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Combining Virtual Reality and Hypnosis? A User Experience Study in Patients with Multiple Myeloma Following Stem Cell Transplantation

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Abstract

Multiple myeloma (MM) and stem cell transplantation (SCT) significantly impact patients' quality of life. Virtual reality with hypnosis (VRH) has emerged as a promising nonpharmacological intervention to address these challenges, yet data on its acceptability and user experience remain scarce. This study assessed the acceptability and user experience of a VRH intervention among adult patients with MM who had undergone allogeneic SCT. Participants used a VRH application and rated their experience through standardized questionnaires and semistructured interviews. Quantitative data were analyzed descriptively, and qualitative data underwent descriptive content analysis. Findings indicated high patients' satisfaction, strong perceived relevance, and low cybersickness. Qualitative analysis revealed perceived emotional and psychological benefits. VRH was deemed particularly suitable during hospitalization and treatment periods. This study shows the potential of combining virtual reality and hypnosis for MM patients following SCT. Indeed, they showed high satisfaction levels, paving the way for further studies evaluating the clinical efficacy of such interventions.

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Introduction

Patients with multiple myeloma (MM) are among the most affected in terms of their quality of life.[1] MM is the second most common hematological malignancy and is among the top ten cancer diagnoses requiring hospitalization.[2] The cumulative time spent receiving treatment represents a significant burden for patients, and treatments have numerous adverse effects such as fatigue, nausea, or weight loss.[3] Among therapeutic solution, autologous and allogeneic stem cell transplantation (SCT) are well-known as one of the most stressful of cancer therapy, due to numerous adverse effects, including organ toxicity, severe mucositis causing pain, infections, graft-versus-host disease impacting both physical and psychological well-being.[4–6] Those symptoms can be accentuated by the limitation of social contacts due to protective isolation protocols required during SCT.[7] Those characteristics point the necessity to develop interventions aiming at improving patients' quality of life during transplantation. Among non-pharmacological interventions that have been developed, hypnosis seems to be a promising solution to decrease pain or anxiety. Hypnosis can be defined as "a state of consciousness involving focused attention and reduced peripheral awareness characterized by an enhanced capacity for response to suggestion."[8] As a complementary technique, it has been shown to help managing symptoms in patients with cancer and improve their well-being.[9] Another type of intervention is virtual reality (VR), defined as a simulation of an environment through technological mediation, re-creating sensory and perceptual elements of real-world experiences.[10] This technique is known to be useful during cancer-related medical procedures for distracting patients from cancer-related symptoms.[11,12] In fact, one the most promising VR technique seems to be virtual exposure to nature which has been tested in adult oncology to decrease pain and anxiety.[13] These beneficial effects of nature exposure, even in virtual modality, can be understood through various theoretical frameworks, notably the Attention Restoration Theory.[14–16] This theory suggests that natural environment foster psychological recovery by gently capturing attention and providing sense of spaciousness, which in turn supports the restoration of attentional resources.[14] As hypnosis and VR seems to share similar cognitive process (ie, distracting attention from present environment), some authors suggest combining them.

The integration of VR with hypnosis (VRH) has the potential to broaden the accessibility of this therapeutic intervention by mitigating several inherent limitations of conventional hypnosis, including the scarcity of qualified practitioners, the substantial time and effort required from therapists for each individual patient, and the cognitive demands placed on patients to effectively engage in the hypnotic process.[17] Among existing programs, interventions have been shown to reduce clinical and experimental pain in randomized controlled trials.[18,19] VRH has also shown promising effects on acute and chronic pain, stress, and anxiety reduction.[20–26] Nevertheless, despite indications of pain and distress in patients, there is a lack of studies on VRH in oncology. Moreover, only few studies explored factors predicting the effective use of this technology (eg, adherence, feasibility, user experience [UX]).[27] A scoping review on the combination of VR and hypnosis for pain management revealed diverse approaches in study designs, including various methods of integrating VR and hypnosis, different application timings, and varying therapy durations.[18] Those elements lead to discrepancies in the literature and should be considered in a person-centered care approach, placing the patient at the heart of the intervention design, proposing a tool adapted to the care context.[28] To do so, UX studies appear adapted.Literature on UX in medical settings suggests considering not only satisfaction but also acceptance by focusing on individuals' experience during and after use, adoption understood as "the decision to use a technology" or intention to use defined as "the intention to use a technology, without this necessarily leading to actual use."[29,30] The acceptability, UX and perception of a VR system has already been tested in several medical applications, and its use was proved suitable in different populations.[22,31–36] This type of study refers to Phase I of the model for the development of non-pharmacological interventions ORBIT.[37,38] According to this model, this phase aims at defining and refining interventions. Guidelines state that studies in this phase can be led on a small number of participants that could be highly selected.

