background music	Playing children		Proximity (far away, nearby) *	Angry*	Anxious gestures: torso is moving, wobbling	Police sirens	Police car
Generic desk	Volume of sound (decibel)*	Someone observing the conversation of patient and avatar		Clothing woman Normal sweater / short dress with cleavage / headscarf /	Sad *	Arms alongside the body	Crying baby	Sign with text that can be adapted/entered (e.g.; count to ten)
Park with fountain	Hertz of sound*	Two (attractive) females		top with panther print, large golden earrings, tattoo	Ashamed*	Shrinking movement, arched shoulders	Screaming people	, ,
Supermarket		Several random people spread out over location		Clothing man Normal sweater or shirt / suit / tracksuit / tank top with		Puffed out chest	Barking dogs	
Car		People drinking alcohol		tattoo		Wild arm gestures	Two fighting people	
Forest		Two broad/strong- looking men				Giving the middle finger	Loud-ticking clock	
		Two skinny/weak- looking men				Kicking movement		
		Two officers				Tilted head (up or down)		
		Family of four				Clenched fists		
		Men walking hand in hand				Pointing		
		Group of police officers (both male and female)						

Figure 4 The dashboard for the personalization blocks of the more tangible idea for a VR application

3.5 Interviews

Interviews were conducted with patients and therapists to identify to what extent the previously identified values were represented in the reactions of the stakeholders to the more tangible idea for a VR application. A further target was to understand which improvements to the tangible idea were needed, to make it suit the values. Table 12 shows the opinions of the patients and therapists about the tangible idea based on the factors of the adapted TAM.

	Attitude toward idea	Perceived potential usefulness	Perceived potential ease of use	Attitude toward potential using
Total patients answered positive	9	9	6	5
Total therapists answered positive	8	8	5	12
Total positive	17	17	10	18

Table 12 Opinions of patients n=10 and therapists n= 12 about the idea based on the factors of the adapted Technology Acceptance Model

Overall the opinion of the participants about the idea was positive. For most participants, the attitude towards the idea was positive (17 out of 22 participants). 9 out of 10 patients and 8 out of 12 therapists were positive about the perceived potential usefulness. All therapists had a positive attitude toward potential use. The least positive factor for the therapists was the ease of use (6 out of 12 positive). The patients were also the least positive about the ease of use (6 out of 10 positive) and about the attitude toward potential use (5 out of 10 positive).

Deductively coding the interviews with the values showed that the opinions of the therapists and patients about the more tangible idea for a VR application several times corresponded with the values. Some values were mentioned as an advantage or positive feature of the new more tangible idea by the participants. Those were coded as possible added values of the new more tangible idea. The participants' answers showed that they found that some values were not represented in the idea or that the opposite would be achieved by the tangible idea. Those answers were coded as possible points for improvement. The possible added values and the possible points for improvement corresponding with the values and how often the therapists and patients mentioned those in the interviews are shown in Table 13. For each value a corresponding quote was added, to illustrate the answers of the participants.

Values	Possible	e added value	Possik improv	-		Quote
	Total n=22	Ther. Pat. n=12 n=10	Total n=22	Ther. n=12	Pat. n=10	(+) =quote for possible added value; (-) = quote for possible point for improvement
Aim application						
Fit with the patient	17 (26)*	9 (16) 8 (10)	4 (4)	3 (3)	1 (1)	"That you can create a makeable environment and you can add unique input for every patient. Based, based on the request for help." Therapist 3 (+)
Bridge between therapy room and practice	15 (30)	8 (12) 7 (18)	4 (6)	2 (3)	2 (3)	<i>"It is definitely a nice step to society, where those situations really happen. Where you can expand the tools that you have received and you have developed" Patient 10 (+)</i>
Insight into behavior, thoughts and feelings	14 (34)	8 (22) 6 (12)	3 (3)	2 (2)	1 (1)	"See, of course you can go outside with someone. And then for example you walk to the supermarket. And out of nowhere he loses his nerve, gets mad or sad or whatever. But then you don't know specifically what happened, so what he responds to. And I kind of like that with this you can try step by step, each time something extra. To actually draw a conclusion based on that. Like, yes this patient responds on this and that or exactly the opposite." Therapist 8 (+)
Skills training/practice	8 (25)	6 (19) 2 (6)	0 (0)	0 (0)	0 (0)	"I know from my own experience, that it really helps particularly to do a lot and to practice. And often also with situations that really happen. And this especially seems a nice method in principle to me. Why? Because you can constantly enter a situation, and you can also evoke it, so to say." Patient 5 (+)
Generalize skills to daily life	5 (7)	4 (6) 1 (1)	2 (4)	1 (3)	1 (1)	"You will practice with situations that can actually really happen. So that may help if they think, 'oh this helps me' and then practice together in the room and if they notice 'this helps me'. Than they can maybe have some more self-confidence that it will really work." Therapist 6 (+)
Safety	1 (1)	1 (1) 0 (0)	5 (9)	2 (3)	3 (6)	"That someone goes home when he is calm. Otherwise he will hit someone on the head in the street because we wired him up here right?" Therapist 4 (-)
Treatment motivation	1 (1)	0 (0) 1 (1)	6 (11)	2 (4)	4 (7)	"Yes, well I think that people then first fear. They think it is strange, since it is new, so strange I think. But I think they will realize later that it helps. But I think it is pure curiosity that makes them scared. Scared for the unknown." Patient 1 (-)
Embedding in treatment						
Unique addition to current treatment	: 13 (21)	6 (13) 7 (8)	2 (5)	1 (4)	1 (1)	"Normally it is always looking back at. And now you can watch how it goes in the moment. I think that this gives more results for your treatment, for your goals so to say." Therapist 7 (+)

Table 13 Values mentioned in the interviews by therapists (n=12) and patients (n=10)

Table 13 (continued)

Cooperation of patient and therapist	11 (14)	6 (6)	5 (8)	3 (3)	2 (2)	1 (1)	"When you do that with your therapist instead of alone you get a sense of security, because you have someone that does it together with you. And is someone also knows you based on your dossier or he knows how you are based on the time you stay here, then it can be a certain relationship of trust. Which makes that you can look somewhat easier and more honest to yourself and open up about yourself." Patient 5 (+)
Content easy to fit in the current treatment	6 (10)	5 (9)	1 (1)	3 (5)	3 (5)	0 (0)	"Yes, based on such a block you can write a very nice plan, like these are thoughts that help. We use that here in Transfore also. With a signal plan and a risk management plan. And I have to be honest, I think that this, at least the idea that you have to bring triggers forward, that that definitely can contribute to a risk management plan. I think, that you can bring forward quicker what exactly the problems are and what are not the problems. Therapist 8 (+)
Practical easy to fit in the current treatment	5 (7)	2 (4)	3 (3)	9 (18)	8 (17)	1 (1)	"I think immediately oh dear then you have to participate with that. In the sense of you must learn how to use such a program. I am not of the generation that spends an hour per day behind a PlayStation. Or actually I did not join my peers, let's say it in that way. So, the practical application for myself" Therapist 5 (-)
Practical use of the appl	ication						
Continuously adapt application	5 (5)	3 (3)	2 (2)	0 (0)	0 (0)	0 (0)	"Yes, and then that is possible to request to develop things, for example when someone comes to you with an idea. For example, you develop things and I come to you with I want such a situation. That that will be easy to develop." Therapist 1 (+)
Widely applicable	1 (1)	1 (1)	0 (0)	10(20)	5 (9)	5 (11)	"Something that comes to mind is that I would not use it for people with psychotic problems for example. I can imagine that that a trigger is for suspicion, for stimulating suspicion. Or maybe even in psychosis, slip into a psychosis." Therapist 2 (-)
Affordable	0 (0)	0 (0)	0 (0)	3 (4)	2 (3)	1 (1)	"I think it is expensive with all those glasses." Therapist 6 (-)

* n_1n_2 : n_1 = the number of interviews mentioned, n_2 = the amount of times mentioned

Based on the interviews, no new values were added to the previously identified values. However, the answers of the participants showed that how easy it is to fit in the application is dependent on practice and the content of the treatment. Therefore, the value 'easy to fit in the current treatment', was split into two values (practical and content). Most of the values (9 out of 14) were mentioned more often as a possible added value than a possible point for improvement. The stakeholders mentioned five values more often as possible points for improvement than as possible added value: 'safety', 'treatment motivation', 'practical easy to fit in the current treatment', 'widely applicable' and 'affordable'.

Differences between patients and therapists

Some values were more often mentioned by therapists, while others were more often mentioned by patients. Therapists more frequently mentioned the values; skills training/practice, generalize skills to daily life and content easy to fit in current treatment as possible added values. Therapists as well mentioned more often that the application would be practically difficult to fit into an existing treatment. Whereas patients more often mentioned treatment motivation as possible added value and as a possible point for improvement. Patients also more often mentioned safety and widely applicable as possible points for improvement.

Suggestions for improvement

Patients and therapists also provided some suggestions to further improve the idea for a VR application. In relation to the value 'practical easy to fit in the current treatment' a suggestion was to train the therapists in using the VR application. Five out of eight therapists suggested that they should be trained before using the VR application. To improve the 'treatment motivation' a therapist suggested telling patients success stories of other patients, to motivate them to participate in using VR. A patient and a therapist also had suggestions related to the value 'Safety'. The patient suggested to have loved ones present, to make a patient feel safe. This therapist suggested a cooling down video to improve the safety of VR use:

"Maybe you can also build something for that. That you put on another pair of glasses and then they are at the sea or something to unwind before sending them home. Some kind of cooling down module." Therapist 4

Related to the value that the application should be 'widely applicable' therapists suggested that the project team should indicate for what patients the VR application should or should not be used. Lastly, in line with 'continuously adapt application' one therapist and two patients suggested to include odor to the application, one of these two patients even suggested to include a chair that moves in response to what happens in the VR application.

Regarding the personalization options, therapists and patients also provided their opinions. The general opinion was that all the personalization options presented in the more tangible idea should be included, since they find as many personalization options as possible important. They suggested some additions to the personalization options, for example the locations pub and clinic, nature sounds as an extra background sound, and disdain as an extra facial expression. These additions can be found in Appendix 14.

4. Discussion

The aim of this study was to identify patients', therapists' and other stakeholders' values concerning Virtual Reality (VR) for forensic mental healthcare, based on which a VR application can be developed. A stakeholder identification, a questionnaire and interviews were used. Thirteen values were constructed that describe three aims: the aim of the application, embedding the application in treatment and practical use of the application. These values were used to construct a new more tangible idea for a VR application. In this more tangible idea, patients, guided by therapists, can practice their skills in challenging daily life situations in a more realistic context. Patients and therapists were interviewed to evaluate if the values were adequately represented in the more tangible idea. Both patients and therapists thought that most of the values were adequately represented in the idea.

However, against expectations, with the questionnaire no significant differences were found between the stakeholders' involvement with the six ideas and between the overall opinion and involvement of the patients, therapists and other stakeholders. This may be the result of a lack of sensitivity of the used questionnaire in order to detect any possible differences between the involvement and grades, and between the three stakeholder groups. Although the project team created the six ideas based on previously conducted research, there may be too many similarities between the six presented ideas, which will make it hard to distinguish between them. Perhaps the six ideas should have contained more extreme examples, to help to obtain further insight into the differences between the ideas and stakeholder groups. Therefore, it is advised that future research into measuring stakeholders' involvement with, and general opinions about multiple ideas, should apply more extreme examples. In addition, the patients and therapists saw points of improvement for some values of the new more tangible idea. They feared that the VR application might harm patients, decrease the treatment motivation of patients, be practically difficult to fit in the current treatment, and might not be applicable for all patient types.

