IO2. Literature Review Report

IO2 - Literature review on VR

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Work Package No.	WP2	**Work Package Title** IO2. Literature Review on the Best Structure and Implementation Methodology by Using Virtual Reality Technology for Drug Users in Rehabilitation
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Reviewer		All partners

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Introduction

The aim of the present project is to close language barrier gap and provide rehabilitation for substance user refugee probationers by developing a virtual reality programme to improve their coping skills (problem solving and emotion regulation skills). Substance use will be used as a sign of deficiency in coping skills; focus will be on teaching coping skills rather than dealing with substance use behavior. Thus, the aim of the literature review is to focus on teaching skills with the use of virtual reality will be conducted, and a proposal on the implementation methodology of using virtual reality in teaching skills to refugee offenders will be structured. Therefore, we must also determine what type of treatment works the best for refugees, rather than regular substance users. In the absence of directly relevant literature for this group, analogies with other groups will be also useful.

Literature Review Procedure

The literature review was conducted in databases as per the review protocol; and can be listed as ScienceDirect, Scopus and PubMed. Only articles published between 2000 and 2021 were included in the analyses. Literature searches were also conducted in bibliographical databases to identify relevant evidence, including EBSCO, Google Scholar, and ProQuest. Inclusion criteria for this report consist of documents published between 2000 and 2023 and if they concern best practices on teaching coping skills/emotion skills/stress management/decision making or if they regard to treatments/interventions/rehabilitation through VR. Also, it was given priority to papers that comprehend forensic settings, but this was not considered an exclusion factor.

In the second phase, the relevant literature search was conducted in databases such as Sopus, Elesvier, Sage, Google Scholar by listed keywords. Priority was given to academic papers published in peer review journals that include evaluations. Inclusion criteria consist of documents published between 2000 and 2023 on teaching coping skills, stress management or decision making or if they regard to treatments/interventions/rehabilitation through VR.

Articles from ScienceDirect:

Keyword: ("virtual reality" OR "vr") AND ("substance use" OR "drug use")

This search yielded 188 results, in which 6 articles were chosen.

1. Saladin, M. E., Brady, K. T., Graap, K., & Rothbaum, B. O. (2006). A preliminary report on the use of virtual reality technology to elicit craving and cue reactivity in cocaine dependent individuals. *Addictive Behaviors*, 31(10), 1881–1894. https://doi.org/10.1016/j.addbeh.2006.01.004

Abstract: In the present feasibility study, we developed a 3-dimensional virtual "crack" cocaine environment and evaluated the environment's ability to elicit subjective craving and cue reactivity (i.e., subjective emotional responding, heart rate and skin conductance) in 11 crack cocaine dependent individuals. Each of the seven 3-D crack cocaine scenes in the cocaine environment depicted actors

engaging in a range of using-related behaviors (i.e., smoking crack) whereas the neutral environment contained scenes depicted 3-D aquariums with active aquatic life (baseline measures were obtained following immersion in the neutral environment). Results indicated that craving was significantly elevated during the cocaine-related scenes as compared to baseline. Craving varied by scene content, with scenes depicting active cocaine use eliciting the highest levels of craving. Heart rate was significantly higher in four of the scenes with drug use content and positive affect (i.e., happiness) ratings were significantly lower during cocaine scenes as compared to baseline. Overall, the results suggest that a standardized and stimulus rich virtual reality environment effectively elicits craving and physiologic reactivity. Such technology has potential utility in the development and refinement of exposure-based behavioral and pharmacological interventions for substance use disorders.

2. Culbertson, C., Nicolas, S., Zaharovits, I., London, E. D., la Garza, R. de, Brody, A. L., & Newton, T. F. (2010). Methamphetamine craving induced in an online virtual reality environment. *Pharmacology Biochemistry and Behavior*, 96(4), 454–460. https://doi.org/10.1016/j.pbb.2010.07.005

Abstract: The main aim of this study was to assess self-reported craving and physiological reactivity in a methamphetamine virtual reality (METH-VR) cue model created using Second Life, a freely available online gaming platform. Seventeen, non-treatment seeking, individuals that abuse methamphetamine (METH) completed this 1-day, outpatient, within-subjects study. Participants completed four test sessions: 1) METH-VR, 2) neutral-VR, 3) METH-video, and 4) neutral-video in a counterbalanced (Latin square) fashion. The participants provided subjective ratings of urges to use METH, mood, and physical state throughout each cue presentation. Measures of physiological reactivity (heart rate variability) were also collected during each cue presentation and at rest. The METH-VR condition elicited the greatest change in subjective reports of "crave METH", "desire METH", and "want METH" at all time points. The "high craving" participants displayed more high frequency cardiovascular activity while the "low craving" participants displayed more low frequency cardiovascular activity during the cue conditions, with the greatest difference seen during the METH-VR and METH-video cues. These

findings reveal a physiological divergence between high and low craving METH abusers using heart rate variability, and demonstrate the usefulness of VR cues for eliciting subjective craving in METH abusers, as well as the effectiveness of a novel VR drug cue model created within an online virtual world.

3. Bordnick, P. S., Graap, K. M., Copp, H., Brooks, J., Ferrer, M., & Logue, B. (2004). Utilizing virtual reality to standardize nicotine craving research: A pilot study. *Addictive Behaviors*, 29(9), 1889–1894. https://doi.org/10.1016/j.addbeh.2004.06.008

Abstract: Traditional cue reactivity provides a methodology for examining drug triggers and stimuli in laboratory and clinical settings. However, current techniques lack standardization and generalization across research settings. Improved methodologies using virtual reality (VR) cue reactivity extend previous research standardizing exposure to stimuli and exploring reactions to drug cues in a controlled VR setting. In a controlled pilot trial, 13 nicotine-dependent participants were allowed to smoke ad libitum then exposed to VR smoking and VR neutral cues and compared on craving intensity. VR smoking cues significantly increased craving compared to VR neutral cues. On average, craving intensity increased 118% during exposure to VR smoking cues. Implications for substance abuse research and treatment using VR to assess cessation and anticraving medications are discussed.

4. Chen, X. J., Wang, D. M., Zhou, L. D., Winkler, M., Pauli, P., Sui, N., & Li, Y. H. (2018). Mindfulness-based relapse prevention combined with virtual reality cue exposure for methamphetamine use disorder: Study protocol for a randomized controlled trial. *Contemporary Clinical Trials*, 70, 99–105. https://doi.org/10.1016/j.cct.2018.04.006

Abstract: Mindfulness-based relapse prevention (MBRP) is a method that combines cognitive behavioral relapse prevention with mindfulness practice. Research suggests that MBRP can effectively reduce withdrawal/craving in people with substance use disorder (SUD). An important part of MBRP is to practice mindfulness meditation to cope with high-risk situations for relapse, such as stimuli and situations associated with drug taking. Virtual reality cue exposure (VRCE) may be a complementary approach to MBRP as it allows for controlled and graded presentations of various high-risk situations with distal and proximal drug cues. The

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aim of the study is to investigate the effects of MBRP combined with VRCE, in comparison to MBRP alone or treatment as usual, on craving and emotional responses in people with methamphetamine use disorders. Method/design: The study is a parallel randomized controlled study including 180 participants with methamphetamine use disorder. Three parallel groups will receive 8 weeks of MBRP combined with VRCE, MBRP alone, or treatment as usual, respectively. Craving, virtual cue reactivity, anxiety, depression, emotion regulation, mindfulness and drug-related attention bias will be assessed at pre-treatment, post-treatment, and 3 and 6 months of follow-up. Discussion: This innovative study aims at investigating the effects of MBRP combined with VRCE in people with SUD. The combined intervention may have important clinical implications for relapse prevention due to its ease of application and high cost-effectiveness. This study may also stimulate research on the neuronal and psychological mechanisms of MBRP in substance use disorder.