Regarding the absence of data on UX of VRH interventions in oncology and hematology settings, this study aims to identify how patients with MM engaged in an SCT protocol feel about those interventions. This goal can be achieved by using both quantitative and qualitative methodologies, one using questionnaire to bring standardize data on the variables of interest and the other to descript deeper those points.

Methodology

Population

This study was proposed to patients with MM undergoing allogeneic hematopoietic SCT by a local patient's representative association. Inclusion criteria were to be over 18, speaking and understanding French, to be in remission from MM for at least 6 months, and to have undergone SCT at least 3 months prior to enrollment. Exclusion criteria included conditions that could impair communication, such as deafness, blindness, confusion, and dementia.

Procedure and Measures

Participants recruitment took place between May and July 2023.

Participants were invited by Myélome Canada (ie, a patient representative association) to participate in a study aiming at providing feedback with a VRH intervention. After having provided their informed written consent, participants were proposed to experience the VRH intervention at Maisonneuve-Rosemont Hospital accompanied by a certified psychologist (DO, clinical psychologist and senior researcher, male). All participants were asked to come to the hospital for the study. The intervention consists of the visualization of landscapes accompanied by nature sounds following a hypnosis protocol. This was extracted from the "Hypnosis" application from the company Super Splendide© (www.supersplendide.com) and displayed with a Meta Quest Pro VR headset. The hypnotic procedure consists of several steps: (1) The induction phase (ie, guidance of participants the focus attention on different elements and facilitate relaxation), (2) absorption and deepening phase (ie, use of verbal metaphor synchronized with nature noises), (3) suggestions (ie, verbal suggestions to facilitate relaxation), and (4) reorientation (ie, progressive return to reality). The intervention and the VR apparatus are described in Supplemental Material 1.

After having been exposed to the 30-min intervention, participants were asked to answer questionnaires regarding different variables. First, sociodemographic and clinical variables questionnaire consisted of evaluating gender, age, marital status, level of education, professional status, date of myeloma diagnosis, and treatment.

Participant satisfaction was measure using a questionnaire comprising 19-item rated on an 11-point Likert scale, from 0 = "strongly disagree" to 10 = "strongly agree".[39] This questionnaire comprises three factors: Relevance and acceptability of the intervention ($\alpha = .29$), satisfaction regarding the intervention ($\alpha = .75$), and expectations toward the intervention ($\alpha = .91$).

The UX was assessed with the User Experience Questionnaire (UEQ)[40] consisting of 26 items rated on a 7-point Likert scale. The UEQ assessed six factors: Attractiveness ($\alpha = .78$), insight ($\alpha = .60$), efficiency ($\alpha = .32$), reliability ($\alpha = .45$), stimulation ($\alpha = .43$), novelty ($\alpha = .70$), and appeal ($\alpha = .43$).

Finally, cybersickness (ie, VR-induced symptoms) was evaluated with a specific questionnaire rating different symptoms on a 4-point Likert scale, from 0 = "not at all" to 4 = "severely".[41] Two main factors are considered: Nausea and Oculomotor symptoms (no reliability score could be calculated here given the absence of variability in the score distribution).

After the questionnaire phase, interviews were conducted to let participants the possibility to expand on the responses they provided through the questionnaires. Thus, interview guide comprised three main categories: Satisfaction regarding VRH, UX, and recommendations regarding the development of VRH interventions. Interviews were conducted by RCT and ODH (respectively male and female, students in psychology), recorded, and transcribed by JG. Transcriptions were carried out using Google Colab, a coding program that transcribes the audios into written text then validated comparing transcripts with audiotapes.

Data Analysis

Quantitative data were analyzed descriptively, displaying mean, standard deviations, and frequency where applicable.

Global mean score of satisfaction, UEQ, and cybersickness questionnaires and standard deviations were considered.

A content analysis of interviews was carried out with the software QDAMiner 6. This analysis was conducted by two raters (ACL, JV; females, students in psychology) following several steps: (1) Extract coding from verbatims; (2) Identify significant elements relative to questions; (3) Detail each one and report it. The discrepancies between the two coders were discussed and resolved by a third evaluator (DO).

Participants' statements were translated from French to English and slightly modified to ensure appropriate syntax without changing the meaning.

Results

Participants Characteristics

Twelve patients had expressed their interest in participating in the study. After screening, one patient was excluded because of being under active treatment and another was lost of sight during the process.

The study population comprised ten participants (7 women and 3 men) with an average age of 53.7 ± 7.5 years (Range: 39-62). Extended individual characteristics are presented in Table 1.