Applicable for different patient types

The stakeholders who participated in this study are uncertain and doubtful about how widely applicable the more tangible idea for a VR application and VR in general is with the forensic patient population. They mentioned that there are various patient groups who could benefit from the proposed VR application (e.g. mildly mentally disabled, autism, aggressive and sexual undesirable behavior) while others could probably not (e.g. mildly mentally disabled, psychosis, low treatment motivation and sexual undesirable behavior). As can be seen from the examples these often conflict. For example, in both the questionnaire and the interviews some participants described VR as unsuitable for patients with undesirable sexual behavior. While other participants provided input in the questionnaire and interviews, that VR may be appropriate or even particularly suitable for patients with sexual undesirable behavior. At the moment, VR is already used for assessment of patients with sexual undesirable behavior [29], which indicates that VR in general can be used for patients with sexual undesirable behavior. Another patient type that was thought of as unsuited for VR by some of the stakeholders, are patients with psychosis. However, a recent study shows that VR can be used for people with psychosis [84]. This ambiguity in the opinions of stakeholders about usability of VR for patients with sexual undesirable behavior and psychosis illustrates that it is still unclear for which specific patients the VR application may be suitable or not. Therefore, further research is needed to understand for which forensic mental healthcare patients VR in general is applicable and what contra-indications are needed.

VR in forensic mental healthcare can be used for various applications (assessment, treatment and understanding). In the new more tangible idea a patient can practice and improve his skills in coping with triggers in this realistic personalized world. This can be considered as a treatment application of VR. In addition, within the more tangible idea for a VR application it is described that the therapist can observe the patient's behavior in a

realistic context. Therapists included in this study mentioned this can help them to write signal and risk management plans, which can be seen as an assessment. The stakeholders also mentioned that the more tangible idea for a VR application may give the therapist insight in the patient and the patient insight in himself and/or others. This may contribute to the understanding application of VR. Some experiments with VR have been done with the application assessment [29, 44, 46], however the experiments with the application treatment [47] and understanding [50] are more limited. Therefore, little is known about using VR in these ways in the forensic patient population. For example, VR for assessment is used for patients with sexual unacceptable behavior [29, 44, 46], but little is known about using VR for treatment or understanding for these patients. Consequently, there is still a knowledge gap for which forensic patient types VR with these applications of VR can be used. The usability of the different applications of the VR described in the more tangible idea for various patient types should be investigated.

The potential harm of VR

Since VR is a relatively new technology for forensic mental healthcare it is important to discuss the possible ethical implications. An ethical implication often mentioned in this study by the stakeholders was that using VR may cause harm to patients and/or their environment. The stakeholders proposed several different coping mechanisms to avoid or minimize harm (e.g. a relative being present and use a cooling down). VR can trigger intense emotions and change behavior, indicating that it can probably also harm the user [85]. This may be especially true for VR applications where triggers for unacceptable behavior are used. An example, given by one of the therapists, was that the triggers in a VR application may make patients so angry that they may hit someone in the real world afterwards. To prevent and reduce these effects, it is important to actively take precautions to minimize this potential harm. Fromberger et al [45] described in their "ethical guidelines for VR research and clinical application in forensic mental healthcare" how to deal with these possible harms. They recommended to inform patients about the possible harms and the current research progress with regard to possible unknown consequences of the use of a VR application. Other recommendations are to research possible harms as early as possible in the development process and provide pre-post measures for possible harms in VR studies [45]. Future research should evaluate the harms that the to-be-developed VR application has on the patients and evaluate the effects of the proposed prevention strategies mentioned by the stakeholders

Fromberger et al also advise to use exclusion criteria for known harms (e.g. migraine) in VR studies [45]. The stakeholders of this study as well proposed that the to-be-developed VR application should have an indication for which types of patients it should and should not be used. It is important that when the above mentioned research for contra-indications is done, that the patients with these contra-indications are excluded from further VR research. This also emphasizes the importance of a good and clear protocol for the use of the to-be-developed VR application. This protocol should be focused on preventing harm and should clearly describe the contra-indications of the VR application.

Visual realism vs presence

The stakeholders that participated in this study found it important that the behavior and emotions of the patients in the VR environment are as similar as possible to the real world, to learn the desired skills with the VR application. It is possible to evoke emotions and reactions in VR similar to those in the real world, as a result of a sense of presence experienced by the users of VR [86]. A sense of presence is the subjective feeling of being in a virtual world while your body is physically located somewhere else [87, 88]. When this sense of presence is achieved, it is beneficial for the impact of VR applications in health care because psychologically a behavior change can be achieved [39, 86]. Results of the current study demonstrate that stakeholders find it important that the visuals within the VR application are

very realistic. Patients, therapists and other stakeholders believe that practicing in a less visual realistic VR world, would not stimulate the same emotions and behavior of a patient as in the real world. In contrast with what the stakeholders in this study mentioned, previous research has shown that that ability to interact and enact intentions in VR is more important than visual realism for electing emotions and behaviors similar to the real world [86, 89, 90]. This shows there sometimes can be a gap between what stakeholders find important (visual realism) and what research shows is important (presence/ interaction), for achieving a certain goal. It is advisable to take the three sources of evidence, therapist, patient and science, into account when balancing these conflicting values, in line with evidence based medicine [91, 92]. In this case to achieve the goal of realism of behavior and emotions, the visual realism of VR and ability to interact and enact in VR should be combined. The optimum combination of these two means for realism of behavior and emotions should be investigated in future research.

Stakeholder participation

Participation of end-users and other stakeholders is one of the spear points in the CeHRes roadmap [9] and in this study. Consequently, stakeholders filled in the questionnaire, helped developing the more tangible idea of a VR application, were interviewed and were part of the project team. The study of Beerlage-de Jong [63] demonstrated that although end-users are able to state their needs, likes, and dislikes about a to-be-developed eHealth technology, some unrecognized needs can still exist when cross-referencing these opinions with other stakeholders [63]. In this study, similar results were found in the questionnaire. The other stakeholders mentioned other advantages, disadvantages and suggestions more frequently than patients and therapists. For example, the other stakeholders mentioned the advantage practicing in a safe way more often than patients and therapists combined, and they had the most suggestions about the posture during VR use. The other stakeholders also chose a different idea most often as their favorite than the therapists. This emphasizes the importance of incorporating multiple types of stakeholders in eHealth development.

4.1 Strengths & limitations

This study has some strengths and limitations. A major strength of this study is the involvement of stakeholders. Involving stakeholders helps to continuously keep their perspective, needs and wishes central [26]. Involving stakeholders can be a way to enlarge the social impact a research study has, especially for stakeholder groups whose voices are less heard such as forensic patients [93]. The results of this study confirm how important it is to involve these stakeholders. The six ideas presented in the questionnaire were based on interviews and focus groups conducted with stakeholders in the previous phase of this project [8, 60], and created by the stakeholders in the project team. The positive PII scores and grades of the participants of the guestionnaire show that these ideas fit well with the stakeholders and the context of forensic mental healthcare. The same is true for the more tangible idea for the VR application. This more tangible idea is based on the values. The values are based on stakeholders' feedback in previous data collection efforts about what they need, like, dislike, and want for the VR application. During the interviews the stakeholders had a positive attitude towards the more tangible idea. This again confirms the good fit between the more tangible idea and the stakeholders, and the designated context of use. This shows that involving stakeholders throughout the whole development process can contribute to development of an eHealth technology that fits the stakeholders and the designated context of use.

Another strength is the three different types of triangulation used in this study, which improves the internal validity [71]. First, methodological triangulation was used, since quantitative and qualitative research was combined [71]. Second, data triangulation was applied, which provided a broad view on the subject [71]. Third, researcher triangulation was used for coding of the questionnaires and the interviews. Since multiple researchers

contributed to the coding process, the chance that the coding was biased by the opinion of one researcher is minimalized [71, 72].

An additional strength of this study is the continuous evaluation and update of previously found results of the project, thus the use of formative evaluation [26]. For example, the stakeholder identification of the Contextual Inquiry was updated and representation of the values in the more tangible idea were evaluated using the interviews. This helps to ensure that the VR application keeps meeting the needs of the stakeholders and the context.

A first limitation of this study is that for the visualization of the six ideas for a VR application different visualization methods were used (animated film, human acting and clay figures). Some stakeholders commented on these visualization methods instead of on the general idea presented, in the three open-ended questions, as positive aspects, negative aspect and as suggestions for the ideas. Although the instruction was to only comment on the general idea itself. In addition, the idea where animated film was used (idea 3), was graded significantly lower than the ideas where human acting was used (ideas 1, 2, 4 and 6). Although the differences were small, with a maximum of 0.41 points, this indicates that the visualization method may have influenced the opinions of the stakeholders about the ideas. Therefore, the stakeholders' grading, PII scores and qualitative data may have been influenced by their opinion about the visualization method used, instead of the underlying idea for a VR application. It is advisable for future research to use the same visualization method when investigating the general idea to prevent this bias, or explicitly research the influences of visualization methods on the opinion of stakeholders about the general idea.

Secondly, biases may have occurred in the participant samples of the questionnaire and interviews. The aim was to spread the questionnaire within patients, therapists and other stakeholders identified in the stakeholder identification. The participants were selected with convenience sampling. Therefore, crucial information from important people may be missed and the best possible results from the sample may not have been achieved [72, 94]. This is confirmed when looking at the participants of the questionnaire. The 37 other stakeholders belonged to the groups: Transfore, forensic mental healthcare organizations, other care organizations, knowledge institutes, VR developers and government & society (Appendix 5). No stakeholders participated that belonged to: financiers of care, (potential) partners/funders and social system. In addition, the interviewed participants were limited to the potential end-users (patients and therapists), the other stakeholders were not interviewed. The results of the questionnaire showed that the opinions of other stakeholders may differ from those of patients and therapists. Consequently, excluding the other stakeholders in the interview phase may have caused a bias in the results.

Selection bias may also have occurred in the sample of the questionnaire and interviews [95]. For example, for filling in the questionnaire a certain level of literacy was necessary, since participants had to answer based on the word pairs of the PII, and they were asked to write down the answers for open-ended questions. For the patients that have a low literacy this may have been too difficult or even a barrier for filling in the questionnaire. Therefore, this patient group may be underrepresented. Since educational level was not asked in the questionnaire, whether the bias occurred is unknown. It is advisable for future research with forensic patients to apply more visually based data collection methods (e.g. smileys, pictures), instead of language based.

In addition, self-selection bias may have occurred, originating from the phenomenon that people are more likely to participate in a research that they are interested in [96]. Stakeholders who are enthusiastic or curious about the use of VR in the forensic setting, were more likely to participate in the questionnaire and interviews. As a result, opinions of the stakeholders that filled in the questionnaire and participated in the interviews, may be more positive compared to the opinions of stakeholders who did not, therefore a bias in the

results may have occurred [96]. Consequently, the results of the questionnaire may be more positive regarding the opinions of stakeholders about VR, as compared with the whole stakeholder population. This could be problematic for the implementation of the VR application because patients and stakeholders who did not participate in this study may have barriers for using the VR application that are not resolved, since they are currently unknown. These biases can be prevented in future research by using purposeful sampling [72]. Participants from each of the identified stakeholder groups could be approached to participate and extra reminders could be sent to underrepresented stakeholder groups. Unenthusiastic stakeholders can also be explicitly searched and recruited for participation, to compensate for the self-selection bias.

Lastly, this study presented six abstract ideas and one more tangible idea of possible VR applications to stakeholders and asked their opinions. There is however a large difference between the idea and a real product. There may be several unforeseen disadvantages that the stakeholders did not think of when presented with the ideas. Therefore, although they liked the ideas, this does not mean that when the idea is made into a real VR application, they will also like the application. This disappointment, due to a mismatch between the expectations of the stakeholders based on an idea and the real functions of a eHealth technology, have been described in previous a study [97]. In addition, since the idea for a VR application presented in the interviews was not a real product, this study could only ask for the intention of stakeholders to use it and not measure if the VR application will actually be used. This intention of the stakeholders is an indication that when this idea is developed a person will use it is not a guarantee that they will really use the VR application [83, 97]. However, by continuously asking the opinions of stakeholders, the likelihood a technology would be developed that does not fit the context and the end-users decreases. In that way, presenting ideas of VR applications to the stakeholders may prevent wasting a lot of time and money on a technology that will not work or will not be used.