5. Wang, Y. guang, Liu, M. hui, & Shen, Z. hua. (2019). A virtual reality counterconditioning procedure to reduce methamphetamine cue-induced craving. *Journal of Psychiatric Research*, 116, 88–94. https://doi.org/10.1016/j.jpsychires.2019.06.007

Abstract: The present work developed a virtual reality (VR) counterconditioning procedure (VRCP), and investigated its efficacy in treatment of cue-induced craving in individuals with methamphetamine (METH) dependence. In study 1, thirty-one patients diagnosed with METH dependence received VRCP, while twenty-nine METH-dependent patients in waiting-list group did not. In study 2, the VRCP was computerized as a VR treatment system. Six-hundred and twelve abstinent individuals with a history of METH dependence received the computerized VRCP, while two-hundred seventy-six abstinent individuals with a history of METH dependence in waiting-list group did not. Patients with METH dependence who received VRCP showed a significantly larger decrease on the score of METH-craving and METH-liking from baseline to follow-up assessments, compared to those who did not received VRCP. Participants received VRCP showed a significantly larger decrease in HRV indexes on time domain and non-linear domain from baseline to follow-up assessments during exposure to VR cues, compared to

those in waiting-list group. These findings indicate that the counterconditioning procedure under VR environment may be a useful strategy in suppressing cue-induced reactivity for patients with METH dependence.

6. Machulska, A., Eiler, T. J., Kleinke, K., Grünewald, A., Brück, R., Jahn, K., Niehaves, B., & Klucken, T. (2021). Approach bias retraining through virtual reality in smokers willing to quit smoking: A randomized-controlled study. *Behaviour Research and Therapy*, 141. https://doi.org/10.1016/j.brat.2021.103858

Abstract: Automatic approach biases toward smoking-related cues have been implicated in the development and maintenance of addictive behaviors. Studies aiming at modifying such biases have shown promise in changing maladaptive approach tendencies for smoking cues and reducing smoking behavior. However, training effects tend to be small and partly inconsistent. The present randomized-controlled trial incorporated virtual reality (VR) technology into Approach Bias Modification (ABM) to improve efficacy. One-hundred-eight smokers attended behavioral counseling for smoking cessation and were thereafter randomized to receive VR-ABM or VR-control training. During VR-ABM, participants trained to implicitly avoid smoking-related objects and to approach alternative objects, while no such contingency existed in the VR-control condition. Trainings were administered in six sessions within a two-week period. Assessments were conducted at baseline, post-intervention (three weeks after baseline), and at follow-up (seven weeks after baseline). VR-ABM did not change approach biases, nor other cognitive biases, but it was superior in reducing daily smoking. However, this effect was limited to the two-week training period. Both groups improved in other smoking- and health-related variables across time. Future work should continue to investigate working mechanisms of ABM, in particular crucial training ingredients. VR could prove valuable for public health as the potential of VR-based treatments is large and not fully explored.

Keyword: ("VR" OR "virtual reality") AND ("coping skills" OR "rehabilitation") AND ("drug" OR "drug use" OR "substance" OR "substance use")

This search yielded 190 results, from which 4 articles were chosen.

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1. Skeva, R., Gregg, L., Jay, C., & Pettifer, S. (2021). Assessment of virtual environments for alcohol Relapse Prevention in a less immersive and cost-effective setup: A qualitative study. *Computers in Human Behavior Reports*, 4, 100120. https://doi.org/10.1016/j.chbr.2021.100120

Abstract: Relapse prevention (RP) - helping people to develop relevant coping skills in high-risk situations that challenge abstinence - is an important part of alcohol use disorder treatment. Recreating personalised, high-risk situations can be challenging in clinical contexts. Virtual Reality Therapy (VRT) has the potential to offer immersive exposure to relevant, interactive stimuli presented in Virtual Environments (VEs). The use of VRT in RP remains unexplored. In this study, 10 casual and 13 high-risk drinkers assessed, via unstructured interviews, the realism of three 'high-risk' VEs: a home, a supermarket and a pub, and the extent to which they induced alcohol temptation when presented in a less immersive, cost-effective setup. Template analysis revealed that proximal (alcohol stimuli) and contextual (stimuli typically associated with alcohol) cues, and a sense of presence within the VEs, were key aspects to inducing realism and alcohol temptation. High-risk drinkers were tempted to drink in any VE and regular drinkers primarily in a social, pub VE. Temptation to smoke was induced in smokers. The results suggest that the VEs may help people with alcohol or comorbid tobacco misuse to practice coping with craving, refusal skills (saying 'no' to prompts to drink) and emotion regulation in social, private and alcohol vending contexts. The interconnections of realism, presence, alcohol temptation and related cues discussed here can inform future VRT applications for alcohol treatment.

2. Ghiţă, A., & Gutiérrez-Maldonado, J. (2018). Applications of virtual reality in individuals with alcohol misuse: A systematic review. In *Addictive Behaviors* (Vol. 81, pp. 1–11). Elsevier Ltd. https://doi.org/10.1016/j.addbeh.2018.01.036

Abstract: Background: Alcohol use and misuse have been intensively studied, due to their negative consequences in the general population. Evidence-based literature emphasizes that alcohol craving plays a crucial role in the development and maintenance of alcohol-drinking patterns. Many individuals develop Alcohol Use Disorders (AUD); significantly, after treatment many also experience relapses, in which alcohol craving has been repeatedly implicated. Cue-exposure therapy

(CET) has been widely used in the treatment of alcohol misuse, but the results are inconsistent. Virtual reality (VR) can add effectiveness to cue-exposure techniques by providing multiple variables and inputs that enable personalized alcohol use assessment and treatment. The aim of this review was to examine the applications of virtual reality in individuals who misuse alcohol. Method: We conducted an exhaustive literature search of the Web of Science, Scopus, Embase, Google Scholar, and PsycInfo databases, using as search items terms such as "alcohol" and its derivates, and virtual reality. Results: We identified 13 studies on alcohol craving that implemented virtual reality as an assessment or treatment tool. Conclusions: The studies that incorporate VR present clear limitations. First, no clinical trials were conducted to explore the efficacy of the VR as a treatment tool; nor were there any studies of the generalization of craving responses in the real world, or of the long-term effects of VR treatment. Despite these limitations, the studies included showed consistent results as regards eliciting and reducing alcohol craving. We suggest that VR shows promise as a tool for the assessment and treatment of craving among individuals with alcohol misuse. Further studies implementing VR in the field of alcohol consumption are now required.

3. Pericot-Valverde, I., Secades-Villa, R., & Gutiérrez-Maldonado, J. (2019). A randomized clinical trial of cue exposure treatment through virtual reality for smoking cessation. *Journal of Substance Abuse Treatment*, 96, 26–32. https://doi.org/10.1016/j.jsat.2018.10.003

Abstract: Introduction: Cue-induced craving is a major motivator of smoking behavior, and, more importantly, a predictor of relapse. Previous studies demonstrated that cue exposure treatment (CET) reduces both cue-induced craving and daily nicotine intake in smokers. However, the efficacy of CET for smoking cessation has rarely been tested in controlled trials. This two-site randomized clinical trial explored the effectiveness of a CET procedure in combination with a Cognitive-Behavioral Treatment (CBT) for smoking cessation among treatment-seeking patients from the general population. Methods: One hundred and two smokers were randomly assigned to one of two treatment conditions: CBT (n = 52) or CBT + CET (n = 50). The CBT intervention involved group-based sessions over the course of 6 weeks. In addition to CBT, participants

in the CBT + CET condition received 5 individual sessions of CET through virtual reality. Results: The CBT + CET group showed a significant reduction in cue-induced craving. However, there were no significant differences in either retention nor abstinence rates between CBT and CBT + CET in any assessment period (end-of-treatment, 1-, 6-, and 12-month follow-up). Moreover, a higher rate of relapse over a 12-month follow-up period was found in the CBT + CET group compared to the CBT group (Wald $\chi 2$ = 4.796, p =.029). Conclusions: Findings support and expand previous evidence by showing that a CET protocol does not increase the effectiveness of a CBT intervention for smoking cessation among treatment-seeking smokers. Moreover, this study also reveals that CET may increase risk of relapse among nicotine-dependent individuals who successfully achieve abstinence. Until the mechanisms underlying the effect of CET are identified, researchers and clinicians should be cautious when utilizing this protocol.