Quantitative Analysis

Satisfaction, Acceptability, and Expectations. Satisfaction regarding the VRH program was rated as high ($M = 9.45$, $SD = 1.41$, Range: 7.5-10). The VRH program was evaluated as suitable for accompanying patients with MM ($M = 9.7$, $SD = 0.95$, Range: 7-10) and in a context of SCT ($M = 9.5$, $SD = 0.96$, Range: 7-10). Participants rated this program as adequate for implementation in a hematology clinic ($M = 9.9$, $SD = 0.32$, Range: 9-10). Participants expected positive outcomes of the intervention (ie, increasing quality of life and mood, decreasing negative emotional outcomes) ($M = 9.5$, $SD = 0.24$, Range: 5-9).

User Experience. Accessibility received a mean score of 2.88 ($SD = 0.05$), attractiveness was rated with a mean score of 2.83 ($SD = 0.07$), originality was scored 2.58 ($SD = 0.35$), stimulation received a score of 2.50 ($SD = 0.65$), efficiency

Table 1. Demographic, Social and Medical Information on Participants.

No	Age	Gender	Civil Status	Educational Level	Occupation	Date of Diagnosis	Treatment	Still under Treatment	End Date
P1	57	Female	Couple	University	Full-time	March 2021	CyBorD Autologous transplant	No	January 2022
P2	51	Female	Couple	Secondary	Temporary sick leave	March 2017	Allogeneic transplant Autologous transplant Bortezomib Daratumumab Dexamethasone	Yes	-
P3	53	Female	Couple	University	Disabled	October 2019	Autologous transplant	Yes	-
P4	62	Female	Single	College	Disabled	September 2021	Bortezomib 2 Autologous transplants	Yes	-
P5	61	Female	Couple	Secondary	Disabled	December 2020	Autologous transplant	Yes	-
P6	60	Female	Single	University	Disabled	February 2007	Autologous transplant Thalidomide Dexamethasone	No	January 2011
P7	46	Female	Single	University	Full-time	November 2013	Autologous transplant Allogeneic transplant	No	January 2019
P8	39	Male	Couple	Other	Temporary sick leave	May 2022	Autologous transplant Allogeneic transplant VRD	Yes	-
P9	59	Male	Couple	University	Full-time	May 2018	CyBorD Autologous transplant Allogeneic transplant Bortezomib	No	October 2020
P10	49	Male	Couple	College	Disabled	April 2016	Autologous transplant Allogeneic transplant	No	January 2018

Note: CyBorD, Cyclophosphamide-bortezomib-dexamethasone; VRD, Bortezomib-lenalidomide-dexamethasone.

was rated with a score of 1.83 (SD = 0.29), and reliability scored 1.85 (SD = 0.43).

Cybersickness. Participants reported low scores of Nausea ($M = 0.04$; SD = 0.07) and of Oculomotor symptoms ($M = 0.30$; SD = 0.17).

Qualitative Data

According to the interview guide, qualitative data address four themes reflecting variables previously quantitatively assessed. The first theme dealt with users' experience of VRH. The second theme was about practicalities in an SCT context. The third theme addressed usability, relevance, and expected effects of VRH. The fourth theme discussed recommendations for improving the VRH intervention. Excerpt of participants' discourses illustrating elements of analysis are displayed in Table 2.

Theme 1: User Experience. Positive Aspects. Positive aspects were mentioned and identified. Half of the participants (5/10) said they appreciated the voice used in the intervention. The sounds combined with the images were appreciated by half the users (5/10). Moreover, images were described as making the experience more immersive (4/10). The quality of the image was also highlighted (3/10). VRH was described a therapeutic tool for increasing well-being, calming anxiety, and reducing stress (4/10).

Negative Aspects. Several participants indicated a lack of comfort during their experience (4/10). In addition, the sound of the environment in the headphones was not loud enough (4/10). Two participants mentioned the unpleasant transition between the bubbles (moment of induction) and the landscapes. A participant had a comment on the loop of images judged to rapid, diminishing the reality of the experience.

Theme 2: Practicalities in the SCT Context. Presentation of VRH. The recommended time to present the VRH was

Table 2. Themes with a Selection of Verbatims.