5. Conclusion

The results of this study provide insight into values for VR for forensic mental healthcare, which can be the foundation for the development of such a VR application. Based on the stakeholders, likes, dislikes and suggestions, 13 values for VR for forensic mental healthcare were constructed. A new more tangible idea for a VR application, created based on these 13 values, was valued positively by stakeholders. However, further improvement of this idea based on safety concerns, treatment motivation, adoption in practice, and usability for all patient types seems necessary. The results support the usability of the CeHRes Roadmap as a framework for VR development, in particular concerning stakeholder involvement and context-based development.

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Appendix 1 Setting: Transfore

This research will take place in the forensic mental healthcare organization in the East of the Netherlands: Transfore. Transfore treats forensic patients with the (risk of) unacceptable aggressive and/or sexual behavior. Transfore's treatment options are: inpatient care, supported living and outpatient care [73], these treatment options vary in security level from 3 to 1. From high to low security the following treatments are given:

- FPK (Forensic Psychiatric Clinic): This inpatient treatment is a highly secured (level 3) closed-environment where patients stay here for a longer period. Access to technologies such as internet is limited [12, 60, 73].
- FPA (Forensic Psychiatric Department): Patients receive this inpatient treatment on when the expectation is that they can go from a closed to a more open setting, within a foreseeable period (6 to 12 weeks). This level 2 secured setting is focused on reintegration [60, 73].
- FBW (Forensic Accompanied Living): The aim is to help patients with their rehabilitation to society on this inpatient treatment, with security level 1. This is not a closed environment, but patients are obligated to be accessible 24 hours per day and receive 24 hour care from nurses [60, 73].
- De Tender: In this outpatient setting, patients visit Transfore for their treatment. They are only obligated to treatment during the appointments with their therapist [60, 73].
- ForFact: For this outpatient setting, the ambulant care is delivered in the home setting of the patients [60, 73].

Level four, the Forensic Psychiatric Center (Dutch: FPC), is not offered by Transfore

Forensic mental healthcare organizations	Other care organizations	Knowledge institutes	Transfore	Government and society	Developers
Clinical case manage	r Consultant mental healthcare	Research inter	n 2*Manager	Officer of the Ministry of Justice and Safety	VR developer
Developer training programs for social rehabilitation	Manager	2*Researcher	Project leader		2* VR supplier
Manager	2* Mental healthcare therapist	Student	Social worker		
Policy officer	Social shelter worker		4*Supporting staff		
2* Probation officer	Therapist regional sheltered housing institutions		2*Team leader		
Team member safety and support (TV&O)	Youth care therapist		Treatment coordinator		
Working in OD			Volunteer		

Appendix 2 Overview of other stakeholders participated in the questionnaire

Appendix 3 Explanation 6 ideas visualized in the videos

Idea 1: The theme of this idea is 'Triggers and helpers'. In this idea the patient learns to deal with his triggers, by using the VR application. Triggers are things that awaken unwanted feelings, thoughts and behavior for the patient. In the VR application, he therapist and patient together search for helpers (things that help patients to cope with the triggers), in a VR environment. The VR environment, triggers and helpers can be adjusted by the therapist and patient, to fit the patients' needs. In the video the patient and therapist talk about the trigger of the patient: seeing a woman walking alone in the park. They also talk about and practice in VR with the helper (watching your mobile phone). Afterwards the patient applies this in his daily life. (visualization method: human acting)

Idea 2: This idea has the theme 'Observing and interpreting body language'. In this idea a VR application is used to give a patient insight in the non-verbal behavior of others. In the VR application 360° videos are used that show a realistic view of the outside world. During the treatment the therapist and patient discuss how a patient responds (behavior and thoughts) on behavior of others. They cooperate in searching for better ways for the patient to respond. In the video the patient enters and goes to a front desk of a clinic. The secretary is busy and cannot immediately respond to the patient. This makes the patient uncomfortable and angry. After practicing the situation in VR, he knows that the secretary will come to him when she is ready. (visualization method: human acting)

Idea 3: In this idea the theme 'Body language and the effect on others' is discussed. The idea for a VR application is to let patients see their own body language to help them improve it. The body language of patients can be intimidating for others. By using VR patients can see their own body language and see how it can be intimidating for others. The environments are taken into account (e.g. busy environment). In the video it is explained that the video can look at his own body language from a distance via VR and it is possible to adapt some factors (e.g. length of the other person). (visualization method: stick figures)

Idea 4: This idea has the theme 'Roleplaying in context'. The idea is about social skills. By roleplaying in a realistic VR environment, a patient can improve his social skills. In the video the patient enters and takes a seat in the waiting room. She does not make contact with the other people in the waiting room. The narrator explains that VR can learn skills such as saying no and making contact. Then we see the therapy room where the possible advantages and disadvantages of roleplaying without VR are mentioned. Then the VR application with the possible personalization options is shown. In the end of the video the patient is sitting in the waiting room and applies her learned lessons in the waiting room, by making contact with other patients. (visualization method: human acting)

Idea 5: 'Moments of choice', is the theme of this idea. In this idea a patient can get insight in the consequences of the choices he makes, by practicing in VR. He practices with a (difficult) moment in VR and based on the choices he makes a different next situation is shown in the VR application. In this video is explained that a patient has multiple options to choose from. In the example a person in a metro is shown. He is sitting in the metro and after a while another person comes and sits next to the patient. This makes the patient angry, resulting in a fight. Afterwards, the situation is discussed and the patient can make another choice (e.g. walking away or starting a conversation). In this idea the patient and therapist can choose from several situations and environments. (visualization method: human acting)

Idea 6: This idea has the theme 'Crime scenario'. Here a patient and therapist remake the situation the previous occurred crime in VR. The patient can then enter the situation, by putting the glasses on. This helps patients and therapists to discuss the previous occurred crime. In the video it is explained that a patient can find it difficult to talk about the crime they committed. The therapist and patient build the crime scenario in VR. This makes it easier for the patient to relive a situation and awaken the feelings. Afterwards. it is also possible to learn alternative behavior. (visualization method: human acting)

Link to the YouTube channel with the 6 videos:

https://www.youtube.com/watch?v=wZg92eBC0NA&list=PLPPQsPUGLUhmgEKfTAr0wJ6Ue mosnAsiS

Appendix 4 Questionnaire

Welkom bij de online vragenlijst van VooRuit met VR Beste deelnemer,

Namens het Projectteam VooRuit met VR willen wij u allereerst hartelijk bedanken voor uw deelname aan deze vragenlijst. Uw meningen en ideeën zijn ontzettend belangrijk voor het project.

Sinds september 2016 zijn we bezig met het ontwikkelen van een Virtual Reality (VR)-toepassing voor de forensische ggz. Deze ontwikkeling doen we zo veel mogelijk samen met patiënten, behandelaren en begeleiders zodat de VR-toepassing zo goed mogelijk zal passen bij de praktijk. Op basis van inspiratiesessies en interviews met behandelaren en patiënten van Transfore zijn er zes ideeën voor mogelijke VR-toepassingen ontwikkeld. Deze ideeën willen we graag laten zien aan mensen die de VR-toepassing in de toekomst écht kunnen gaan gebruiken.

Daarom hebben we zes filmpjes gemaakt die we laten zien in deze vragenlijst. In elk filmpje wordt het doel van de VR-toepassing uitgelegd. We vragen u per idee vragen om uw mening te geven. Dat doen we door na elk filmpje een aantal stellingen aan u voor te leggen. Ook stellen we per filmpje drie korte open vragen. Daarnaast volgen er nog enkele afsluitende vragen aan het einde van de vragenlijst.

De filmpjes duren ongeveer 1 tot 2 minuten. Het kan per persoon verschillen hoeveel tijd het invullen van de vragenlijst kost, maar verwacht wordt dat dit ongeveer 30 minuten duurt. Onder deelnemers die hun e-mailadres aan het einde van de lijst achterlaten, zullen we een aantal VR-brillen verloten. Alle informatie wordt anoniem verwerkt: uw e-mailadres of andere persoonlijke gegevens worden niet aan uw antwoorden gekoppeld.

Op de volgende pagina van deze vragenlijst vragen we u om uw officiële toestemming voor deelname aan dit korte onderzoek (informed consent). Hierna stellen we wat achtergrondvragen, en dan beginnen de filmpjes. Veel plezier en succes, en alvast hartelijk dank voor uw deelname!

Het VooRuit met VR projectteam,

Informed consent

Ik verklaar op een voor mij duidelijke wijze te zijn ingelicht over de aard, methode, doel en belasting van het onderzoek. Ik weet dat de gegevens en resultaten van het onderzoek alleen anoniem en vertrouwelijk aan derden bekend gemaakt zullen worden. Ik begrijp dat mijn antwoorden of bewerking daarvan uitsluitend bestemd zijn voor gebruik binnen het VooRuit met VR project en wetenschappelijke analyse en/of presentaties. Ik stem geheel vrijwillig in met deelname aan dit onderzoek. Ik behoud me daarbij het recht voor om op elk moment zonder opgaaf van redenen mijn deelname aan dit onderzoek te beëindigen.

Indien u hiermee instemt, vink dan onderstaand hokje aan.

☐ Ja, ik stem in met deelname aan dit onderzoek

Introductievragen

Er volgen nu eerst enkele korte vragen over demografische gegeven en uw relatie met de forensische geestelijke gezondheidszorg (fggz). We hebben deze achtergrondinformatie nodig om een goed beeld te krijgen van wie deze vragenlijst in heeft gevuld.

Wat is uw geslacht?

- Man
- Vrouw

Wat is uw leeftijd (in jaren)?

Bent u...

- Behandelaar/ begeleider in de forensische ggz
- Patiënt/ voormalig patiënt in de forensische ggz
- Anders, namelijk...

Vragen voor behandelaar/begeleider in de forensische ggz:

Er volgen nu enkele vragen over uw ervaring en rol als behandelaar en/of begeleider in de forensische ggz.

Hoeveel jaar bent u werkzaam binnen de forensische ggz/psychiatrie?

Bij welke instelling voor forensische geestelijke gezondheidszorg bent u op dit moment werkzaam?

Wat is uw functie op dit moment?

Met welk type problematiek werkt u momenteel hoofdzakelijk?

- Ik behandel/begeleid momenteel hoofdzakelijk patiënten met zedenproblematiek.
- Ik behandel/begeleid momenteel hoofdzakelijk patiënten met agressieproblematiek.
- Het aantal patiënten met agressieproblematiek en zedenproblematiek dat ik behandel/begeleid is momenteel ongeveer gelijk verdeeld.
- Anders, namelijk...

Waar bent u op dit moment werkzaam? Er zijn meerdere antwoorden mogelijk

- Forensisch Psychiatrisch Centrum (FPC)
- Forensisch Psychiatrische Kliniek (FPK)
- Forensisch Psychiatrische Afdeling (FPA)
- Poliklinische behandeling
- For-FACT
- Forensisch Beschermd Wonen (FBW)
- Anders, namelijk...

Heeft u al eens een virtual reality (VR)-bril opgehad?

- Ja
- Nee, maar ik weet wel wat virtual reality (VR) is
- Nee, en ik weet niet wat virtual reality (VR) is

Heeft u al eens virtual reality (VR) gebruikt in uw behandeling?

- Ja, heel vaak
- Ja, een paar keer
- Nee, nog nooit

Op een schaal van 1 tot 10, hoe positief bent u over het gebruik van virtual reality (VR) in de behandelingen van de forensische geestelijke gezondheidszorg? [insert likert schaal van 1 (heel erg negatief) tot 10 (heel erg positief)]

Vragen voor patiënt in de forensische ggz

Bent u op dit moment in behandeling en/of verblijft u in een instelling binnen de forensische ggz?

- Ja
- Nee, maar ik ben ex-patiënt

• Nee, ik ben nooit in behandeling geweest (u wordt doorverwezen naar categorie Anders, namelijk)

Bij welke instelling voor forensische geestelijke gezondheidszorg wordt u behandeld en/of verblijft u op dit moment?

Hoeveel jaar bent u in totaal in behandeling binnen de forensische ggz?

Waar bent u op dit moment in behandeling/ verblijft u? Er zijn meerdere antwoorden mogelijk.

- Forensisch Psychiatrisch Centrum (FPC)
- Forensisch Psychiatrische Kliniek (FPK)
- Forensisch Psychiatrische Afdeling (FPA)
- Poliklinische behandeling
- For-FACT
- Forensisch Beschermd Wonen (FBW)
- Anders, namelijk...