4. Bordnick, P. S., Traylor, A., Copp, H. L., Graap, K. M., Carter, B., Ferrer, M., & Walton, A. P. (2008). Assessing reactivity to virtual reality alcohol based cues. *Addictive Behaviors*, 33(6), 743–756. https://doi.org/10.1016/j.addbeh.2007.12.010

Abstract: The use of virtual reality (VR) programs in behavioral science research has been gaining prominence over the past several years. In the field of substance abuse, VR cue reactivity programs have been successfully tested for feasibility in nicotine and cocaine dependent samples. Seeking to expand VR applications in alcohol cue research, a novel VR alcohol cue reactivity assessment system incorporating visual, auditory, and olfactory stimuli was developed and tested. In a controlled trial, 40 non-treatment-seeking drinkers with alcohol use disorders were exposed to VR alcohol cue environments. Subjective craving, attention to alcohol cues, and level of presence (realism of experience) in VR were assessed across the environments. Overall, subjective craving for alcohol increased across the VR alcohol-related cue environments versus VR neutral cue environments. Participants reported high levels of presence in VR, indicating that the environments were perceived as realistic and compelling. These initial findings support the use of VR based cue reactivity environments for use in alcohol cue-based treatment and research. © 2007 Elsevier Ltd. All rights reserved.

Articles from PubMed

Keyword: ("virtual reality" OR "vr") AND ("substance use" OR "drug use")

There were 2129 results from which 4 articles were selected.

1. Ghiţă, A., Hernández-Serrano, O., Fernández-Ruiz, J., Moreno, M., Monras, M., Ortega, L., Mondon, S., Teixidor, L., Gual, A., Gacto-Sanchez, M., Porras-García, B., Ferrer-García, M., & Gutiérrez-Maldonado, J. (2021). Attentional bias, alcohol craving, and anxiety implications of the virtual reality cue-exposure therapy in severe alcohol use disorder: A case report. *Frontiers in Psychology*, 12. https://doi.org/10.3389/fpsyg.2021.543586

Abstract: Aims: Attentional bias (AB), alcohol craving, and anxiety have important implications in the development and maintenance of alcohol use disorder (AUD). The current study aims to test the effectiveness of a Virtual Reality Cue-Exposure Therapy (VR-CET) to reduce levels of alcohol craving and anxiety and prompt changes in AB toward alcohol content. Method: A 49-year-old male participated in this study, diagnosed with severe AUD, who also used tobacco and illicit substances on an occasional basis and who made several failed attempts to cease substance misuse. The protocol consisted of six VR-CET booster sessions and two assessment sessions (pre- and post-VR-CET) over the course of 5 weeks. The VR-CET program consisted of booster therapy sessions based on virtual reality (VR) exposure to preferred alcohol-related cues and contexts. The initial and final assessment sessions were focused on exploring AB, alcohol craving, and anxiety using paper-and-pencil instruments and the eye-tracking (ET) and VR technologies at different time points. Results: Pre and post assessment sessions indicated falls on the scores of all instruments assessing alcohol craving, anxiety, and AB. Conclusions: This case report, part of a larger project, demonstrates the effectiveness of the VR-CET booster sessions in AUD. In the post-treatment measurements, a variety of instruments showed a change in the AB pattern and an improvement in craving and anxiety responses. As a result of the systematic desensitization, virtual exposure gradually reduced the

responses to significant alcohol-related cues and contexts. The implications for AB, anxiety and craving are discussed.

2. Hernández-Serrano, O., Ghiţă, A., Figueras-Puigderrajols, N., Fernández-Ruiz, J., Monras, M., Ortega, L., Mondon, S., Teixidor, L., Gual, A., Ugas-Ballester, L., Fernández, M., Montserrat, R., Porras-Garcia, B., Ferrer-Garcia, M., & Gutiérrez-Maldonado, J. (2020). Predictors of changes in alcohol craving levels during a virtual reality cue exposure treatment among patients with alcohol use disorder. *Journal of Clinical Medicine*, 9(9), 1–19. https://doi.org/10.3390/jcm9093018

Abstract: Background/Objective: Determining the predictive variables associated with levels of alcohol craving can ease the identification of patients who can benefit from treatments. This study aimed to describe changes (improvement or no change/deterioration) in alcohol craving levels and explore the predictors of these changes from admission to discharge in outpatients with alcohol use disorder (AUD) undergoing treatment-as-usual (TAU), or treatment-as-usual supplemented with virtual reality cue-exposure therapy (TAU + VR-CET). Method: A prospective cohort study was conducted amongst 42 outpatients with AUD (n = 15 TAU + VR-CET and n = 27 TAU) from a clinical setting. Changes in the levels of alcohol craving between admission and discharge were assessed with the Multidimensional Alcohol Craving Scale. Sociodemographic characteristics (age, gender, education, and socioeconomic and civil status), cognitive-affective behavioral patterns (AUD severity, abstinence duration, psychiatric comorbidity, state anxiety, attentional bias, and substance use), and type of treatment (TAU + VR-CET and only TAU) were also evaluated. Results: The TAU + VR-CET group showed greater changes of improvement in the levels of alcohol craving than the TAU group ($\chi2$ = 10.996; p = 0.001). Intragroup changes in alcohol craving from pre to post-treatment were significant in the TAU + VR-CET group ($\chi2$ = 13.818; p = 0.003) but not within the TAU group ($\chi2$ = 2.349; p =.503). The odds of an improvement in any of the craving levels between pre-and post-test was 18.18 (1/0.055) times higher in the TAU + VR-CET group with respect to the TAU group. The use of illicit drugs in the month prior to the test increased the odds of having a positive change by 18.18 (1/0.055) with respect to not having consumed. Conclusions: Including VR-CET in TAU programs may provide benefits in the treatment of AUDs mainly among patients

with intense alcohol craving and individuals having used illicit substances prior to treatment.

3. Hone-Blanchet, A., Wensing, T., & Fecteau, S. (2014). The use of virtual reality in craving assessment and cue-exposure therapy in substance use disorders. *Frontiers in Human Neuroscience*, 8(OCT). https://doi.org/10.3389/fnhum.2014.00844

Abstract: Craving is recognized as an important diagnosis criterion for substance use disorders (SUDs) and a predictive factor of relapse. Various methods to study craving exist; however, suppressing craving to successfully promote abstinence remains an unmet clinical need in SUDs. One reason is that social and environmental contexts recalling drug and alcohol consumption in the everyday life of patients suffering from SUDs often initiate craving and provoke relapse. Current behavioral therapies for SUDs use the cue-exposure approach to suppress salience of social and environmental contexts that may induce craving.They facilitate learning and cognitive reinforcement of new behavior and entrain craving suppression in the presence of cues related to drug and alcohol consumption. Unfortunately, craving often overweighs behavioral training especially in real social and environmental contexts with peer pressure encouraging the use of substance, such as parties and bars. In this perspective, virtual reality (VR) is gaining interest in the development of cue-reactivity paradigms and practices new skills in treatment. VR enhances ecological validity of traditional craving-induction measurement. In this review, we discuss results from (1) studies using VR and alternative virtual agents in the induction of craving and (2) studies combining cue- exposure therapy with VR in the promotion of abstinence from drugs and alcohol use.They used virtual environments, displaying alcohol and drugs to SUD patients. Moreover, some environments included avatars. Hence, some studies have focused on the social interactions that are associated with drug-seeking behaviors and peer pressure. Findings indicate that VR can successfully increase craving. Studies combining cue-exposure therapy with virtual environment, however, reported mitigated success so far.