Theme 1: User experience	
Positive aspects	"The little voice that talks to you. It's so gentle that you have no choice but to let yourself go" P5 "The timbre of your voice is so relaxing. I didn't think it was you who was going to speak, when you started, I'm going to say, no, my god, beautiful voice, relaxing." P7 "It seemed to me that there were little droplets at one point. It's really nice. It's better than a trip to Cuba." P5 "It's the images we like that transport us to a place where we feel good. It's even more immersive." P4 "The quality of the image is super beautiful, well shot, it's clear, you really feel like you're there." P10 "it's just providing the patient with another therapeutic tool to increase his well-being […] he'll feel good, 'we care about me'." P1
Negative aspects	"Yes, on the beach, or in an armchair, let's put it there, like they have in oncology. It's certain that you could have relaxed more than when you're sitting in a straight chair". P2 "When you speak, when you guide us, ideally, it's either you mute the sound and bring in your voice to bring us in, to transcend us, then you turn the sound back on gently or you turn the sound down and then you speak." P6 The little bubbles are blue, it's dark, and then all of a sudden […] it's clear, it's white, the beach is sunny, so yes, the contrast, that, I'd say, would be something to work on." P2 "We always have the same little birds in the loop, it would have been the fun that calmed down, that disappeared, the others that were silent like in real life, […] breaking the loops allows the brain to have the impression of really traveling." P10
Theme 2: Practicalities in SCT context	
Presentation of VRH	"Among other things, hypnosis scares people. They'll think it's like a hypnosis spectacle. Then you can't control yourself anymore. […] But that can scare some people." P6
Frequency, duration, and moment	"The fact of being hospitalized all the time in a room, in some cases not always, but in some cases all the time in a room, it could be good even daily, it's a little session a day, a bit like meditation." P8 "You must get your body used to it again slowly. Maybe ask for a 10-min session, if possible, to see if the patient is receptive to it." P6 "Before bedtime, you know, to clear your head, because during the day, you've got the injections, you've got the pills. So, once the graft is done, but at bedtime that same day. We've spent the day being manipulated." P5 "Maybe when the patient has just been diagnosed, you must allow time for everything to settle, like a month, or a distance. In the weeks that follow, say, after a month, we could try to make suggestions, or the nurses will talk about it. They say there's an alternative, do you need it, would you like it, propose it." P2
Theme 3: Expected effects, usability, and relevance	
Usability and relevant	"I think it can be relevant, it's comforting, especially it's soothing and comforting in a period that's very stressful, that we're moving towards the unknown a lot, that the transplant." P8 "It's because we have so many low moments, that it's a moment of happiness for me right now." P5 "Yes, it's consistent with the transplant, because we're tired. We don't have the energy to make decisions. We don't want to make decisions. We've lost control of our whole life. So, when it's simple, you don't have to do anything or do anything." P1 "Patient well-being is lacking in oncology, you know. It seems like, yes, they're going to give you treatments, they're going to cure you, they're going to … But everything else, the well-being around the patient, it seems like it's like … 'Ah, you've got a heartache, we're going to give you some medicine, you know'." P2
Theme 4: Recommendations for improving VRH	
Complementary additions	"A little smell might help with nausea." P2 "Does color make it uncomfortable? Why would color make it uncomfortable? I don't know, but it's bound to happen. There's pink. I've always hated orange. After my transplant, I began to love orange. But why? I've no idea. Maybe orange will be aggressive for someone." P9

considered to be after the disease has been diagnosed, precisely when treatment begins (2/10).

Most of the participants said VRH should be presented as a tool for relaxation, stress, and anxiety reduction (7/10). Moreover, they suggested that patients should be offered to test the headset during the presentation (4/10). A certain diversity is observed in the way objectives of VRH should be presented: Pain relief (2/10), immersion in a journey (2/10), easy to use (2/10), a way to get rid of its responsibilities as a patient (1/10). Finally, a short presentation of what hypnosis is and aims should be considered to demystify it (2/10).

Frequency, Duration, and Moment. Most of the participants reported that the ideal frequency would be three times a week (6/10), with a minimum of twice a week (3/10). Others added that they could do it every day (3/10). The ideal duration of the session would be 30 min for half the participants (5/10). For the remaining participants, it varies around 15 min (1/10), 20 min (2/10), 45 min (1/10), and even sleeping with it (1/10). One participant suggested a short 10-min session for habituation.

According to most participants, the preferred time for VRH was reported to be during transplantation (5/10).

In addition, the period of hospitalization seemed to be suitable for VRH (5/10), and some specified during chemotherapy (ie, before the SCT) (3/10). Then, some participants added that the right moment would also be after the SCT (2/10).

When addressing which time should be avoided for VRH sessions, participants enounced different answers. For instance, three participants cited the day of transplantation as a time to avoid (3/10), and one during chemotherapy (1/10), nor at the time of the patient's diagnosis.

Theme 3: Expected Effects, Usability, and Relevance. *Expected Effects of VRH.* Most of the participants expected relaxation and appeasement from VRH (6/10). Among these participants, some added that their expectation was to calm anxiety (4/10). Some participants declared they didn't know what to expect from the experience (3/10). On the other hand, the hypnosis experience was assumed to be like a hypnosis spectacle by two users (2/10). Finally, two contradictory ideas were put forward, one that VRH had the expectation of controlling nausea (1/10) and the other of increasing nausea (2/10).

Usability and Relevance. Half of the participants considered the experience as relevant (5/10). Some participants found VRH relevant to distract themselves, compensating for loneliness, and getting away from the place and what they're going through (4/10).