Voor welk type grensoverschrijdend gedrag bent u in behandeling/ verblijft u?

- Seksueel grensoverschrijdend gedrag
- Agressief grensoverschrijdend gedrag
- Seksueel en agressief grensoverschrijdend gedrag
- Anders, namelijk...

Heeft u al eens een virtual reality (VR)-bril opgehad?

- Ja
- Nee, maar ik weet wel wat virtual reality (VR) is
- Nee, en ik weet niet wat virtual reality (VR) is

Heeft u al eens virtual reality (VR) gebruikt in uw behandeling?

- Ja, heel vaak
- Ja, een paar keer
- Nee, nog nooit

Op een schaal van 1 tot 10, hoe positief bent u over het gebruik van virtual reality (VR) in de behandelingen van de forensische geestelijke gezondheidszorg? [insert likert schaal van 1 (heel erg negatief) tot 10 (heel erg positief)]

Bij Nee, ex-patiënt:

Bij welke instelling voor forensische geestelijke gezondheidszorg bent u voor het laatst behandeld?

Hoe lang geleden (in jaren) is uw behandeling beëindigd?

Hoe lang bent u in totaal in behandeling geweest binnen de forensische ggz en/of verbleven (in jaren)?

Waar bent u in behandeling geweest en/of verbleven? Er zijn meerdere antwoorden mogelijk.

- Forensisch Psychiatrisch Centrum (FPC)
- Forensisch Psychiatrische Kliniek (FPK)
- Forensisch Psychiatrische Afdeling (FPA)
- Poliklinische behandeling
- For-FACT
- Forensisch Beschermd Wonen (FBW)
- Anders, namelijk...

Voor welk type grensoverschrijdend gedrag bent u op in behandeling geweest?

- Seksueel grensoverschrijdend gedrag
- Agressief grensoverschrijdend gedrag
- Seksueel en agressief grensoverschrijdend gedrag
- Anders, namelijk...

Heeft u al eens een virtual reality (VR)-bril opgehad?

- Ja
- Nee, maar ik weet wel wat virtual reality (VR) is
- Nee, en ik weet niet wat virtual reality (VR) is

Is er al eens virtual reality (VR) gebruikt in uw behandeling?

- Ja, heel vaak
- Ja, een paar keer
- Nee, nog nooit

Op een schaal van 1 tot 10, hoe positief bent u over het gebruik van virtual reality (VR) in de behandelingen van de forensische geestelijke gezondheidszorg? [insert likert schaal van 1 (heel erg negatief) tot 10 (heel erg positief)]

Vragen voor Anders, namelijk

Heeft u op een bepaalde manier een relatie met de forensische geestelijke gezondheidszorg?

- Ja
- Nee
- Let op: als u geen enkele relatie met de forensische ggz hebt, kunnen we uw gegevens helaas niet meenemen in de analyse. U bent natuurlijk vrij om de vragenlijst wel verder in te vullen.

Wat is uw relatie met de forensische ggz? Graag zo specifiek mogelijk beschrijven.

Bij welke instelling(en) voor forensische geestelijke gezondheidszorg bent u betrokken?

Hoe bent u bij de forensische ggz betrokken (in jaren)?

Heeft u al eens een virtual reality (VR)-bril opgehad?

- Ja
- Nee, maar ik weet wel wat virtual reality (VR) is
- Nee, en ik weet niet wat virtual reality (VR) is

Op een schaal van 1 tot 10, hoe positief bent u over het gebruik van virtual reality (VR) in de behandelingen van de forensische geestelijke gezondheidszorg? [insert likert schaal van 1 (heel erg negatief) tot 10 (heel erg positief)]

Vragen over filmpjes

Hartelijk dank voor het invullen van deze achtergrondvragen. Er volgen nu zes filmpjes waar vragen over gesteld zullen worden. Er zijn geen goede of foute antwoorden, we zijn vooral op zoek naar uw mening en ideeën.

Let op: het kan zijn dat de filmpjes niet afgespeeld kunnen worden op het netwerk van uw instelling en/of uw computer. In dat geval zijn er enkele andere opties:

- U kunt de vragenlijst invullen in een niet-afgeschermde omgeving, zoals uw mobiele telefoon, laptop, of een andere computer op uw locatie waar het bekijken van filmpjes wel mogelijk is.
- In de vragenlijst staan QR codes. Als u deze scant met uw mobiele telefoon komt u automatisch terecht bij het filmpje waar de vragen over gaan. U kunt de vragenlijst dan gewoon op de computer invullen, en de filmpjes op uw mobiel kijken. Daarvoor heeft u wel een QR code scanner app nodig, deze kunt u downloaden in uw Appstore door te zoeken op 'QR Code scanner'.

Triggers en helpers

In dit filmpje wordt een idee voor een VR-toepassing getoond. Dit type toepassing richt zich op het omgaan met bepaalde 'triggers'. Deze triggers kunnen ongewenste gevoelens, gedachten en gedragingen oproepen bij patiënten. Voorbeelden van triggers zijn alcohol, voetbalfans van een andere club, drugsdealers of, zoals in onderstaand filmpje, vrouwen. In dit idee voor een VR-toepassing gaan behandelaar en patiënt in de VR-toepassing op zoek naar 'helpers'. Deze helpers kunnen de patiënt ondersteunen in het goed omgaan met hun triggers.

Nadat u het filmpje hebt gekeken volgen er enkele stellingen en open vragen. Let op: deze vragen gaan over het achterliggende idee voor VR-toepassing en niet over de kwaliteit of het voorbeeld van het filmpje. [insert filmpje 1]

Er volgen nu enkele woordparen die bestaan uit tegenstellingen. Geef voor elke tegenstelling aan welk woord het meest van toepassing is op uw mening over het idee voor de VR-toepassing. Er zijn geen goede of foute antwoorden, we zijn vooral benieuwd naar uw mening.

Dit idee voor een VR-toepassing is voor mij:

Belangrijk	
Saai	
Relevant	
Enthousiasmerend	
Betekenisloos	
Aansprekend	
Fascinerend	
Waardeloos	
Betrokken	
Niet nodig	

Niet belangrijk Interessant Niet relevant Niet enthousiasmerend **Betekenisvol** Niet aansprekend Alledaags Waardevol Niet betrokken Nodia

Open vragen

Nu volgen er enkele open vragen waarin u uw mening over het idee voor de VR-toepassing kwijt kunt. Wat vindt u positief, interessant en/of leuk aan dit idee?

Wat vindt u negatief, minder leuk en/of nadelig aan dit idee?

Welke suggesties of ideeën heeft u om dit idee beter te maken?

Welk rapportcijfer geeft u aan dit idee voor een VR-toepassing? 1-10

Lichaamstaal observeren en interpreteren

In dit filmpje wordt een idee voor een VR-toepassing getoond. Deze toepassing richt zich op de reactie van patiënten op de lichaamstaal van een ander in het dagelijks leven. De patiënt bekijkt via zogenaamde 360-graden filmpies gefilmde situaties waarin het non-verbale gedrag van een ander centraal staat. Denk hierbij aan een persoon die te dicht langs je loopt, een caissière die je negeert, of iemand op een terras die je te lang aankijkt. De filmpjes, en gedachten en gevoelens die ze oproepen, worden besproken met de behandelaar. Samen wordt gezocht naar betere reacties. Nadat u het filmpie hebt gekeken volgen er enkele stellingen en open vragen. Let op: deze vragen gaan over het achterliggende idee voor VR-toepassing en niet over de kwaliteit of het voorbeeld van het filmpje.

[insert filmpje 2, insert vragen]

Lichaamstaal en het effect op anderen

In dit filmpje wordt een idee voor een VR-toepassing getoond. Deze toepassing richt zich op inzicht van een patiënt in de invloed van zijn of haar eigen lichaamstaal op een ander. De invloed van de omgeving, bijvoorbeeld een drukke of rustige ruimte, wordt hier ook in meegenomen. Via deze toepassing krijgt de patiënt meer inzicht in het effect van eigen lichaamstaal, zoals een heel intimiderende houding, het juist heel klein maken, of drukke, onrustige bewegingen. [insert filmpje 3, insert vragen]

Rollenspel in context

In dit filmpje wordt een idee voor een VR-toepassing getoond. Deze toepassing richt zich op het oefenen met sociale vaardigheden via een rollenspel in een virtuele omgeving. Via een stemvervormende microfoon speelt de behandelaar de ander. Het uiterlijk van die ander kan aangepast worden, net als de omgeving waarin het rollenspel plaatsvindt. Denk bijvoorbeeld aan een rollenspel in een treincoupé, een drukke kroeg, of een voetbalveld. De patiënt kan zo sociale vaardigheden in een realistische omgeving aanleren of verbeteren. [insert filmpje 4, insert vragen]

Moments of choice

In dit filmpje wordt een idee voor een VR-toepassing getoond. Deze toepassing richt zich op het krijgen van inzicht in de gevolgen van het eigen gedrag. De patiënt kan in verschillende soorten virtuele scenario's geplaatst worden. Gedurende een scenario zijn er meerdere keuzemomenten waarop de patiënt aan moet geven wat hij zou doen in die situatie. Op basis van die keuze worden de gevolgen getoond in het virtuele scenario. Dit alles wordt besproken met de behandelaar. *[insert filmpje 5, insert vragen]*

Delictscenario

In onderstaand filmpje wordt een idee voor een VR-toepassing getoond. Deze toepassing richt zich op het zelf bouwen en betreden van een delictscenario. Patiënt en behandelaar gaan aan de slag met een virtuele bouwdoos waarin ze zelf omgevingen en personen kunnen bouwen. Zo maken ze samen een delictscenario die de patiënt via een VR bril kan betreden. In deze omgeving kan hij samen met de behandelaar gedrag analyseren, en op zoek naar alternatief, beter gedrag. *[insert filmpje 6, insert vragen]*

Afrondende vragen

U heeft nu alle zes filmpjes bekeken en daar uw mening over gegeven. Nu volgen nog enkele afsluitende vragen over alle filmpjes samen.

Als u een keuze moet maken, welke idee/welke ideeën spreken u het meest aan? Let op: het gaat hier over het achterliggende idee, niet de kwaliteit van het filmpje. *(meerdere opties mogelijk)*

- Triggers en helpers. Een VR-toepassing om patiënten om te leren gaan met triggers en op zoek te gaan naar helpers. [insert screenshot uit filmpje]
- Lichaamstaal observeren en interpreteren? Een VR-toepassing die patiënten inzicht geeft in hoe ze reageren op lichaamstaal en non-verbaal gedrag van de ander.
- Lichaamstaal en effect op anderen? In deze toepassing leert de patiënt welke invloed zijn of haar lichaamstaal op iemand anders kan hebben.
- Rollenspel in context. Deze toepassing richt zich op het trainen van sociale vaardigheden via een rollenspel in een relevante context. [insert screenshot uit filmpje]
- Moments of choice. Een VR-toepassing om de patiënt inzicht te geven in de gevolgen van bepaald gedrag. [insert screenshot uit filmpje]
- Delictscenario. In deze VR-toepassing wordt gewerkt aan het bouwen en betreden van een delictscenario. [insert screenshot uit filmpje]

Waarom heeft dit idee/deze ideeën uw voorkeur?

.....

Ten slotte: van welke mogelijkheden van VR in het algemeen wordt u het meest enthousiast?

Afsluiting

Hartelijk dank voor uw deelname! Mocht u nog vragen of opmerkingen hebben, kunt u een e-mail sturen naar [e-mail adres]

Onder alle deelnemers die hun e-mailadres achterlaten verloten we vijf VR-brillen. Mocht u deel willen nemen aan deze verloting, kunt u uw e-mailadres hieronder achterlaten. Dit e-mailadres zal niet gekoppeld worden aan uw antwoorden.

.....

Uw meningen en ideeën zijn van groot belang voor ons project en daarom zijn we continu op zoek naar mensen die vanuit hun expertise en ervaring met ons mee willen denken. Als u geïnteresseerd bent in deelname aan vervolginterviews of focusgroepen voor dit project, willen we u vragen om uw emailadres hieronder (opnieuw) in te vullen.