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4. Segawa, T., Baudry, T., Bourla, A., Blanc, J. V., Peretti, C. S., Mouchabac, S., & Ferreri, F. (2020). Virtual Reality (VR) in Assessment and Treatment of Addictive Disorders: A Systematic Review. *Frontiers in Neuroscience*, 13. https://doi.org/10.3389/fnins.2019.01409

Abstract: Background: Substance Use Disorder (SUD) and behavioral addictions are common and require a multidisciplinary approach. New technologies like Virtual Reality could have the potential to improve assessment and treatment of these disorders. Objective: In the present paper, we therefore present an overview of Virtual Reality (Head Mounted Devices) in the field of addiction medicine for craving assessment and treatment. Method: We conducted a systematic review by querying PubMed database for the titles of articles published up to March 2019 with the terms [virtual] AND [addictive] OR [addiction] OR [substance] OR [alcohol] OR [cocaine] OR [cannabis] OR [opioid] OR [tobacco] OR [nicotine] OR [methamphetamine] OR [gaming] OR [gambling]. Results: We screened 319 abstracts and analyzed 37 articles, dividing them into two categories, the first for assessment of cue reactivity (craving, psychophysiological response and attention to cue) and the second for intervention, each drug (nicotine, cocaine, alcohol, cannabis, gambling) being detailed within each category. Conclusions: This overview suggest that VR provide benefits in the assessment and treatment of substance use disorders and behavior addictions and achieve high levels of ecological validity. While, craving provocation in VR is effective across addiction disorders, treatments based exclusively on virtual exposure to drug related cues as shown heterogenous results.

Keywords: ("VR" OR "virtual reality") AND ("coping skills" OR "rehabilitation") AND ("drug" OR "drug use" OR "substance" OR "substance use")

This search yielded 74 results, from which 3 articles were chosen.

1. Bordnick, P. S., Traylor, A. C., Carter, B. L., & Graap, K. M. (2012). A feasibility study of virtual reality-based coping skills training for nicotine dependence. *Research on Social Work Practice*, 22(3), 293–300. https://doi.org/10.1177/1049731511426880

Abstract: Objective: Virtual reality (VR)-based cue reactivity has been successfully used for the assessment of drug craving. Going beyond assessment of cue reactivity, a novel VR-based treatment approach for smoking cessation was developed and tested for feasibility. Method: In a randomized experiment, 10-week treatment feasibility trial, 46 nicotine-dependent adults, completed the10-week program. Virtual reality skills training (VRST) combined with nicotine replacement therapy (NRT) was compared to NRT alone. Participants were assessed for smoking behavior and coping skills during, at end of treatment, and at posttreatment follow-up. Results: Smoking rates and craving for nicotine were significantly lower for the VRST group compared to NRT-only group at the end of treatment. Self-confidence and coping skills were also significantly higher for the VRST group, and number of cigarettes smoked was significantly lower, compared to the control group at follow-up. Conclusions: Feasibility of VRST was supported in the current study. © SAGE Publications 2012.

2. Langener, S., Vandernagel, J., van Manen, J., Markus, W., Dijkstra, B., Defuentes-merillas, L., Klaassen, R., Heitmann, J., Heylen, D., & Schellekens, A. (2021). Clinical relevance of immersive virtual reality in the assessment and treatment of addictive disorders: A systematic review and future perspective. *Journal of Clinical Medicine*, 10(16). https://doi.org/10.3390/jcm10163658

Abstract: (1) Background: Virtual reality (VR) has been investigated in a variety of psychiatric disorders, including addictive disorders (ADs); (2) Objective: This systematic review evaluates the current evidence of immersive VR (using head-mounted displays) in the clinical assessment and treatment of ADs; (3) Method: PubMed and PsycINFO were queried for publications up to November 2020; (4) Results: We screened 4519 titles, 114 abstracts and 85 full-texts, and analyzed 36 articles regarding the clinical assessment (i.e., diagnostic and prognostic value; n = 19) and treatment (i.e., interventions; n = 17) of ADs. Though most VR assessment studies (n = 15/19) showed associations between VR-induced cue-reactivity and clinical parameters, only two studies specified diagnostic value. VR treatment studies based on exposure therapy showed no or negative effects. However, other VR interventions like embodied and aversive learning paradigms

demonstrated positive findings. The overall study quality was rather poor; (5) Conclusion: Though VR in ADs provides ecologically valid environments to induce cue-reactivity and provide new treatment paradigms, the added clinical value in assessment and therapy remains to be elucidated before VR can be applied in clinical care. Therefore, future work should investigate VR efficacy in randomized clinical trials using well-defined clinical endpoints.

3. Man, D. W. K. (2020). Virtual reality-based cognitive training for drug abusers: A randomised controlled trial. *Neuropsychological Rehabilitation*, 30(2), 315–332. https://doi.org/10.1080/09602011.2018.1468271

Abstract: Non-pharmacological means are being developed to enhance cognitive abilities in drug abusers. This study evaluated virtual reality (VR) as an intervention tool for enhancing cognitive and vocational outcomes in 90 young ketamine users (KU) randomly assigned to a treatment group (virtual reality group, VRG; tutor-administered group, TAG) or wait-listed control group (CG). Two training programmes with similar content but different delivery modes (VR-based and manual-based) were applied using a virtual boutique as a training scenario. Outcome assessments comprised the Digit Vigilance Test, Rivermead Behavioural Memory Test, Wisconsin Cart Sorting Test, work-site test and self-efficacy pre- and post-test and during 3- and 6-month follow-ups. The VRG exhibited significant improvements in attention and improvements in memory that were maintained after 3 months. Both the VRG and TAG exhibited significantly improved vocational skills after training which were maintained during follow-up, and improved self-efficacy. VR-based cognitive training might target cognitive problems in KU.

Articles from Scopus

Keyword: ("virtual reality" OR "vr") AND ("substance use" OR "drug use")

128 documents were found, and 4 of them were selected.

1. Junker, A., Hutters, C., Reipur, D., Embol, L., Adjorlu, A., Nordahl, R., Serafin, S., Petersen, D. T., & Fink-Jensen, A. (2021). Fighting alcohol craving using virtual reality: The role of social interaction. *Proceedings - 2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops*, VRW 2021, 257–263. https://doi.org/10.1109/VRW52623.2021.00054

Abstract: Craving is a cause of relapse in patients suffering from a substance use disorder. Cue-exposure therapy builds on eliciting feelings of craving in patients in safe and controlled environments to condition them to control these feelings. Different efficient and resource-friendly methods of eliciting craving exist, (such as written material, still pictures, etc.). However, these methods create knowledge and skill transfer gaps between therapy sessions and real life scenarios. Virtual reality allows more true-to-life experiences, and research demonstrates its capabilities in eliciting craving in patients. Studies have identified different environments that elicits craving, suggesting bars to be one of the most effective ones. Research also suggests the presence of others to be an effective method of eliciting craving in users. However, the effect of social interaction has not yet been explored. Therefore, this paper presents a virtual bar with the purpose to investigate whether social interaction affects alcohol craving in users. The VR intervention is designed with close cooperation with a psychiatrist experienced in working with individuals suffering from alcohol use disorder. In this paper, we present the designed and developed VR intervention and discuss how an experiment can be conducted after the COVID-19 shutdowns.