The experience was perceived as more acceptable when participants declared having a previous experience of meditation, Pilates, yoga, or hypnosis (3/10). Some participants reported that VRH was advantageous when they lack energy because they don't need to make any decision (2/10).

Finally, after the experience, most of the participants reported a reduction in anxiety or stress (7/10), increasing in relaxation (3/10), and a recovery of energy (1/10). The relevance of VRH is centered on patient well-being (2/10).

Theme 4: Recommendations for Improving VRH. *Interface.* Half of the participants suggested have a variety of landscapes so that users can choose what they like according to their preference (5/10). In addition, some added that it would be nice to have different "strands" for anxiety, fear, pain, nausea, and a speech adapted to myeloma disease so that the patient finds himself in the hypnosis speeches (4/10).

When asked about the choice of landscapes scrolling during hypnosis, participants reported liking landscapes with water, such as the sea and lakes (5/10) or forest landscapes (5/10). Mountains were also suggested (2/10).

Complementary Additions. Some participants suggested to add an olfactory component (2/10). In addition, having adjustable parameters was considered as relevant, such as image speed, color, sound rhythm (2/10).

Discussion

This study aimed to evaluate the UX of an intervention combining VR and hypnosis (VRH) in patients with MM previously treated with a SCT, providing insight to improving this tool.

Acceptability and Expectations

Findings of this study show a great acceptability of VRH interventions with high expectations. Indeed, participants declare expecting improvements in the emotional impact of SCT (eg, anxiety, mood, distress), but also on the physical aspects (eg, fatigue, nausea, pain), and, more generally, an improvement of their quality of life. Despite having been shown to be effective on some of these aspects,[24] VRH should remain considered as a complementary intervention. In that sense, clear and realistic communication about the potential benefits and limitations of VRH is essential to ensure that expectations are aligned with achievable outcomes. Now that acceptability is established, further studies are needed to prove efficacy of such interventions and elements that could influence it. Indeed, findings suggest that there could be multiple appropriate times for employing VRH with patients with MM in transplantation settings (eg, before and after transplantation, during treatments, during hospitalization, chemotherapy). Thus, further studies are needed to explore which moment is more suitable in a larger sample of patient to evaluate a potentially differentiated efficacy and profiles of patients that respond better according to the moment of the intervention. Regarding the duration of the intervention, existing studies on VRH reported therapy durations ranging between 16 and 40 min.[23–25] The present findings suggest that a 30-min session can be optimal and is generally appreciated. In that sense, comparative studies manipulating the duration of the intervention in the same context could be brought to identify the optimal one. Despite showing promising results, the literature on the efficacy of VRH doesn't allow for deciphering which elements of the intervention are decisive. In that sense, it is recommended to conduct larger studies differentiating constitutional elements of VRH (ie, VR alone, hypnosis alone both in-person and virtual) and identify their respective efficacy and potential synergy.

Recommendations for Developing VRH Interventions

Findings of this study suggest several points of attention for making this intervention more adapted and pleasant. First, the content of interventions are expected to propose more various environments for an immersion in natural environments (eg, different landscapes and sounds, adding of animals to add life into the virtual environments, enhance realism with material elements). A second potential source of improvement relates to interactivity of intervention. Indeed, findings outline the necessity for the intervention to be fully customizable by

the participants (eg, choice of environment, of the volume of music or voices, of the speed of images, of the content of audio material). This is in line with the literature on digital interventions suggesting that patients want to keep a power of action in the interventions.[42] This suggests a strong interest for interactive environments in VR. However, despite showing promising results, the literature on VR and VRH doesn't allow for distinguishing the proper effect of passivity or agentivity in the use of such devices. On those tailoring aspects, the findings underline the need to adapt the frequency and duration of the intervention to patients' needs. Finally, regarding the way the intervention is introduced to participants, it seems necessary to better define the different concepts that are used, such as hypnosis, to ensure a good understanding of what is done.

This study adopts a patient-centered approach by collecting patients' point-of-view on a co-developed intervention. This approach is becoming crucial to ensure that intervention meet patients' needs and making them feel empowered.[43] Indeed, empowerment of patients is recognized as a key goal in rehabilitation.[44] In that sense, the literature identifies core elements of patient-centered care including Patient participation and empowerment (ie, encouraging patients to actively participate in their care and having the possibility to tailor care to their physical and emotional needs).[45] Thus, the development of interventions aiming at buffering the impact of diseases and treatment on patients should encompass a strong participatory design.