U bent niet verplicht om uw e-mailadres achter te laten. Dit e-mailadres wordt alleen gebruikt voor de loting en/of om contact met u op te nemen over deelname aan vervolgonderzoeken en zal in geen geval gekoppeld worden aan uw antwoorden.

Nogmaals hartelijk dank, uw antwoorden zijn erg waardevol voor het ontwikkelproces!

Appendix 5 Dutch word pairs PII

The 'personal involvement inventory' (Zaichkowsky, 1994) [68]

1.	Unimportant	_	Important *
2.	Boring	_	Interesting
3.	Irrelevant	_	Relevant *
4.	Unexciting	_	Exciting *
5.	Means nothing	_	Means a lot to me
6.	Unappealing	_	Appealing *
7.	Mundane	_	Fascinating*
8.	Worthless	_	Valuable
9.	Uninvolving	_	Involving*
10	. Not needed	_	Needed

* Indicates item is reverse scored

Dutch version of the 'personal involvement inventory' (Zaichkowsky, 1994). Dit idee voor een VR-toepassing is voor mij:

Niet belangrijk* 1. Belangrijk -2. Saai Interessant -3. Relevant Niet relevant* 4. Enthousiasmerend Niet enthousiasmerend* -5. Betekenisloos **Betekenisvol** 6. Aansprekend Niet aansprekend* 7. Fascinerend Alledaags* 8. Waardeloos Waardevol 9. Betrokken Niet betrokken* 10. Niet nodig Nodig

* Indicates item is reverse scored

Appendix 6 Interview text scenario and interview scheme

6.1 Text scenario

Het doel vandaag is om uw mening te horen over dit concrete idee voor een VRtoepassing te horen.

- 1 Triggers: prikkels die ongewenste gevoelens, gedachten en gedragingen oproepen bij patiënten. Dat kan bijvoorbeeld geluid, een voorwerp, lichaamshouding, wat iemand tegen je zegt of bepaalde kleding zijn. Een bepaalde prikkel of een bepaalde combinatie prikkels kan voor een persoon ervoor zorgen dat hij ongewenst gedrag vertoont.
- 2 Helpers kunnen de patiënt ondersteunen in het goed omgaan met hun triggers. Dit kunnen weer geluiden en dingen die je ziet zijn, maar je kan ook helpers in jezelf vinden, bijvoorbeeld bepaalde rustige gedachten (tot 10 tellen) of besluiten dat je zegt om weg te lopen.

Het gebruik van de VR-toepassing wordt uitgelegd aan de hand van een het verhaal van Jos de Groot. Dit verhaal legt uit hoe hij de VR-bril kan gebruiken in zijn behandeling. De VRtoepassing kan ook nog op andere manieren gebruikt worden (bijvoorbeeld andere patiëntengroepen (zowel agressie als zeden) of andere context (klinisch en ambulant). Jos is een man van 32 jaar oud en al 2 jaar in behandeling bij de forensische ggz. Hij heeft een geschiedenis alcoholproblematiek, persoonlijkheidsstoornis, en problemen met agressief

gedrag. Hij wordt behandeld op de FPA. Hij weet niet goed wat zijn agressieve gedrag uitlokt en heeft niet veel zin om hier iets aan te doen.

Jos praat met zijn behandelaar Anne over zijn risicofactoren. Tijdens dit gesprek komt naar boven dat Jos niet goed kan vertellen wat zijn triggers zijn voor agressief gedrag. Hij weet dat hij erg boos en agressief kan worden, maar denkt dat dit zonder redenen is en hij hier niks aan kan doen. Ook weet niet wat zijn helpers zijn. Anne heeft een vermoeden dat Jos wel bepaalde specifieke triggers en helpers heeft, maar wil graag weten of dit klopt. Vandaar dat ze voorstelt om samen op zoek te gaan naar de triggers en helpers van Jos, door een VR-toepassing te gebruiken.

Jos is huiverig en wil eerst weten wat die VR-toepassing precies is. Anne legt uit wat een VR-bril is: het is een soort grote skibril en als je die opzet zie je 3D beelden, waardoor het lijkt alsof je in een hele andere wereld bent. Bij deze toepassing kunnen we samen bepalen in welke omgeving je bent, welke geluiden je hoort, wat voor mensen je ziet en welke voorwerpen in deze omgeving staan. Vervolgens kun je de bril opzetten en oefenen in de door ons samengestelde omgeving. Zo kan je in een realistische virtuele omgeving erachter komen wat je triggert en kunnen we kijken hoe je hiermee om kan gaan met helpers. Jos is nog steeds een beetje wantrouwend, maar besluit toch om het te proberen. Anne en Jos gaan samen achter de computer zitten en praten over de hoe ze de omgeving willen inrichten.

Ze gebruiken de "blokkendoos". Hierin staan alle keuze opties die gebruikt kunnen worden om de VR-omgeving te bouwen. De precieze opties zullen we later nog bespreken. Voor nu is het belangrijk om te weten dat:

Er vele generieke personalisatie opties zijn in deze VR-toepassing. Deze zijn ingedeeld op omgeving, tegenspeler en stimuli, met bijbehorende sub categorieën. Jos en Anne kunnen ervoor kiezen om één of meerder bokken van iedere subcategorie te kiezen. Maar ze kunnen bepalen dat er geen tegenspeler, geen stimuli, geen achtergrondgeluiden en/of geen figurant(en) worden toegevoegd, alleen het kiezen van een type omgeving is een vereiste. De combinatie van de juiste relevante personalisatie opties, zal ervoor zorgen de VRomgeving relevant is voor Jos. Zo kan hij in een levensechte omgeving opzoek naar zijn triggers. Sommige opties zijn categorisch (man of vrouw), en andere zijn opschaal (bijvoorbeeld geluid van hard naar zacht). De blokken op schaal zijn aangegeven met een * (asterisk). Daarbij kan de felheid van het licht en het volume van de geluiden worden aangepast.

Jos en Anne beslissen om te beginnen met een rustige omgeving met één tegenspeler, geen figuranten en geen stimuli. Het licht van de VR-toepassing wordt op gemiddeld gezet. Ze kiezen type omgeving park met fontein. Aangezien Jos aangeeft moeite te hebben met mannen die boos op hem worden, kiezen Anne en Jos als tegenspeler een man van 30 jaar, lang, normaal gebouwd, witte etniciteit en normale kleding. De emotie van de tegenspeler wordt op boven gemiddeld boos gezet. Om deze emotie te ondersteunen kiezen ze als lichaamshouding wilde armgebaren. Daarbij wordt het volume van de stem op boven gemiddeld hard gezet. Jos zet de bril op en bevindt zich in een park, met tegenover zich de boze man. Anne kijkt mee op een scherm naar de beelden die Jos ziet en spreekt met de stem vervormende microfoon de stem van de tegenspeler in.

Na even deze situatie te oefenen in de VR-omgeving zet Anne de VR-toepassing op pauze voor een reflectiemoment. Hierin bespreken Jos en Anne dat Jos niet erg werd getriggerd door de man. Ze past de houding en emotie van de tegenspeler aan, als reactie op het rustige gedrag van Jos. Daarna evalueren ze het VR-gebruik. Ze besluiten om de volgende oefening een stapje moeilijker te maken door meer mogelijke triggers toe te voegen.

Bij de volgende oefening besluiten ze weer dezelfde man als tegenspeler te gebruiken, maar om het een stapje moeilijker te maken stelt Anne voor om de omgeving te veranderen in een straat 's nachts met een aantal mensen verspreid over de locatie en de auditieve stimuli luide muziek en schreeuwende mensen toe te voegen. Jos is het hiermee eens. Jos doet weer de bril op en Anne spreekt weer de stem van de tegenspeler in. Jos bevindt zich nu in een straat 's nachts, met een aantal mensen erin. Hij ziet weer dezelfde man voor zich staan en hoort allemaal geluiden op de achtergrond. Jos wordt al snel boos.

Na even deze situatie te oefenen zet Anne de VR-toepassing weer op pauze. Ze vraagt aan Jos hoe hij de oefening nu vond. Jos antwoord boos en vertelt dat hij de man erg vervelend vond. Anne en Jos praten hierover en concluderen dat wanneer er meer auditieve stimuli zijn, Jos heftiger reageert op situaties. Ze bedenken samen wat hiertegen kan helpen. Anne stelt voor dat Jos de rust in zichzelf zoekt en steeds tot 10 telt als hij voelt dat hij agressief gaat reageren. Anne zet de VR-toepassing weer aan, en Jos probeert zichzelf te kalmeren, maar reageert al snel weer boos. Na even oefenen zet Anne de VR-toepassing weer op pauze. Jos geeft aan dat het tot tien tellen niet werkt.

Anne vraagt wat hij denkt dat wel werkt. Jos zegt dat hij al die geluiden zo naar vindt, en liever iets anders hoort. Dus stelt Anne voor dat hij wegloopt en naar zijn eigen muziek luistert. Dit probeert Jos in de volgende oefening en dit helpt. Hij blijft rustig, ondanks dat er veel geluiden zijn en de man tegen hem blijft schreeuwen.

De VR applicatie kan op drie manieren worden ingezet: het opzoek kan gaan naar wat de patiënt nou precies triggert, de patiënt aanleren hoe je omgaat met bepaalde triggers door middel van helpers, en de behandelaar inzicht geven in hoe de patiënt reageert op triggers en helpers.

6.2 Interview scheme

Dutch

- Wat vindt u van deze toepassing/dit idee? Waarom? (attitude ten aanzien van het idee)
- Denkt u dat u deze toepassing nuttig zou zijn voor behandelingen in de forensische ggz? (perceptie van potentieel nut). Waarom wel/niet?
- Denkt u dat zo'n soort toepassing makkelijk te gebruiken is in behandelingen van de forensische ggz? (perceptie van potentieel gebruiksgemak) Waarom wel/niet?
- Zou u deze toepassing willen gaan gebruiken? (attitude ten aanzien van het potentiële gebruik/ intentie van het potentiële gebruik) Waarom wel/niet?
- Wat zou er veranderd moeten worden aan dit idee om zo veel mogelijk toegevoegde waarde te hebben?
- Zijn er nog onbesproken positieve/negatieve punten aan dit idee die u nog wilt delen?

English

- What are your opinions about this application/ this idea? Why? (attitude toward idea)
- Think you that this application would be useful for treatment in forensic mental healthcare? Why (not)? (perceived potential usefulness)
- Do you think that this application would be easy to use in forensic mental healthcare? Why (not)? (perceived potential ease of use)
- Do you want to use this application? Why (not)? (attitude toward potential using)
- What should be change give this idea as much added value as possible?
- Are there undiscussed positive of negative points that you want to share?

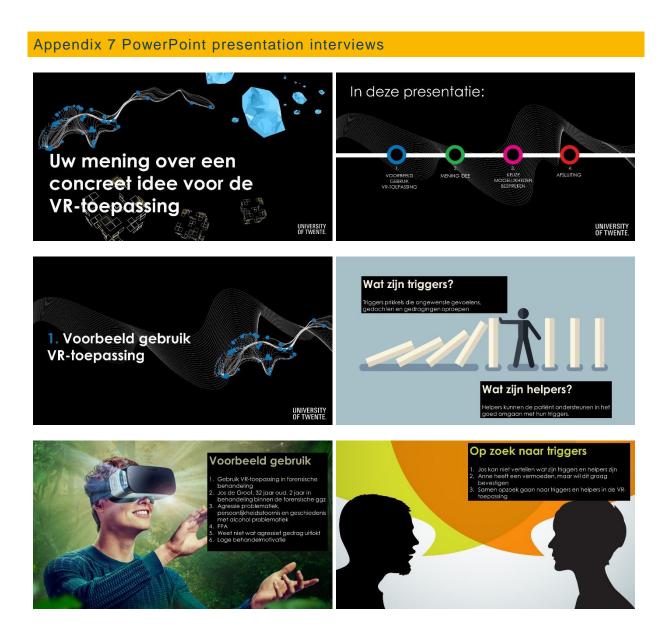
Nu gaan we de blokkendoos bespreken/ Now we will discuss the personalization options:

Dutch

- Welke personalisatiemogelijkheden zijn volgens u het nuttigst (deze omcirkelen)?
- Wat mist er nog of moet er veranderd worden in de personalisatiemogelijkheden om voor zo veel mogelijk patiënten een relevante VR-omgeving te bouwen?