2. Hernández-Serrano, O., Ghiţă, A., Figueras-Puigderrajols, N., Fernández-Ruiz, J., Monras, M., Ortega, L., Mondon, S., Teixidor, L., Gual, A., Ugas-Ballester, L., Fernández, M., Montserrat, R., Porras-Garcia, B., Ferrer-Garcia, M., & Gutiérrez-Maldonado, J. (2020). Predictors of changes in alcohol craving levels during a virtual reality cue exposure treatment among patients with alcohol use disorder. *Journal of Clinical Medicine*, 9(9), 1–19. https://doi.org/10.3390/jcm9093018

Abstract: Background/Objective: Determining the predictive variables associated with levels of alcohol craving can ease the identification of patients who can

benefit from treatments. This study aimed to describe changes (improvement or no change/deterioration) in alcohol craving levels and explore the predictors of these changes from admission to discharge in outpatients with alcohol use disorder (AUD) undergoing treatment-as-usual (TAU), or treatment-as-usual supplemented with virtual reality cue-exposure therapy (TAU + VR-CET). Method: A prospective cohort study was conducted amongst 42 outpatients with AUD (n = 15 TAU + VR-CET and n = 27 TAU) from a clinical setting. Changes in the levels of alcohol craving between admission and discharge were assessed with the Multidimensional Alcohol Craving Scale. Sociodemographic characteristics (age, gender, education, and socioeconomic and civil status), cognitive-affective behavioral patterns (AUD severity, abstinence duration, psychiatric comorbidity, state anxiety, attentional bias, and substance use), and type of treatment (TAU + VR-CET and only TAU) were also evaluated. Results: The TAU + VR-CET group showed greater changes of improvement in the levels of alcohol craving than the TAU group ($\chi2 = 10.996$; $p = 0.001$). Intragroup changes in alcohol craving from pre to post-treatment were significant in the TAU + VR-CET group ($\chi2 = 13.818$; $p = 0.003$) but not within the TAU group ($\chi2 = 2.349$; $p =.503$). The odds of an improvement in any of the craving levels between pre-and post-test was 18.18 (1/0.055) times higher in the TAU + VR-CET group with respect to the TAU group. The use of illicit drugs in the month prior to the test increased the odds of having a positive change by 18.18 (1/0.055) with respect to not having consumed. Conclusions: Including VR-CET in TAU programs may provide benefits in the treatment of AUDs mainly among patients with intense alcohol craving and individuals having used illicit substances prior to treatment.

3. Lebiecka, Z., Skoneczny, T., Tyburski, E., Samochowiec, J., & Kucharska-Mazur, J. (2021). Is virtual reality cue exposure a promising adjunctive treatment for alcohol use disorder? In *Journal of Clinical Medicine* (Vol. 10, Issue 13). MDPI. https://doi.org/10.3390/jcm10132972

Abstract: This narrative review presents recent developments in virtual reality (VR)-based interventions for alcohol use disorders (AUDs). The latest advances in mental healthcare hail an imminent cyber revolution, ushering in novel

treatment options, with immersive virtual technology at the very forefront of expected change. With an aim to (a) provide a background on VR use in mental healthcare of AUD patients, (b) summarize existing evidence on conventional approaches to the treatment of AUDs and a trending paradigm shift towards VR applications in their management, and (c) describe key issues and future directions in research on craving assessment and VR cue-induced therapy in AUDs, a search for experimental and meta-analytic evidence was performed in six databases: PubMed and EBSCO (Medline, ERIC, PsychINFO, Academic Search Ultimate, and Health Source: Nursing/Academic Edition). Pooled results were screened for eligibility, and relevant papers were selected for inclusion. The analysis revealed VR's promising effects in the treatment of AUDs. Its remarkable potential to simulate cues underlying subsequent addictive behaviors makes its application in the assessment and treatment of AUDs an attractive alternative to researchers and clinicians alike. Nevertheless, more evidence is needed before virtual reality cue exposure therapy (VR-CET) can become a clinical standard of care.

4. Tsamitros, N., Sebold, M., Gutwinski, & S., & Beck, A. (2021). Virtual Reality-Based Treatment Approaches in the Field of Substance Use Disorders. *Current Addiction Reports*, 8, 399–407. https://doi.org/10.1007/s40429-021-00377-5/Published

Abstract: Purpose Substance use disorders (SUD) are burdening chronic conditions characterized by high relapse rates despite severe negative consequences. Substance-related cues that elicit craving by means of automatic physiological and behavioural responses have long been suggested to predict relapse. One major mechanism contributing to relapse behaviour are cue-induced behavioural approach tendencies towards the addictive agent. Recently, there has been an emerging interest in virtual reality (VR)-based approaches to assess and modify craving and its related responses. This review aims at elucidating (1) VR techniques applied in the field of SUD, (2) VR as an induction/assessment tool for biopsychological correlates of craving and (3) VR-based therapeutic approaches. Findings There is an emerging number of studies focusing on different substances of abuse incorporating VR in craving induction/assessment as well as therapy. Despite some limitations as missing of

randomized controlled clinical trials with large samples and missing data on the long-term effects of VR treatment, the VR approach showed consistent results in eliciting and reducing craving across different substances. Summary This review suggests virtual reality as a promising tool for the assessment and treatment of craving among individuals with substance use disorders. Because of its ecological validity, VR unifies the benefits of a laboratory setting with the advantages of a realistic environment. Further studies with large samples and randomized controlled clinical trials using more homogenous VR techniques as well as assessment of objective biophysiological craving markers are required.

Keywords used: Virtual reality/ VR, coping skills, decision making, Stress management, Skill teaching, Emotion regulation, Refugee, Teaching coping skills / stress management / emotion regulation in the rehabilitation of drug users, Teaching skills by using VR, Treatment.

Articles from Google Scholar

Keyword: ("virtual reality" OR "rehabilitation" OR "drug users")

This search led to 42 000 hits, of which five were selected.

1. Yuah, Y., Huang, J., & Yan, K. (2019). Virtual Reality Therapy and Machine Learning Techniques in Drug Addiction Treatment. *10th International Conference on Information Technology in Medicine and Education (ITME).*

> The first study concluded that "the experimental results (…) provide firm evidence that the patient's response to drug stimulation is severely reduced after VR treatments. The conclusion was drawn that virtual reality is indeed effective in assisting detoxification".

2. Ticknor, B. (2019). Virtual Reality and Correctional Rehabilitation. *International Association for Correctional and Forensic Psychology*.

The second study suggests that 'using VR for correctional rehabilitation can enhance traditional offender treatment" and explores specifically the topic of substance abuse treatment.

3. Hone-Blanchet, A., Wensing, T., & Fecteau, S. (2014). The use of virtual reality in craving assessment and cue-exposure therapy in substance use disorders. *Frontiers in Human Neuroscience*.

The third review concluded that "VR can successfully increase craving. Studies combining cue–exposure therapy with virtual environment, however, reported mitigated success so far."

4. Amista, N., Kim, J., & Kim, N. (2017). Trend and Future of Virtual Reality for Addiction Treatment of Substance Use Disorders: *A Systematic Review. Journal of Digital Contents Society*, 18, 8, pp. 1551-1560.

The fourth is a systematic review that "overall concluded that research on addiction treatment using VR have shown a potential for the treatment of substance use disorders."