Limitations and Perspectives

Despite bringing interesting findings, this study comprises several limitations that should be accounted. First, there is a risk for evaluation bias. Indeed, it should be noted that participants who underwent the study were highly motivated in testing a VR device. This point could be common to most of individuals that show a great interest into new technologies. This point could be buffered by familiarizing participants with the intervention before evaluation their satisfaction. Moreover, the participatory design of the study, presented as aiming at improving VRH interventions on the basis of patients' insights could have promoted patient motivation, improved their sense of self-efficacy and satisfaction.[46] Then, a desirability bias could have occurred when their opinion could have been influenced by the desire to satisfy the experimenter. A second point of limitation is that displayed landscapes remained identical where it could have been interesting to compare different landscapes (eg, forest vs mountain). Those point could be addressed in larger-scale randomized studies.

This study was a Phase I study according to the ORBIT model.[37,38] Despite its limitations, it brought promising elements that led to consider the future phase of the model. In that sense, to following steps will comprise studies consisting in Phase II preliminary testing (ie, proof-of-concept study, pilot testing, feasibility pilot). Those will be reached with the setting of comparative studies aiming at investigating the superiority of the intervention, compared to a control group.

Conclusion

This study highlights the interest of an intervention combining VR and hypnosis in patients with MM who underwent SCT. It demonstrated their high level of satisfaction and the potential to be used in larger scale studies. Thus, this UX study paves the way for further studies evaluating the clinical efficacy of such interventions in this population.

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Ethical Approval

This study was approved by the Ethics Committee of the Integrated Health and Social Services Centers (CISSS) and Integrated University Health and Social Services Centers (CIUSSS) of the Montreal-East-Island, Maisonneuve-Rosemont Hospital (reference number 2023-3251).

Consent for Participation

Informed consent was obtained from all the participants in the study.

Author Contributions

The authors refer to CRediT (Contributor Roles Taxonomy). **Conceptualization**: Pierre Rainville and David Ogez; **Methodology**: Danny Wade, Sandie Oberoi, Pierre Rainville, and David Ogez; **Software**: Jade Véronneau, Alexandra Chevestrier-Lefeuvre, Valentyn Fournier, Audrey Laurin, and Floriane Rousseaux; **Validation**: Pierre Rainville and David Ogez; **Formal analysis**: Jade Véronneau, Alexandra Chevestrier-Lefeuvre, Valentyn Fournier, Audrey Laurin, and Floriane Rousseaux; **Investigation**: Rémi Caron-Trahan, Joséphine Guiné, and Odile Dubey-Harispe; **Resources**: David Ogez; **Data curation**: Jade Véronneau and Alexandra Chevestrier-Lefeuvre; **Visualization**: Jade Véronneau, Alexandra Chevestrier-Lefeuvre, Valentyn Fournier, and Audrey Laurin; **Supervision**: Floriane Rousseaux and David Ogez; **Project administration**: David Ogez; **Funding acquisition**: Karim Jerbi, Pierre Rainville, and David Ogez; **Writing—original draft**: Jade Véronneau, Alexandra Chevestrier-Lefeuvre, Valentyn Fournier,

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Declaration of Conflicting Interests

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Supplemental Material

Supplemental material for this article is available online.