English

- Which personalization options are the most useful, according to you? (circle those options)?
- What options are missing or should be changed to build a relevant VR environment for as many patients as possible?





De blokken voor Jos

Originiting				Tager				
Type orngoving	Achtergrondgeluid	Figurant(an)	Umrlijk	Uiterlijke kenmerken	Gezichts- uitdrukking	Lichaumshouding	Auditief	Varaeel
tonial Scientis	Grosveroes	Douler (meil beuptieue)	Varew/Man	Langle (grout - klein)*	nd.	Lithalen/ daesde beweging	Teleform site algoal	Special je ogyet telefour
Wandelstraat overdag	and gepraat	teole grocp mences v20	Losftijd (6.80)*	Boww [smal - bread] *	prof.	Stepgsbaar (handen voorat)	Lode mazek	rissen alsoholdirata b
Trein	Luidsuchtig spidende kinderen	Wangjorgeros		Etakiteit (wit/ noord Afrikaans/ Afrikaans)	8005*	Armen over elsaar	Egos maziek	Op straat 1 gebouw wraaderen (ontershop skije rij/ konteel/ drogsterij
ituskamer	Achtergrondmaze k	spelende kinderen		Nabijheid (ver wog - dichtbij)*	Bodroufd*	Chrustig taraa, bewegen, widteken	Shines (politic)	ecoas bion
Gonoricke balle	Volumo goluld (decibel) *	MookEkor mot gesprok begetepeler		kleding vrouw (Normala trai / kort jarkja mat decoleti / hoefddock/ togie	Beschaamd*	Annen naact Ichaam	Hullord Sind	Gepenstraficent fort met tekst (b]-context() fot tim)
	there's yan gelood*	Twee surtrakiolijka krouwen	-	mot pantorprint, grota porbellen en tatoeagri	Bestraal*	Elense maker/schoolers koromin	Schwessende mesen	
Sapernunkt		Aartal monsim perspreid over de locati		Seding mas (Normals trait of overheims)/-		Boril voor uit	Baffende konden	
2605		Alsohei drinkende messee		pak/ trainingspak/ hendje mit blote armen met fattsearst		Wilde armgebaren	Twice molende in orisin	
8.04		Insta/decis menter				Middebyinger opyteken	Elsen tikkennte kirk	
		Ourse/Mappe master				Schoppen		
		Groage publismenters alogenin				har breds		
		2 agenter Gezin				Vakiten ballen/ gespannen Wilden	1	
	-	Twee massion hand in hand						

De blokken voor Jos 2

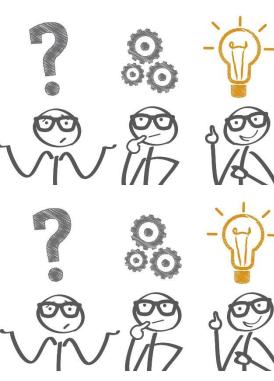
Orngesting			1	Teger	Stimuli			
Type orngeving	Achtergrondgeluid	Figurantjen)	Uherlijk	Ulterlijke kenmerken	Gestchts- uitdrukking	Uchaamshooding	Auditief	Visueel
	Gentecemore	Easier (met hezphoje)	Veren/Man	Lengte (groot - klein)*	ailt.	Uthaber/shande bewegng	Teleform die elipset	Spallatja agan talabour
Vandel streat overdag	Lord pepcant	Cecle groep manaer ×10	504(0)/ (6-80)*	Scow (smal - brand)*	ned.	Steppelan (souther worset)	taide matiet	t lessen allochol/keatje to
Treis	Lathuchig spelende Linderan	Hanglongenes		thicket (uit/ need Alikans/ Afrikans)	Bass*	Armen over ellaar	zgei nuse	Opstreat 1 pelceov weranderen (coTeachop säperig hordeel/ shopsberg)
insidiariter	Achtengrondmuziek	Spelende kindere n		Nabijhold (vor weg - dichtbij)*	secrete*	Orrustig torso, bewegen, widdelen	Sirenas (politie)	Politicaute
Ocnoriolic take	Volume geluid (deable) *	Moskákor met gesprek tegerepeter		Koding vrozw (Normale trut / kurt parkje met decollete / boolddoek/tope	Beschaamd*	Armen naszt lehaam	Hufted kind	Gepersonaliszend bard met tekst (bijvoorbeeld t tot Genl
Park met fontein	Hortz van gelukd*	Twee contractiolipice		met panlesprint, grote unsbeken en taloe agel	Neutroa*	illeiner maken/ schouders krommen	Schreewonde reesses	
Supermont				Kolling man (Normale trui of overheind/ ouk/ truiningoal/ heindie		Borst voorwit	Balfesde konden	
Auto		Alcohol drinkende mensen		met blobe ermen met telonage)		Wilde amgeburen	Twee nubbode merses	
Res		Brede/sterks mannen			1.1	Middebilger opsteken	Hand tildende klok	
		Ounne/Sizppe mannen	1			Scheppen		
		Grouppe politionanners				Hold scheely nae bevery noer teneden		
		2 aposton				Witten ballen' propannen		
		Gerin				Wilms		
		Twee manners hand in hand						

De blokken voor Jos 2

	Onigeving			Teger	Stimuli			
Type omgeving	Achtergrondgelaid	Figurant(en)	Ulterlijk	Uterlijke kenmerken	Gezichts- uitskubking	Lishaamshouding	Auditief	Visueel
	Gertaezembes	Ender (met heaptes)e)	Vicus/Mar	Lengte (groot - klein)*	ul.	Utilialet/ sharafe bezeging	Teleform die efgant	Spelletje eigen teleform
Wandel strast oserdag	Luid,gepriot	Goote groep messes	Lewitipi (6-80)*	Rouw (smal - breed) *	Rang*	Shappelaor (handen vooralt)	tuide mutiek	Resen alcohoù kratje hie
Tenin	Cultracility spelende kinderen	Kangjongeren		Ebsicheit (wit/ coord Afrikaans/ Afrikaans)	Book*	Annes over elkaar	figen markek	Op staad 1 petrose vecanderen (cathershop siljtarij/bordeel/ doogleberij
Ituiskaener	Aritergrondmasiek	Speliesde kinderen	-	Rabijbeid (ver weg - dichtbij)*	Seaturis*	Derustig forse, bewegen, anathelen	Scenes (polde)	Politicado
Generieke balle	Volume gehiti (disabel) *	Meekijker met gespiek begenspieler		Kleding vrozni (Normale trvi / kort jurkje met desoliete / hoshdroek/ topie	hesthaund*	Armen mast lich aan	itulend itrit	Gepersonaliseeni bord met tekst (bijvoorbaeld b fottijes)
Park met fonben	Fierly van geluid*	Taxee contracked by vicusies		met panterprint, grote oorbeilen en tatoeage)	Neutron*	Eleiner mekery'schoudery kommen	Schreeuwende mense	- 11001A
Supermarkt		Accelul represent mempeoid must be for after		Keeling man (Normale trai of overhened/ pak/ trainingspak/ hemdje		Rens) voorsalt	Maltes de hondes	
Astes		Manifed detributede ministratio		met blote annen met tatosage)		Wilde armgeharen	Ture rotinie rorran	
B18		Bredeylderke mannen				Middelstoger opsteken	Hard Skiercle Mok	
		Conne/stappe manner				Schoppen		
		Groupje pobliemannen, vrouwen				itoefd ichiel/ near bover/ near beteden		
		2 agonton		2		Vulsten bollen/gespannen		
		Grein				W(ren		
		Twee mannen hand in hand						

De blokkendoos

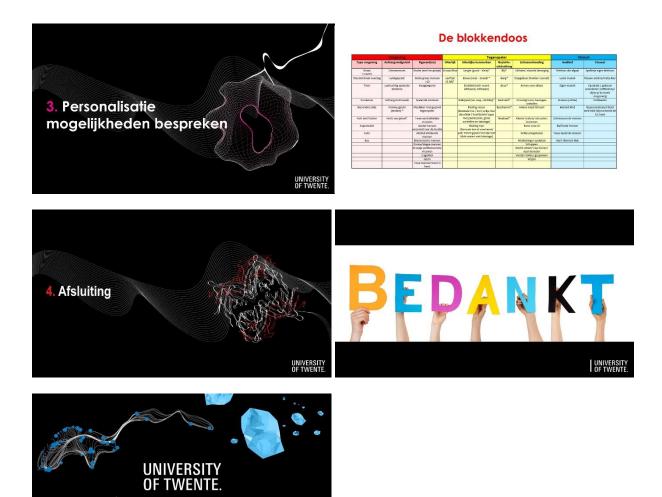
	Omgeving			Tege	Stimuli			
Type ongeving	Achtergrondgehuld	Figurant(en)	Utterlijk	Ulterlijke kenmerken	Gezichts- uitdrukking	Lichaamshouding	Auditicf	Visueel
Straat 's nachts	Geroczemoes	Dealer (met heuptasjo)	and the	Longte (groot - klein)*	811.	Uthalen/ slaande beweging	Telefoon die afgaat	Spolletje eigen telefoor
Wandel streat overdag	Lidd gepreet	Grote groep mensen >10	Levelitiji (6-00/*	Boww (sma) - breed) *	Barg*	Stopgebaar (handen voorsit)	Luide muclek	Elessen alcohol/kratje bi
Trein	Luidrachtig spelende kinderen	Hangkingeren		Etricteit (uit/noord Atrikzans/Afrikzans)	Boss*	Armen over elkaar	Digen muziek	Op streat 1 gebouw veranderen (coffeeshop, skjterij/ kordeel/ drogisterij)
Hustaner	Achterprondmusek	Spelende kinderen	9	uspiperq (net mell - ercpcpil),	Betroels*.	Constig torsa, bewegen, wiebelen	Sirenes (public)	Politieauto
Generate bate	Volume gelaid (decibel) *	Meeksker met gesprek tegenspeler		Kleding vrouw (Kormale trul / kort Jurkje met decolleté / hochódoek/ togie	beschaamd*	Armen naast lichaam	mailend kind	Depersonal seerd bord met tekst (teprocriseeld to tot tion)
Park mot fontein	Hertz van geluid*	Twee zantrekkelijke vreuwen		met panterprint, grote corbellen en tatoesgej	Noutroal*	Kleiner maken/ schouders krommen	Schrequivende menson	
Supermarkt		Aontal mensen verspreid ever de locatie		Kloding man (Normale trut of overhernd)		Bant voorvit	Blaffende honden	1
Auto		Alcohol drinkende mensen		pak/ training:pak/ hemdje met blote armen met tatoeage)		Wilde armgebaren	Twee ratercle mersen	
ites		Brede/Atesice mannen				Muldelvinger upsheken	Hand tikke rule klok	
2		Durne/slappe mannen	Q 2			Schoppen		2 C
		Groepje publiemannen/ strowen				Hoold scheel/ near boven/ near beteden		
1		2 agentes	0			Valsten balles/ gespannen		15 C
2		Gezin	1		-	Wilson		8
() (Paver mannen hand in hand				1000		











Appendix 8 Adaption Technology Acceptance Model

The technology acceptance model (TAM) is a model where the actual system use (AI), is predicted based on the perceived usefulness (U), perceived ease of use (E), attitude toward using (A) and behavioral intention to use (BI) (Figure The Technology Acceptance Model) [76, 77].

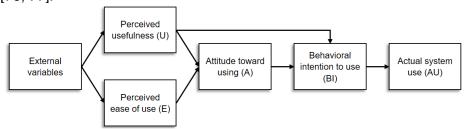


Figure The Technology Acceptance Model, [77]

In this the perception of ease of use (E) is defined as: the degree to which a person beliefs that using the system is effortless [76]. E influences A, which is defined as the positive and negative feeling can have about performing the aimed behavior [77, 98]. A is also influenced by U the perceived usefulness, which is the degree to which a person beliefs that the use of

the system will improve his work [76]. A and U together influence the behavioral intention to use (BI). BI is the power of someone's intention to perform a certain behavior. [77, 98]. This BI influences a persons' actual system use (AU) [76, 77].