5. Kip, H., Kelders, S., Weerink, K., Kuiper, A., Brüninghoff, I., Bouman, Y., Dijkslag, D., & Gemert-Pijnen, L. (2019). Identifying the Added Value of Virtual Reality for Treatment in Forensic Mental Health: A Scenario-Based, Qualitative Approach. *Frontiers in Psychology*.

The fifth and last is a qualitative study suggesting that "VR offers a broad range of possibilities for forensic mental health. Examples are offering training in behavioral and cognitive skills in a realistic context to bridge the gap between a therapy room and the real world, increasing treatment motivation, being able to adapt a VR application to individual patients, and providing therapists with new insights into a patient".

Keyword: ("virtual reality" OR "rehabilitation" OR "justice system")

This search led to 81 900 hits, of which three were selected for analysis.

1. Ticknor, B., & Tillinghast, S. (2011). Virtual Reality and the Criminal Justice System: New Possibilities for Research, Training, and Rehabilitation. *Journal of Virtual Worlds Research*, 4, 1.

> The first paper suggests that "the criminal justice system can benefit from this rapidly expanding technology in three specific ways. First, the issues of experimental control and problematic research methodologies can be addressed. Second, both practitioners and offenders can benefit from training within virtual environments. Third, rehabilitation efforts can be improved by providing offenders a safe and controlled environment for treatment".

2. Kip, H., Kelders, S., Weerink, K., Kuiper, A., Brüninghoff, I., Bouman, Y., Dijkslag, D., & Gemert-Pijnen, L. (2019). Identifying the Added Value of Virtual Reality for Treatment in Forensic Mental Health: A Scenario-Based, Qualitative Approach. *Frontiers in Psychology*.

> The second article discusses and suggests that "using VR for correctional rehabilitation offers several advantages over traditional offender treatment. First, VR can be used to demonstrate, role-play and model skills in a more realistic environment. Offenders can see how the skill can be used in scenarios that mimic what they might actually encounter in their everyday lives. Second, the software inherent in the virtual environment can assist facilitators in providing feedback, correcting behavior and use reinforcement when the targeted behavior is achieved. Finally, conducting a group in a virtual environment provides opportunities for treatment for those who would not otherwise have access".

3. Ticknor, B. (2018). *Virtual Reality and the Criminal Justice System: Exploring the Possibilities for Correctional Rehabilitation*. Lexington Books.

> The third is a book that concludes that "Done properly, VR can be used to enhance current correctional treatment strategies. (…) VR provides another tool that can be used for treatment to assist criminal justice practitioners in reintegrating offenders back into society". It is additionally discussed the role of VR in substance abuse.

Articles from EBSCO

Keyword: ("teaching skills" OR "skill teaching" OR "coping skills" OR "decision making" OR "virtual reality" OR "augmented reality")

This search led to 89 hits, in which one was selected for analysis.

1. Fromberger, P., Jordan, K., & Müller, J.L. (2017). Virtual reality applications for diagnosis, risk assessment and therapy of child abusers. *Wiley*.

> The article "reviews and discusses innovative research projects with regard to their impact on current clinical practice regarding risk assessment and treatment as well as other implementations of VR applications in forensic mental health.".

Keyword: ("virtual reality" OR "augmented reality" OR "coping skills" OR "decision making" OR "emotion regulation" OR "stress management")

The search led to 116 hits, in which one was selected.

1. Colombo, D., Díaz-García, A., Fernandez-Álvarez, J., & Botella, C. (2021). Virtual reality for the enhancement of emotion regulation. *Clinical Psychology & Psychotherapy*.

> The paper "provides an overview of the existing evidence about VR-based interventions in the field of emotion regulation, emphasizing the promising findings and the barriers that still have to be addressed".

Keyword: ("virtual reality" OR "augmented reality" OR "AR" OR "drugs" OR "substance use" OR "drug addiction")

This search led to 313 hits, of which one was selected for analysis.

1. Sharma, M., Jordan, V., & Sharma, M. (2019). Potential Applications of Virtual Reality (VR) in Alcohol and Drug Education. *Journal of Alcohol and Drug Education*, 63, 3.

> In this paper, the authors identify some virtual reality (VR) applications in the alcohol and drug field and explore future research directions.

Articles from ProQuest

Keyword: ("virtual reality" OR "coping skills")

This search led to 155 731 hits, of which two were selected for analysis.

1. Segawa, T., Baudry, T., Bourla, A., Blanc, J.V., Peretti. C.S., Mouchabac, S., & Ferreri, F. (2020). Virtual Reality (VR) in Assessment and Treatment of Addictive Disorders: A Systematic Review. *Frontiers in Neuroscience*.

> A systematic review concluded that studies "suggest that VR provides benefits in the assessment and treatment of substance use disorders, behavioral addictions and achieve high levels of ecological validity. While craving provocation in VR is effective across addiction disorders, treatments based exclusively on virtual exposure to drug-related cues show heterogeneous results. The addition of learning coping strategies in VRCBT studies is promising, however more rigorous methodological studies are warranted".

2. Bosse, T., Gerritsen, C., Man, J., & Treur, J. (2014). Towards virtual training of emotion regulation. *Springerlink*.

> The second paper underlines that "the outcomes of the experiment indicate that, depending on its setup, virtual training may either strengthen the emotional responses to stimuli or weaken them". Although this study was not conducted in a forensic context, it provides substantial efficacy evidence. Therefore, the criterion of applicability/transferability should be considered, and the findings generalized.

Problem-Solving and Decision-Making

1. Araiza-Alba, P., Keane, T. Won Sun Chen & Kaufman, J. (2021). Immersive virtual reality as a tool to learn problem-solving skills, *Computers & Education*, 164, 104-121, ISSN 0360-1315, https://doi.org/10.1016/j.compedu.2020.104121.

- a tool to learn and practice problem-solving skills - its ability to stimulate the senses of the user and present the information in a more realistic manner.

- "engaging and motivating the user while also supporting cognitive processing and the transfer of knowledge".

2. Howard, M., C. & Gutworth, M. B. (2020). A meta-analysis of virtual reality training programs for social skill development, *Computers & Education*, Volume 144, 103707, ISSN 0360-1315, https://doi.org/10.1016/j.compedu.2019.103707.

- "VR training programs, on average, perform better than alternative training programs for developing social skills…". Although the difference was not statistically significant, training programs using immersive displays were less effective than those using monitors and training programs using specialized input devices had significantly lesser effects than those using a keyboard, mouse, and/or joystick. These results imply that improved hardware devices do not improve the efficacy of VR training programs for social skill development, whether they be output or input devices.

- The improvement of social skills was only little impacted by VR training programs that taught emotional regulation skills. For better results the authors suggested problem-focused skills rather that emotion-focused skills.

- Games should be cautionary included in training; more impact on trainings that used Second Life[1].

3. Shin, D. (2008). Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience?, *Computers in Human Behavior*, 78, 64-73, ISSN 0747-5632, https://doi.org/10.1016/j.chb.2017.09.012.

- "The way users view and accept VR stories derives from the way they envisage and intend to experience them. Rather than simply being influenced by technological features, users have intentional and purposeful control over VR stories. The findings of this study suggest that the cognitive processes by which users experience quality, presence, and flow determine how they will empathize with and embody VR stories".

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[1] https://secondlife.com/

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- "Users actively create their own VR, based on their understanding of the story, their empathic traits, and the nature of the medium. In other words, VR developers propose immersion, but users process it, based on their own preferences and needs".

Stress Management - Coping Skills and Emotion Regulation

1. Bosse, T., Gerritsen, C., De Man, J., & Treur, J. (2013). Learning emotion regulation strategies: A cognitive agent model. Paper presented at the Proceedings - 2013 IEEE/WIC/ACM International Conference on Intelligent Agent Technology, IAT 2013, , 2 245-252. doi:10.1109/WI-IAT.2013.116

- an adaptive computational model of emotion regulation strategies. The model can be used both to gain more insight in emotion regulation training itself and to develop intelligent virtual reality-based training environments.
- "depending on its setup, virtual training may either strengthen the emotional responses to stimuli or weaken them".