References

1. Martino M, Rossi M, Ferreri A, et al. Quality of life outcomes in multiple myeloma patients: A summary of recent clinical trials. *Expert Rev Hematol*. 2019;12(8):665-684. doi:10.1080/17474086.2019.1634541
2. van de Donk NWCJ, Pawlyn C, Yong KL. Multiple myeloma. *Lancet*. 2021;397(10272):410-427. doi:10.1016/S0140-6736(21)00135-5
3. Rajkumar SV. Multiple myeloma: 2020 update on diagnosis, risk-stratification and management. *Am J Hematol*. 2020;95(5):548-567. doi:10.1002/ajh.25791
4. Coluzzi F, Rolke R, Mercadante S. Pain management in patients with multiple myeloma: An update. *Cancers (Basel)*. 2019;11(12):2037. Published online 2019.
5. Braamse AMJ, Gerrits MMJG, van Meijel B, et al. Predictors of health-related quality of life in patients treated with auto- and allo-SCT for hematological malignancies. *Bone Marrow Transplant*. 2012;47(6):757-769. doi:10.1038/bmt.2011.130
6. Fenech AL, Van Benschoten O, Jagielo AD, et al. Post-traumatic stress symptoms in hematopoietic stem cell transplant recipients. *Transplant Cell Ther*. 2021;27(4):341.e1-341.e6. doi:10.1016/j.jtct.2021.01.011
7. Jacobs JM, Fishman S, Sommer R, et al. Coping and modifiable psychosocial factors are associated with mood and quality of life in patients with chronic graft-versus-host disease. *Biol Blood Marrow Transplant J Am Soc Blood Marrow Transplant*. 2019;25(11):2234-2242. doi:10.1016/j.bbmt.2019.06.024
8. Elkins GR, Barabasz AF, Council JR, Spiegel D. Advancing research and practice: The revised APA division 30 definition of hypnosis. *Int J Clin Exp Hypn*. 2015;63(1):1-9. doi:10.1080/00207144.2014.961870
9. Grégoire C, Faymonville ME, Vanhaudenhuyse A, et al. Effects of an intervention combining self-care and self-hypnosis on fatigue and associated symptoms in post-treatment cancer patients: A randomized-controlled trial. *Psychooncology*. 2020;29(7):1165-1173. doi:10.1002/pon.5395
10. Steuer J. Defining virtual reality: Dimensions determining telepresence. *J Commun*. 1992;42(4):73-93.
11. Fereidooni M, Toni E, Toni E, Ayatollahi H. Application of virtual reality for supportive care in cancer patients: A systematic review. *Support Care Cancer*. 2024;32(9):1-25. doi:10.1007/s00520-024-08763-1
12. Zeng Y, Zhang JE, Cheng ASK, Cheng H, Wefel JS. Meta-analysis of the efficacy of virtual reality–based interventions in cancer-related symptom management. *Integr Cancer Ther*. 2019;18:1534735419871108. doi:10.1177/1534735419871108
13. Wu Y, Wang N, Zhang H, Sun X, Wang Y, Zhang Y. Effectiveness of virtual reality in symptom management of cancer patients: A systematic review and meta-analysis. *J Pain Symptom Manage*. 2023;65(5):e467-e482. doi:10.1016/j.jpainsymman.2023.01.023
14. Kaplan S. The restorative benefits of nature: Toward an integrative framework. *J Environ Psychol*. 1995;15(3):169-182. doi:10.1016/0272-4944(95)90001-2
15. Ohly H, White MP, Wheeler BW, et al. Attention restoration theory: A systematic review of the attention restoration potential of exposure to natural environments. *J Toxicol Environ Health Part B*. 2016;19(7):305-343. doi:10.1080/10937404.2016.1196155
16. Twohig-Bennett C, Jones A. The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environ Res*. 2018;166:628-637. doi:10.1016/j.envres.2018.06.030
17. Askay SW, Patterson DR, Sharar SR. Virtual reality hypnosis. *Contemp Hypn*. 2009;26(1):40-47. doi:10.1002/ch.371
18. Rousseaux F, Bicego A, Ledoux D, et al. Hypnosis associated with 3D immersive virtual reality technology in the management of pain: a review of the literature. *J Pain Res*. 2020;13:1129-1138. doi:10.2147/JPR.S231737
19. Schmitt YS, Hoffman HG, Blough DK, et al. A randomized, controlled trial of immersive virtual reality analgesia, during physical therapy for pediatric burns. *Burns*. 2011;37(1):61-68. doi:10.1016/j.burns.2010.07.007
20. Enea V, Dafinoiu I, Opriş D, David D. Effects of hypnotic analgesia and virtual reality on the reduction of experimental pain