The TAM is focused on the real use of a technology, however this study is focused on the acceptation of the idea for a technology [77]. Davis et al advise to use the tam for further developed prototypes to predict future use [77]. Nevertheless, some changes need to be made to the TAM, to make is usable for this study. This because in this study an idea is used, instead of a highly developed prototype. Previous research shows that using an adapted TAM is possible [81].

For this study, all the factors of the TAM are made into potential technology, instead of existing technology (Figure The adapted Technology Acceptance Model). In this adapted model, the acceptation of the idea (AI is measured). In addition, the other factors of the TAM are translated in a potential state: Perceived potential usefulness (PU), perceived potential ease of use (PU), attitude toward potential using (PA) and behavioral intention to potential use (PBI).

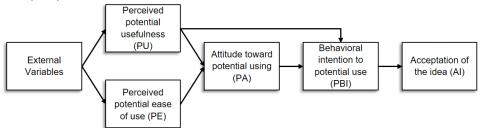


Figure The adapted Technology Acceptance Model

Appendix 9 Tables quantitative tests questionnaire

Table Wilcoxon test grades differences grades between ideas

	Idea 1		Idea 2		Idea 3		Idea 4		Idea 5		ldea 6
	Z	Р	Z	Р	Z	Р	Z	Р	Z	Р	ΖP
Idea 1											
ldea 2	07	.948									
Idea 3	-1.87	.062**	-2.51	.012*							
Idea 4	38	.708	09	.928	-2.28	.023*					
Idea 5	96	.337	-1.11	.267	-1.03	.302	-1.03	.301			
ldea 6	97	.334	99	.324	-2.29	.022*	67	.506	-1.92	.055**	

Idea 1: Triggers & helpers, idea 2: Observing and interpreting body language, idea 3: Body language and the effect on others, idea 4: Roleplaying in context, idea 5: Moments of choice, idea 6: Crime scenario *p<0.05 **p<0.10

Table Wilcoxon test PII scores differences between ideas

	Idea 1		Idea 2		Idea 3		Idea 4		Idea	5	Idea	a 6
	Z	Р	Z	Р	Z	Р	Ζ	Р	Ζ	р	Ζ	р
Idea 1												
Idea 2	31	.755										
Idea 3	44	.659	-8.63	.388								
Idea 4	71	.481	36	.719	-1.30	.193						
Idea 5	09	.931	18	.860	52	.603	-7.62	.446				
Idea 6	-1.72	.086**	-1.42	.156	-1.58	.114	68	.496	-1.67	.095**		

Idea 1: Triggers & helpers, idea 2: Observing and interpreting body language, idea 3: Body language and the effect on others, idea 4: Roleplaying in context, idea 5: Moments of choice, idea 6: Crime scenario *p<0.05 **p<0.10

Table Kruskal Wallis Test mean PII scores and grade for groups (patient, therapist, other)

	mean PII score	mean grade per
	per person	person
Kruskal-Wallis H	3,900	,222
Df	2	2
Asymp. Sig.	,142	,895

Table Mann-Whitney therapists and patients

	mean PII score	mean grade per
	per person	person
Mann-Whitney U	303,000	427,000
Wilcoxon W	423,000	547,000
Z	-1,948	-,399
Asymp. Sig. (2-tailed)	,051	,690

Table Mann-Whitney therapists and others

	mean PII score	mean grade per
	per person	person
Mann-Whitney U	560,500	619,000
Wilcoxon W	791,500	2510,000
Z	-,749	-,229
Asymp. Sig. (2-tailed)	,454	,819

Table Mann-Whitney patients and others

	mean PII score	mean grade per
	per person	person
Mann-Whitney U	560,500	619,000
Wilcoxon W	791,500	2510,000
Z	-,749	-,229
Asymp. Sig. (2-tailed)	,454	,819

Table Mann-Whitney inpatient and outpatient

	mean PII score	mean grade per
	per person	person
Mann-Whitney U	345,000	387,000
Wilcoxon W	751,000	822,000
Z	-1,167	-,730
Asymp. Sig. (2-tailed)	,243	,465

Table Mann-Whitney aggressive and sexual unacceptable behavior

	mean PII score	mean grade per
	per person	person
Mann-Whitney U	71,000	111,000
Wilcoxon W	116,000	156,000
Z	-1,737	-,227
Asymp. Sig. (2-tailed)	,082	,820
Exact Sig. [2*(1-tailed Sig.)]	,086 ^b	,838 ^b

Appendix 10 Modification suggestions six VR ideas questionnaire

Idea	Code	Definition	Freq
	Make their own videos	Let a patient make his own video of a	2
& helpers		situation that is personal relevant for him.	
	Work toward the trigger	Work toward a trigger, instead of starting with	1
		the trigger.	
Idea 2:	Add verbal situations	Extend the videos with non-verbal stations	3
Observing and		with videos by adding conversation-based	
interpreting		situations.	
body language	Make their own videos	Let a patient make his own video of a situation that is personal relevant for him.	1
	Add consequences to the	Let the VR application respond on the	1
	reaction of a patient	reaction a patient has.	
	Add moments of choice	Offer choice options in the VR application.	3
	Start with learning about yourself	Change the order, first learn to deal with yourself and ten with others.	2
	Limit it to recognizing	Use the application for recognizing non- verbal behavior, do not use it for solutions by choice options.	1
Idea 3: Body language and the effect on others	Show patients themselves	Show patients a reflection of their own appearance, in which he can see his posture.	7
Idea 4:	Add triggers	Include triggers in the roleplaying	1
Roleplaying in context	Use an avatar	Show the patient a virtual person in the VR environment with facial expressions and body language that fit with what the therapists says,	1
	Other clients talk via the	Use other clients that talk to the client via the	1
	microphone	microphone, next to the therapist	
Idea 5: Moments of choice	Keep the surprising element		2
-	Mimic a situation from the pas	stMake a situation that really happened in the past in VR.	1
Idea 6: Crime scenario	Add risk factors	Use risk factors, beside to the crime scenario.	2
	Practice future comparable situations	Find out how you can prevent the crime scenario happening again in future similar situations that a patient can practice in. Add other decisions.	1
			-
	Remake it less precise	Build some standard-environments that can be finetuned based on the crime scenario	2

-

Appendix 11 Table two closing questions questionnaire

Table Why favorite idea and most enthusiastic about VR for therapists, patients and other stakeholders						
Main and sub codes	Definition of code	Total n=74	Ther.	Pat.	Other	
<i>Treatment/ Therapist</i> Addition to treatment	VR offers new possibilities for treatment	26	14	8	4	
Practicing in a safe wa	yPatients can practice in VR without harming	18	(54%) 16	(31%) 1	(15%) 1	
	themselves or their environment		(89%)	(6%)	(6%)	

i Ulai		230	154 (67%)	23 (10%)	53 (23%)
Total	Total amount of positive codes used		<u>(3378)</u> 154	23	53
without support	application without any further explanation	5	' (33%)	2 (67%)	(0%)
Positive judgement	A positive comment about VR or an VR	3	1	2	0
Unsupported remarks	effort from therapists		(100%)	(0%)	(0%)
Learning to use VR	Learning to use VR will cost too much time and effort from therapiets	1	1	0	0
treatment			(100%)		(0%)
Time to use in	Using VR within treatment costs too much time	1	1	0	0
	treatment		(75%)	(0%)	(25%)
New technology	VR is a possibility to use technology within	4	3	0	1
	real life		(77%)	(0%)	(23%)
Visual realism	Environments and people in VR are similar to	13	10	0	3
Practical			(0%)	(100%)	(0%)
Context VR usage	Use VR in some specific circumstances	1	0	1	0
application	idea for a VR application	_	(100%)	(0%)	(0%)
Modification in the VR	Change a specific thing or add something to the	2	2	0	0
	people seems realistic to the user		(75%)	(0%)	(25%)
Realism of behavior	Behavior of and interaction between virtual	12	9	0	3
	to the needs of an individual patient	15	(77%)	0 (0%)	3 (23%)
Adaptation of persons	The appearance of virtual people can be adapted	13	(79%) 10	(0%) 0	(21%) 3
Adaptation of environments	The design of virtual environments can be adapted to the needs of an individual patient	14	11 (79%)	0	3
Adoptotion of	to the needs of an individual patient	14	(80%)	(0%)	(20%)
Adaptation of scenarios	s The content of virtual scenarios can be adapted	15	12	0	3
Content					
patient	individual patient		(100%)	(0%)	(0%)
Check if suitable for	Make sure that VR usage is appropriate for the	1	1	0	0
history	to build a relevant VR environment	-	(100%)	•	(0%)
Dishonesty about own	Patients do not give honest personal information	1	1	0	0
Support in reliving situations	VR can be used to help a patient re-experience a specific offense-related scenario	I	0 (0%)	1 (100%)	0 (0%)
Support in roliving	increases because of the use of VR	1	(75%) 0	(0%) 1	(25%)
Treatment motivation	The motivation to actively participate in treatment	4	3	0	1
behavior	interpret the behavior of others		(50%)	(13%)	(38%)
Insight into other's	The patient learns to better understand and	8	4	1	3
behavior	future behavior of the patient	-	(44%)	(11%)	(44%)
Improvement future	The use of VR leads to a positive change in the	9	(40 <i>7</i> 0) 4	1	4
target groups	vix can be used for specific types of patients	10	4 (40%)	4 (40%)	∠ (20%)
behavior Suitable for specific	and its consequences VR can be used for specific types of patients	10	(52%) 4	(10%) 4	(38%) 2
Insight into own	The patient is more aware of his own behavior	21	11	2	8
Patient					
	used to reach a goal	•	(100%)	•	(0%)
VR not necessary	Instead of VR, regular, in person activities can be	1	(00 %)	(0 %)	(40 %)
Implement for specific treatment	Use VR for a current treatment option that it suits well	5	3 (60%)	0 (0%)	2 (40%)
less lans aut fan an aritig	Lie ND for a summer two strength and in the tit suits	-	(100%)	- /	(0%)
Input for conversation	Events in VR can become topics of treatment	5	5	0	0
patient	by observing his behavior in VR		(67%)	(8%)	(25%)
Insight into behavior	realistic way The therapist gains new insights into the patient	12	(62%) 8	(8%) 1	(31%) 3
Good way to practice	VR is a good way to practice with behavior in a	13	8	1	4
	treating patients		(69%)	(0%)	(31%)
Fit current treatment	VR can be well used within the current way of	16	11	0	5

Appendix 12 Attributes and values

All attributes:

- 1. Interaction with a virtual other, played by the therapist is possible in the VR application.
- 2. The content/storyline of the VR application can be adapted to the individual patient.
- 3. The appearance of the virtual persons can be adapted to the individual patient.
- 4. The virtual environment can be adapted to the individual patient.
- 5. The VR-application is suited for a broad spectrum of patient groups.
- 6. The VR application can be used by sexual offenders.
- 7. The VR application looks as realistic as possible.
- 8. The behavior of virtual persons feels as realistic as possible.
- 9. The VR application adds something new to the current treatment, that is not currently done.
- 10. The VR application fits the current way of treating.
- 11. The VR application is easy to use.
- 12. Therapists will be trained well for the use of the VR application.
- 13. The VR application functions as a bridge between the closed and open setting.
- 14. The VR application can be used in outpatient and inpatient settings.
- 15. The VR application does not elect unnecessary negative feelings for the patient.
- 16. The VR application is affordable/does not cost too much.
- 17. The patient can practice with behavior in a virtual environment.
- 18. Therapist get more insight into behavior of the patient by using the VR application.
- 19. The future behavior of the patient will be improved by the VR application.
- 20. The patient gets more insight in his/her behavior by the VR application.
- 21. The patient gets more insight in behavior of others by the VR application.
- 22. The VR application has a positive contribution to the treatment motivation.
- 23. The patient can relive situations with the VR application.
- 24. The patient is honest about the influence the VR application has on her/him.
- 25. The VR application is not used for target groups that it is not suited for.
- 26. The skills and knowledge that is learned in the VR application can be transferred to practice.
- 27. The VR application has personalization options for environment, opponent and scenario/content.
- 28. Applying the VR application does not cost un unnecessary amount of time.
- 29. VR scenarios and environments can be built in cooperation of the patient and the therapist (co-creation).
- 30. Sufficient time will be spent on building the scenarios for an individual patient.
- 31. Other technologies can be added to the VR application (e.g. wearables).
- 32. The VR application can be improved and altered after the implementation.
- 33. The patient can learn skills for daily life in the VR application.
- 34. The patient can learn social skills in the VR application.
- 35. The patient can learn emotion regulation skills in the VR application.
- 36. The patient can be exposed to meaningful, emotion electing stimuli in the VR application.
- 37. The patient can observe daily life in the VR application.
- 38. The patient can observe the behavior of others in the VR application.
- 39. The therapist can get insight in triggers of the individual patient in the VR application.
- 40. The therapist can get more insight in the perspective and experiences of the patient, by VR.