2. Colombo, D., Díaz-García, A., Fernandez-Álvarez, J., & Botella, C. (2021). Virtual reality for the enhancement of emotion regulation. Clinical Psychology & Psychotherapy.

- Overview of the literature available VR in relation with emotion regulation.
- "Regarding the specific case of ER, the studies discussed in this narrative review suggest that more evidence is needed before drawing definitive conclusions about the adoption of VR for the enhancement of ER skills in both healthy and clinical populations. Nevertheless, the findings from both non-immersive and immersive VR-based literature are encouraging, showing significant clinical improvements associated with the proposed interventions. The available evidence emphasizes the importance of concepts such as gaming, gamification, and persuasive technology for the development of VR-based treatments targeting ER".

3. Villani, D., Cipresso, P., & Repetto, C. (2014). Coping with stress and anxiety: The role of presence in technology mediated environments. *Interacting with presence: HCI*

and the sense of presence in computer-mediated environments (pp. 139-151) doi:10.2478/9783110409697.9

- possibility to learn by living real experiences in technology-mediated environments - Virtual Reality Exposure (VRET), positive technology (PT) Cyber-interventions based on the Stress Inoculation Training protocol (Cyber-SIT). To link all these approaches, the *sense of presence* is the key factor.
- Interreality approach – "it is possible to take advantage of the sense of presence to overcome the limitations of existing protocols for psychological stress and anxiety. Furthermore, a larger availability of unobtrusive biosensors makes possible the effective measurement of presence (and the related affective states) during the interaction instead of using post-experience self-assessments."

4. Pallavicini, F., Orena, E., Achille, F., Cassa, M., Vuolato, C., Stefanini, S., Caragnano, C., Pepe, A., Veronese, G., Ranieri, P. (2022) Psychoeducation on Stress and Anxiety Using Virtual Reality: A Mixed-Methods Study. *Applied Science*, 12, 9110. https://doi.org/10.3390/app12189110

- Relaxing environments – especially naturalistic ones (island, forest, beach, river) are more effective in managing the stress and anxiety.
- "Results showed that the virtual reality psychoeducational experience: (a) was highly usable and satisfying; (b) increased positive emotions (i.e., happiness and surprise) and decreased negative emotions (i.e., fear, sadness) and state anxiety; (c) elicited a strong sense of presence, especially spatial presence; and (d) was practical, simple, motivating, and engaging for learning information."

5. Montana, J. I., Matamala-Gomez, M., Maisto, M., Mavrodiev, P. A., Cavalera, C. M., Diana, B., Mantovani, F., & Realdon, O. (2020). The Benefits of emotion Regulation Interventions in Virtual Reality for the Improvement of Wellbeing in Adults and Older Adults: A Systematic Review. *Journal of clinical medicine*, 9(2), 500. https://doi.org/10.3390/jcm9020500

- "the results of this systematic review show that technology can improve the ability of people to handle emotionally-rich life situations by training more contextually adaptive emotion regulation strategies. The use of virtual reality in this sense is promising because it allows the user to learn complex ER strategies in the context of life-like digital environments. VR interventions can modify the user's ER by inspiring new actions, allowing for the modification of the emotional response across a reappraisal of emotional stimuli, and subsequently, memorizing the re-evaluated experience. Finally, virtual reality is a tool that fosters a sense of environmental mastery, and, a feeling of personal growth and autonomy."

Rehabilitation - Mental Health, Substance Abuse and Criminal Behaviour

1. Trahan, M. H., Maynard, B. R., Smith, K. S., Farina, A. S. J., & Khoo, Y. M. (2019). Virtual Reality Exposure Therapy on Alcohol and Nicotine: A Systematic Review. *Research on Social Work Practice*, *29*(8), 876–891. https://doi.org/10.1177/1049731518823073

- Review of Virtual reality exposure therapy (VRET) for alcohol and nicotine dependence that delivers cue exposure therapy using a virtual reality environment.
- A great potential of VRET especially when combined with CBT interventions.
- Special attention should be paid to the number of session and duration. Also, it is important to have a clear profile of the participants (age, how many cigarettes they smoke, depression on anxiety issues).
- Piloting the environments prior to the implementation in order to ensure the cue reactivity.
- The interventions should be implemented as intended (fidelity)

2. Hone-Blanchet, A., Wensing, T., & Fecteau, S. (2014). *The use of virtual reality in craving assessment and cue-exposure therapy in substance use disorders*. Frontiers in Human Neuroscience.

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- "Findings indicate that VR can successfully increase craving. Studies combining cue–exposure therapy with virtual environment, however, reported mitigated success so far."

3. Ticknor, B., & Tillinghast, S. (2011). Virtual Reality and the Criminal Justice System: New Possibilities for Research, Training, and Rehabilitation. *Journal of Virtual Worlds Research*, 4, 1.

- "Virtual reality systems are used to achieve a broad range of goals in a variety of fields of study. The criminal justice system can benefit from this rapidly expanding technology in three specific ways. First, the issues of experimental control and problematic research methodologies can be addressed. Second, both practitioners and offenders can benefit from training within virtual environments. Third, rehabilitation efforts can be improved by providing offenders a safe and controlled environment for treatment. With dwindling resources and increasing correctional populations, virtual reality offers cost-efficient and effective means of addressing the diverse needs of the criminal justice system."

General Evaluation

This literature review aims to concentrate on teaching skills through the use of virtual reality and structure a proposal on the application technique of using virtual reality in teaching skills to refugee offenders. Although virtual reality technology use for the treatment and rehabilitation of substance abuse was explored in the early and late 2000s (Bordnick et al., 2004, 2008; Saladin et al., 2006), research on the subject is relatively new. A literature search given the keyword combinations above yielded 0 results on PsycINFO. Moreover, there was no research concerning the usage of virtual reality (VR) for teaching coping mechanisms to refugee substance abusers. Recent studies with the many people and groups given in this review demonstrate that VR-based training services are frequently offered to many at-risk groups that commonly face issues that also affect refugees, such as communication challenges. When teaching refugees coping mechanisms or providing them with training, these psychological and social challenges might be considered.

Present research indicates that substance cues can be introduced in a VR setting, with effects similar to the real-world experience. For an instance, smoking cues in a VR environment appear to induce cravings in nicotine-dependent subjects (Bordnick et al., 2004). Besides, the literature suggests that adding substance-related cues in VR produces highly comparable effects to real-life substance use experiences. Hence, VR may be a convenient learning tool for modeling substance use circumstances. It might create a more secure setting where people might acquire coping mechanisms to quit substance use.

Treatment of substance addiction problems with VR can advance exposure-based behavioral therapy (Saladin et al., 2006). Cue exposure and cognitive-behavioral intervention have changed because of virtual reality (Bordnick et al., 2011). The properties of the virtual reality environment appear to be crucial for a successful cue exposure experience. CBT components improve adaptive decision-making and highlight practical coping strategies to reduce the likelihood of ingesting alcohol or drugs. Cue exposure therapy often entails repeatedly exposing patients to stimuli previously linked to substance abuse to remove conditional reactions to such cues (Conklin & Tiffany 2002). Using VR technology is helpful for creating a high-risk realistic situation for reducing the cravings (Ticknor & Tillinghast, 2011). The consistency of the furniture and setting in the virtual environment with what is experienced in real life situations appear to be crucial (Skeva et al., 2021). In addition, the study conducted by Skeva et al. (2021) also reveals those other factors such as realistic virtual agents, immersive background sounds and lightning consistent with the ambiance. Participants in this particular study also note that the feeling of being present in the environment is important for a more realistic experience, so that they can project their drinking habits to the virtual reality environment. Moreover, the extent to which participants can interact with the environment is crucial for immersion as well. Possible designs for an interactive environment with more responsive virtual agents to simulate peer pressure for cue exposure therapy is still discussed (Junker et al., 2021). Despite the promising results of VR cue exposure experiments so far, a review by Ghiţă and Gutiérrez-Maldonado (2018) suggests that using VR poses limitations, since there are no studies which assess the generalization, nor the long-term effects of the VR treatments. On the other hand, a narrative review conducted by Lebiecka et al. (2021) indicates that 13 experimental studies and 16 reviews they have screened have revealed that virtual reality treatments

show promise since they can successfully simulate the cues related to the addictive behaviors which patients appear to exhibit.