among high and low hypnotizables. *Int J Clin Exp Hypn*. 2014;62(3):360-377. doi:10.1080/00207144.2014.901087
21. Oneal BJ, Patterson DR, Soltani M, Teeley A, Jensen MP. Virtual reality hypnosis in the treatment of chronic neuropathic pain: A case report: Brent J. Oneal, David R. Patterson, Maryam Soltani, Aubriana Teeley und Mark P. Jensen. *Int J Clin Exp Hypn*. 2008;56(4):451-462. doi:10.1080/00207140802255534
22. Ong TL, Ruppert MM, Akbar M, et al. Improving the intensive care patient experience with virtual reality—a feasibility study. *Crit Care Explor*. 2020;2(6):e0122. doi:10.1097/CCE.0000000000000122
23. Patterson DR, Hoffman HG, Palacios AG, Jensen MJ. Analgesic effects of posthypnotic suggestions and virtual reality distraction on thermal pain. *J Abnorm Psychol*. 2006;115(4):834-841. doi:10.1037/0021-843X.115.4.834
24. Patterson DR, Jensen MP, Wiechman SA, Sharar SR. Virtual reality hypnosis for pain associated with recovery from physical trauma: David R. Patterson, Mark P. Jensen, Shelley A. Wiechman und Sam R. Sharar. *Int J Clin Exp Hypn*. 2010;58(3):288-300. doi:10.1080/00207141003760595
25. Soltani M, Teeley AM, Wiechman SA, Jensen MP, Sharar SR, Patterson DR. Virtual reality hypnosis for pain control in a patient with gluteal hidradenitis: a case report. *Contemp Hypn Integr Ther*. 2011;28(2):142-147.
26. Teeley AM, Soltani M, Wiechman SA, Jensen MP, Sharar SR, Patterson DR. Virtual reality hypnosis pain control in the treatment of multiple fractures: a case series. *Am J Clin Hypn*. 2012;54(3):184-194. doi:10.1080/00029157.2011.619593
27. Fussell SG, Truong D. Using virtual reality for dynamic learning: An extended technology acceptance model. *Virtual Real*. 2022;26(1):249-267. doi:10.1007/s10055-021-00554-x
28. Indovina P, Barone D, Gallo L, Chirico A, De Pietro G, Giordano A. Virtual reality as a distraction intervention to relieve pain and distress during medical procedures: a comprehensive literature review. *Clin J Pain*. 2018;34(9):858-877. doi:10.1097/AJP.0000000000000599
29. Jensen MP, McArthur KD, Barber J, et al. Satisfaction with, and the beneficial side effects of, hypnotic analgesia. *Int J Clin Exp Hypn*. 2006;54(4):432-447. Accessed May 14, 2024. https://www.tandfonline.com/doi/abs/10.1080/00207140600856798
30. Sagnier C, Loup-Escande E, Lourdeaux D, Thouvenin I, Valléry G. User acceptance of virtual reality: An extended technology acceptance model. *Int J Human–Computer Interact*. 2020;36(11):993-1007. doi:10.1080/10447318.2019.1708612
31. Ashmore J, Pietro JD, Williams K, et al. A free virtual reality experience to prepare pediatric patients for magnetic resonance imaging: Cross-sectional questionnaire study. *JMIR Pediatr Parent*. 2019;2(1):e11684. doi:10.2196/11684
32. Bruno RR, Wolff G, Wernly B, et al. Virtual and augmented reality in critical care medicine: The patient's, clinician's, and researcher's perspective. *Crit Care*. 2022;26(1):326. doi:10.1186/s13054-022-04202-x
33. Holsteg S, Askeridis JM, Krajewski J, et al. Virtual reality role-plays for patients with depression: A user experience evaluation. *Internet Interv*. 2024;35:100713.
34. Johnson T, Bauler L, Vos D, et al. Virtual reality use for symptom management in palliative care: A pilot study to assess user perceptions. *J Palliat Med*. 2020;23(9):1233-1238. doi:10.1089/jpm.2019.0411
35. Pittara M, Matsangidou M, Stylianides K, Petkov N, Pattichis CS. Virtual reality for pain management in cancer: A comprehensive review. *IEEE Access*. 2020;8:225475-225489. doi:10.1109/ACCESS.2020.3044233
36. Zhou Z, Li J, Wang H, et al. Experience of using a virtual reality rehabilitation management platform for breast cancer patients: A qualitative study. *Support Care Cancer*. 2023;31(5):307.
37. Czajkowski SM. Using the ORBIT model to design an intervention promoting healthy weight gain during pregnancy: The value of an iterative and incremental approach to intervention development. *Int J Behav Med*. 2019;26(5):457-460. doi:10.1007/s12529-019-09812-4
38. Czajkowski SM, Powell LH, Adler N, et al. From ideas to efficacy: The ORBIT model for developing behavioral treatments for chronic diseases. *Health Psychol Off J Div Health Psychol Am Psychol Assoc*. 2015;34(10):971-982. doi:10.1037/hea0000161
39. Kazdin AE. Assessing the clinical or applied importance of behavior change through social validation. *Behav Modif*. 1977;1(4):427-452. doi:10.1177/014544557714001
40. Schrepp M, Hinderks A, Thomaschewski J. Applying the User Experience Questionnaire (UEQ) in different evaluation scenarios. In: Marcus A, ed. *Design, User Experience, and Usability. Theories, Methods, and Tools for Designing the User Experience*. Springer International Publishing; 2014:383--392. doi:10.1007/978-3-319-07668-3_37
41. McCauley ME, Sharkey TJ. Cybersickness: Perception of self-motion in virtual environments. *Presence Teleoperators Virtual Environ*. 1992;1(3):311-318. doi:10.1162/pres.1992.1.3.311
42. Barello S, Triberti S, Graffigna G, et al. Ehealth for patient engagement: A systematic review. *Front Psychol*. 2016;6. doi:10.3389/fpsyg.2015.02013
43. Vagal A, Wahab S, Lecky S, et al. Optimizing patient experience using human-centered design. *J Am Coll Radiol*. 2020;17(5):668-672. doi:10.1016/j.jacr.2019.11.020
44. Riva G, Gaggioli A. Rehabilitation as empowerment: The role of advanced technologies. In: *Advanced technologies in rehabilitation*. IOS Press; 2009:3-22.
45. Kitson A, Marshall A, Bassett K, Zeitz K. What are the core elements of patient-centred care? A narrative review and synthesis of the literature from health policy, medicine and nursing. *J Adv Nurs*. 2013;69(1):4-15. doi:10.1111/j.1365-2648.2012.06064.x
46. Zhang C, Yu S. Technology to enhance patient motivation in virtual reality rehabilitation: A review. *Games Health J*. 2024;13(4):215-233. doi:10.1089/g4h.2023.0069