- 41. The VR application ensures a safe practice environment in a realistic context for the patient.
- 42. The VR application is input for conversations between the therapist and the patient.
- 43. Social contacts of the patient can get insight in the situation of the patient with VR.

Values	Attributes
	Stakeholders find it important that
Fit with the	2. The content/storyline of the VR application can be adapted to the individual
patient	patient.
	3. The appearance of the virtual persons can be adapted to the individual
	patient.
	4. The virtual environment can be adapted to the individual patient.
	25. The VR application is not used for target groups that it is not suited for.
	27. The VR application has personalization options for environment, opponent
	and scenario/content.
	36. The patient can be exposed to meaningful, emotion electing stimuli in the VR
Skille training/	application. 1. Interaction with a virtual other, played by the therapist is possible in the VR
Skills training/	
practice	application. 8. The behavior of virtual persons feels as realistic as possible.
	33. The patient can learn skills for daily life in the VR application.
	34. The patient can learn social skills in the VR application.
	35. The patient can learn emotion regulation skills in the VR application.
Safety	18. The patient can learn enfolion regulation skills in the VR application.
caloty	application.
	20. The patient gets more insight in his/her behavior by the VR application.
	21. The patient gets more insight in behavior of others by the VR application.
	23. The patient can relive situations with the VR application.
	24. The patient is honest about the influence the VR application has on her/him.
	37. The patient can observe daily life in the VR application.
	38. The patient can observe the behavior of others in the VR application.
	39. The therapist can get insight in triggers of the individual patient in the VR
	application.
	40. The therapist can get more insight in the perspective and experiences of the
	patient, by VR.
	43. Social contacts of the patient can get insight in the situation of the patient
	with VR.
	7. The VR application looks as realistic as possible.
to daily life	13. The VR application functions as a bridge between the closed and open
	setting.
	17. The patient can practice with behavior in a virtual environment.
	41. The VR application ensures a safe practice environment in a realistic context
	for the patient.
Bridge between	19. The future behavior of the patient will be improved by the VR application.
therapy room	26. The skills and knowledge that is learned in the VR application can be
and practice	transferred to practice.
Insight into	15. The VR application does not elect unnecessary negative feelings for the
behavior	patient.
	41. The VR application ensures a safe practice environment in a realistic context
Treetweent	for the patient.
Treatment	22. The VR application has a positive contribution to the treatment motivation.
motivation Unique addition	9. The VR application adds something new to the current treatment, that is not
to current	currently done.
treatment	
Easy to fit in the	10. The VR application fits the current way of treating.
current	11. The VR application is easy to use.
treatment	12. The vit application is easy to use. 12. Therapists will be trained well for the use of the VR application.
	28. Applying the VR application does not cost un unnecessary amount of time.

	42. The VR application is input for conversations between the therapist and the patient.
Cooperation of patient and	29. VR scenarios and environments can be built in cooperation of the patient and the therapist (co-creation)
therapist	 Sufficient time will be spent on building the scenarios for an individual patient.
Widely	5. The VR-application is suited for a broad spectrum of patient groups.
applicable	6. The VR application can be used by sexual offenders.
	14. The VR application can be used in outpatient and inpatient settings.
Affordable	16. The VR application is affordable/does not cost too much.
Continuously	31. Other technologies can be added to the VR application (e.g. wearables).
adapt application	n 32. The VR application can be improved and altered after the implementation.

Appendix 13 Description more tangible idea for a VR application

The following elements of the six ideas were used in the more tangible idea for the VR application:

- The idea of 'Triggers & helpers' is the foundation of this idea for multiple reasons. Firstly, it fits well in the current way of treatment of forensic mental healthcare, where patients and therapists already search for triggers that evoke undesirable behavior. Thereby the VR application differentiates itself with this specialized aim from existing VR applications used in the regular mental healthcare. Lastly the format of triggers and helpers offers a broad foundation where the elements of other ideas can be added.
- "Roleplaying in context" is used in two ways. The first element that is included the merged VR application is the personalization option, the method to adapt the VR-world and make the VR application relevant for the individual patient: the building blocks (for environment, counterpart and stimuli). Secondly a form of interaction is based on Roleplaying in context, namely the counterpart, played by the therapist. The therapist can interact with the patient via an avatar of the counterpart and talk with the patient via a voice modulator microphone.
- Of the idea 'Crime scenario' the element co-creation was used. The therapist and patient make the VR-world together, by choosing which blocks are relevant for the patient. This collective building process also generates topics for treatment conversations and therefore it makes the VR application part of the treatment.
- The element, moment of reflection was used of '*Moments of choice*'. This is done by pausing the VR application and giving the patient (and therapist) a moment to reflect on what happened in the VR-world and think about logical consequences.
- The idea 'Observing and interpreting body language' was used for the body language of the counterparts and other virtual people in the virtual world. The body language of these people can also be used as a trigger for the patients.
- Body language and effect on others' was the most difficult to fit in the merged idea for a VR application. This because the VR user sees his environment, and not himself, in contrast with the idea of body language and effect on others. However, it is possible to pay attention on the body language of the patient during the VR-usage (e.g. direct feedback of the therapist, responses of the virtual opponent based on the body language of the patient, videotaping body language or biofeedback using a heartrate monitor/skin conductance). These possibilities can be investigated in a later stage of the development of the VR application

The tangible idea

The aim of the VR application is to give forensic patients more skills in difficult daily life situations. The application does this by supporting therapists and patients in finding the

patients' triggers and helpers. Where triggers are defined as "stimuli that evoke unwanted feelings, thoughts and behaviors" and helpers as "things that help patients to cope with the triggers". The target group is all forensic patients that are 18 years or older (e.g. inpatient, outpatient, aggressive undesirable behavior, sexual undesirable behavior, mildly intellectual disabled, personality disorders, addiction problems) and their therapists.

In the current forensic mental healthcare treatment searching for triggers is done verbally. This makes the therapist very dependent on the information that the patient gives him. It can be hard for the patient to verbalize his triggers and the reasons behind the triggers. The triggers can be specific persons (men with broad shoulders, girl 13 years old), external characteristics (tattoo, headscarf), verbal communication (cursing, insulting), non-verbal communication (staring, stop movement), visual stimuli (alcohol, police car), audio stimuli (music, yelling) or certain environments (park, busy street). When the triggers of a patient are known, coping techniques with the use of helpers can be searched. Helpers can be external factors (music, distraction in the form of a cellphone) but also internal factors (relaxation exercises, counting to ten).

When practicing with triggers and helpers in the treatment room is difficult since a realistic context with relevant stimuli misses. When a patient practices outside, in daily life, the therapist is not close to help him with feedback or interfere when things go wrong. VR can be a nice bridge between the therapy room and daily life. VR lets patient practice in a realistic environment, which can make practicing in the therapy room more visual and experience based. This requires less self-reflection abilities of the patient, makes the therapist less dependent since he can observe the patient and VR can give the patient therapist new insights. Therefore, this may be an important and helpful tool.

The VR-usage will be incorporated in the treatment. First the patient and therapist have a face-to-face consult about triggers and helpers. Thereafter they will co-create a relevant environment for the patient together using the blocks on the dashboard. The building blocks consist of characteristics of the environment (type of environment, background noises and extras), characteristics of the counterpart (appearance, external characteristics, facial expression, body language) and the stimuli (auditive and visual). The patient and therapist can choose zero, one or more blocks of each sub-category. Only choosing an environment is obligatory. The blocks are generic, however by combing the generic blocks it should be possible to build a relevant VR-world for every patient. This is important concerning the broad target group and variety of treats of patients in forensic mental healthcare.

After choosing the blocks, the patient can put on the VR-glasses and practice with the triggers in the created world. When a counterpart is chosen, the therapist can control the accompanied avatar and speak with the patient using the voice modulating microphone. In this way, the non-verbal and verbal triggers can also be practiced. When deemed necessary, the therapist can pause the VR application and have a moment of reflection with the patient. In these moments the patient and therapist can discuss what happened in the VR-world and what can help the patient. The building blocks can also be changed to better fit the patient, to find other triggers or to find other helpers. In this way patient and therapist will work in several sessions with the VR application to identify triggers and helpers. Protocols will be developed to instruct the therapist how to use the VR application. The VR application can be used in three ways: finding what are triggers for a patient, learn a patient how to cope with triggers in the form of helpers and giving the patient and therapist insight in how the patient responds on difficult daily life situations.

	1. Environment			2. Virtual avatar o	2. Virtual avatar of counterpart		3. Stimuli to a	idd to scenario
1.1 Type of environment	1.2 Background noise (constantly present)	1.3 Extra(s)	2.1 Basic appearance	2.2 Physical appearance	2.3 Facial expression*	2.4 Posture and gestures	3.1 Auditive stimuli	3.2 Visual stimuli
Pedestrian street during night-time	Buzzing of people	Drug dealer with small bag	Male/female	Length (enlarging/ reducing) *	Happy*	Punching gesture	Ringing phone	Game on own phone
Pedestrian street during daytime	Loud talking	Large crowd of people (>10)	Age (6-80)*	Physique skinny built/ broadly built *	Scared*	Stopping gesture (hands forward)	Loud music	Bottles of alcohol/beer
Train	Noise of playing children	Loitering adolescents		Ethnicity (white/north- African/African)	Neutral*	Arms crossed	Music by own choice	One building that can be changed into coffeeshop, liquor store, brothel or pharmacy
Living room	Background music	Playing children		Proximity (far away, <i>nearby</i>) *	Angry*	Anxious gestures: torso is moving, wobbling	Police sirens	Police car
Generic desk	Volume of sound (decibel)*	Someone observing the conversation of patient and avatar		Clothing woman Normal sweater / short dress with cleavage / headscarf /	Sad *	Arms alongside the body	Crying baby	Sign with text that can be adapted/entered (e.g.: count to ten)
Park with fountain	Hertz of sound*	Two (attractive) females		top with panther print, large golden earrings, tattoo	Ashamed*	Shrinking movement, arched shoulders	Screaming people	
Supermarket		Several random people spread out over location		Clothing man Normal sweater or shirt / suit / tracksuit / tank top with		Puffed out chest	Barking dogs	
Car		People drinking alcohol		tattoo		Wild arm gestures	Two fighting people	
Forest		Two broad/strong- looking men				Giving the middle finger	Loud-ticking clock	
		Two skinny/weak- looking men				Kicking movement		
		Two officers				Tilted head (up or down)		
		Family of four				Clenched fists		
		Men walking hand in hand				Pointing		
		Group of police officers (both male and female)						

Figure The dashboard for the personalization blocks

Appendix 14 Additions for personalization options for the more tangible idea

Environment:

Type environment: Playground/ community center Station Café/ city center Pub Forensic clinic Shopping street Village party Fair Disco

Background sound: Nature sounds Traffic

Figurant: Drunk person

Opponent: Appearance: Baby External features: Antilleans Neo-Nazis Skinny jeans East Europe facial features Facial expression: Blaming Disdain Tired Treating Grumpy Bird perspective

Body posture: Walking Cycling Tics Non-aggressive Nonchalant Stimuli:

Auditive: Crying baby/ crying child Cats in heat Silence

Visual: Too much light Flashing lights Joint

Odor: Marijuana