In addition to providing exposure, VR can also be used to practice and teach cognitive reappraisal abilities (Colombo et al., 2021). VR appears to provide an exceptional opportunity for offenders to practice coping skills in simulated environments that could produce disorder-relevant behavior—without endangering others (Fromberger et al., 2014 cited in Fromberger et al., 2017). When VR presents highly salient stimuli, it enables the evaluation of the offender's self-regulation abilities (Benbouriche et al., 2014 cited in Fromberger et al., 2017).

The reviews concerning substance abuse and virtual reality interventions offer mixed results. While it is certain that VR environments can effectively present cues to increase craving, results of the treatment plans relying solely on VR intervention remain inconclusive (Hone-Blanchet et al., 2014; Segawa et al., 2020). It is clear that VR settings can be used to create ecologically valid environments for inducing cues; however, inconsistent methodologies and small sample sizes prevent results of such research from being generalized to overall population (Langener et al., 2021; Tsamitros et al., 2021).

Even though VR appears to induce craving successfully, the effectiveness of treatment is still not fully studied. There is a lack of randomized controlled clinical trials, and most studies are conducted with small samples. However, VR also appears to be a promising tool for assessment and treatment of substance use disorders via cue exposure and/or counterconditioning, and with a larger sample size and well-grounded methodology, it can be a powerful method to rehabilitate individuals.

Conclusion for TRAIVR Scenarios

While existing literature predominantly explores the use of virtual reality (VR) applications in the context of drug abuse treatment, the TRAIVR project takes a novel approach by focusing on the multifaceted challenges faced by refugee populations. Rather than directly targeting drug abuse, the project identifies drug use as a potential symptom of broader adaptation difficulties among refugee groups. Through a nuanced understanding of the underlying issues, TRAIVR endeavors to address the root causes

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of substance misuse by targeting fundamental coping mechanisms. Specifically, the project aims to bolster problem-solving abilities, enhance emotional regulation skills, and bolster stress management techniques within refugee communities. By leveraging VR technology as a rehabilitative tool, TRAIVR seeks to empower individuals who may face language barriers in their host countries, providing them with immersive and interactive experiences designed to facilitate learning and skill development. This innovative approach not only offers a promising avenue for mitigating substance misuse but also holds the potential to foster greater integration and resilience among refugee populations facing significant socio-cultural challenges. Through its holistic framework and innovative methodologies, TRAIVR represents a pivotal step forward in addressing the complex needs of vulnerable communities within the European Union.

Refugees often encounter significant challenges when adapting to life in host countries, with one of the most formidable obstacles being the language barrier. This barrier not only impedes effective communication but also contributes to heightened stress levels and emotional distress among refugees, hindering their ability to integrate successfully into their new communities. While cultural-specific programs have traditionally been utilized to address the unique needs of refugee populations, there is increasing recognition of the potential effectiveness of general programs that focus on stress management and emotional regulation in overcoming language barriers and related challenges.

General programs that are not culture-specific can provide valuable support in equipping refugees with essential coping skills to navigate the complexities of their new linguistic environments. By targeting fundamental aspects of stress management and emotional regulation, these programs offer practical strategies that transcend cultural boundaries, empowering refugees to confront and overcome the obstacles posed by language barriers. Through the acquisition of universal coping mechanisms, refugees can develop resilience and adaptability in coping with the demands of their new linguistic contexts.

Furthermore, the accessibility and scalability of general programs make them particularly advantageous in addressing the diverse needs of refugee populations across different cultural backgrounds. These programs can be easily implemented and disseminated within refugee communities, providing widespread access to essential skills and

resources for managing stress and regulating emotions in the face of linguistic challenges.

In conclusion, while the language barrier presents a significant hurdle for refugees in their adaptation process, general programs focusing on stress management and emotional regulation offer a promising approach to enhancing refugees' skills and abilities in coping with this obstacle. By providing practical and culturally inclusive support, these programs contribute to the successful integration and well-being of refugees in their host countries.

The overarching goal of the TRAIVR project was to pioneer a methodological framework informed by a comprehensive literature review, aimed at enhancing the universal applicability of project outcomes across diverse cultural contexts. Recognizing the imperative to bridge cultural divides, the project aimed to develop a Virtual Reality technology tool meticulously designed to support the adaptation processes of refugees facing substance misuse issues, regardless of their cultural backgrounds. Building upon insights gleaned from extensive literature reviews and meticulous needs analyses, the project sought to address a multifaceted challenge: the intersection of substance misuse, language barriers, and the adaptive needs of refugee populations. By leveraging VR technology, the project aimed to transcend linguistic barriers, offering immersive experiences tailored to facilitate stress management, problem-solving, and emotional regulation skills. This innovative approach not only sought to empower refugee probationers in partner countries but also aspired to foster broader societal integration and inclusivity across targeted EU member states. By prioritizing cultural inclusivity and technological innovation, the TRAIVR project aimed to pave the way for a more universally accessible and impactful intervention paradigm in addressing the complex needs of refugee populations within the European Union and beyond.

Annexes

Annex 1 - List of Keywords

Database	Keywords	Results generate in English	Relevant results for the literature review
ScienceDirect	vr / virtual reality / substance use / drug use	188 results	6 selected
	vr / virtual reality / coping skills / rehabilitation / drug / drug use / substance / substance use	190 results	4 selected
PubMed	vr / virtual reality / substance use / drug use	2129 results	4 selected
	vr / virtual reality / coping skills / rehabilitation / drug / drug use / substance / substance use	74 results	3 selected
Scopus	VR / virtual reality problem-solving/decision-making	132 results	2 selected

	VR / virtual reality coping skills/ emotion / treatment	116 results	1 selected
	vr / virtual reality / substance use / drug use	128 results	4 selected
Science Direct/Elesvier	VR / coping skills/ emotion regulation/ stress management	89 results	2 selected
	augmented reality/ treatment/ coping skills/ problem-solving	43 results	1 selected
SAGE	Vr / virtual reality coping skills/ emotion / treatment	116 results	2 selected
	Vr / virtual reality problem-solving/decision-making	32 results	1 selected

Google Scholar	Vr / virtual reality coping skills/ emotion / treatment	19,500 results	2 selected
	Vr / virtual reality problem-solving/decision-making	5,500 results	2 selected
	Virtual reality / rehabilitation / drug users	42000 results	5 selected
	Virtual reality / rehabilitation / justice system	81900 results	3 selected
EBSCO	Teaching Skills / Skill Teaching / Coping Skills / Decision Making / Virtual Reality / Augmented Reality	89 results	1 selected
	virtual reality / augmented reality / coping skills/ emotion regulation / decision making / stress management	116 results	1 selected

	Virtual reality / vr / augmented reality / AR / drugs / substance abuse / drug addiction	313 results	1 selected
ProQuest	Virtual reality / coping skills	155731 results	2 selected