



LITERATURE REVIEW: THE USE OF VIRTUAL REALITY  
TECHNOLOGY FOR THE REHABILITATION OF DRUG ADDICTION

## Foreword

This Intellectual Output 1 was developed by District Governorate of Torbali, the coordinator in the project VRforDrugRehabilitation: Developing and Using Virtual Reality Technology for Rehabilitation of Drug Users in Probation Service, No. 2018-3-TR01-KA205-061550, financed by ERASMUS + programme.

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VRforDrugRehabilitation project is co-financed by the European Commission under the “ERASMUS + KA2 – Cooperation for Innovation and Exchange of Good Practices KA205 – Strategic Partnership for youth”. It aims to support youth workers by promoting quality of Virtual Reality (VR) technology for drug addiction rehabilitation, in probation contexts for young adult offenders. Given the large use of drugs among juvenile offenders, prison and probation settings are important settings for the provision of responses addressing drug use.

The project assumes that using lifelike scenarios in virtual environments, users are repeatedly exposed to cues and encouraged to ignore the craving response. It is the only project to prepare, apply and share a methodology for drug rehabilitation by using virtual reality technology on European countries and Turkey.

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## USE OF VIRTUAL REALITY TECHNOLOGY FOR REHABILITATION OF DRUG ADDICTION

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**Objective:** This review aims to investigate applications of virtual reality technology on substance/drug addiction rehabilitation and to evaluate its results concerning methodological best practices.

**Method:** A comprehensive literature review was conducted at the Science of Direct, Pubmed and Google Scholar. The search criteria were “virtual reality” “exposure therapy” “substance use” “drug” “addiction” as keywords. Studies that were not written in English were not included in the review.

**Discussion:** Seven studies were reached. Publications which have been researched for this review covered the studies conducted between 2001-2010. The substances included in the studies were cannabis, heroin, cocaine, and methamphetamine.

**Conclusion:** Although the use of virtual reality in treatment and rehabilitation of substance use disorders is an open area susceptible to improvement, there is a need for studies on drug addiction rehabilitation by using virtual reality technology.

**Keywords:** addiction, drug, cue exposure therapy, substance use, virtual reality

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## 1. INTRODUCTION

Virtual reality (VR) is a method of transporting a person to a parallel reality that they feel and know that is not physically real, though feeling as if it was (Rebelo et al., 2012). Virtual reality allows practitioners to design environments and conditions for a study that will be difficult to practice in the real-world (Tal & Wansink, 2011). It is a new exposure tool that uses three-dimensional computer-graphic-based technologies to mislead one's senses and make them feel as they were literally in a virtual environment (Ticknor & Tillinghest, 2011). In virtual reality's applications, a head-mounted display, head monitoring devices, sound, vibrotactile and odour stimulators can be used (Bordnick et al., 2009).

To the best of our knowledge, the idea to use VR technology emerged at first to combat psychological disorders in November 1992 at Clark Atlanta University (North et al., 1997). Also, VR has been applied successfully in behavioural science research and treatment since 1995 (Bordnick et al., 2011).

VR technology is used in the treatment of many disorders in psychiatry. For instance, it is used as an exposure technique in the treatment of anxiety disorder. Usage of VR has proven to be effective in the treatment of body dysmorphic disorder, panic disorder, agoraphobia, acrophobia, flying phobia, spider phobia and binge eating disorder (Riva, 2003). It is also used in the treatment of post-traumatic stress disorder and sexual disorders (Botella et al., 2004).

There are studies on the use of VR in the treatment of substance abuse disorders, smoking and alcohol dependence. Hence, related to smoking addiction; VR cue exposure reveals more craving indication compared to conventional devices (Lee et al., 2004; Traylor et al., 2009), VR leads to a reduction in nicotine dependence (Girard et al., 2009) and provides strong evidence that could be used as a useful tool for social workers and clinicians (Bordnick et al., 2013). Regarding alcohol addiction; it has been found that increases validity of Cue Exposure Treatment (CET) and leads to a reduction in craving (Lee et al., 2007), VR is a useful method in addition to treatment of alcohol dependence (Lee et al. 2009), and an effective approach to educating young people about dangers of alcoholic driving (Montgomery et al., 2006).

### 1.1. Use of Virtual Reality in Substance Addiction Rehabilitation

Drug addiction is a public health problem of increasing importance worldwide. The number of people diagnosed with substance abuse disorder exceeds 15 million worldwide (World Health Organization, 2014). Technology-based treatment is reported to be an effective and low-cost intervention in the treatment of addictive disorders such as alcohol, smoking, and drug (Newman

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et al., 2011). Addictive behaviour emerged scenario is repeated by using the VR while the counselor has the opportunity to observe those behaviours and reactions in their patients. The observations of the counsellor help in preparing the appropriate treatment plan for the client (Srivastava et al., 2014). VR experiment related to substance addiction disorders has the potential to contribute to the development of exposure-based behavioural therapies (Saladin et al., 2006). VR has led to changes in cognitive-behavioural intervention and cue exposure (Bordnick et al., 2011).

Cue exposure is a potentially effective tool in the treatment of addictive behaviours (Conklin&Tiffany 2002). In general, cue exposure therapy involves repeated exposure of an addictive person to stimuli previously associated with drug use to eliminate conditional responses to such cues (Conklin&Tiffany 2002). As stated aforementioned, the use of VR allows the creation of realistic and high-risk situations to reduce craving (Ticknor&Tillinghast, 2011).

Craving is accepted as an important diagnostic criterion and predictable relapse factor in substance use disorders. Individuals diagnosed with substance use disorder are vulnerable to social and environmental cues related to substance abuse, especially during recovery. In particular, substance-related environments and social relationships can trigger a craving. Existing behavioural therapies for substance use disorders apply a cue exposure approach to reduce the effectiveness of social and environmental conditions that may trigger a craving. However, in real social and environmental conditions, craving outweighs behaviour training. Here comes the importance of using virtual reality (Hone-Blanchet et al., 2014).

Previous studies have shown that the use of VR is more effective or equal than cue exposure paradigms that reveal craving in adults. VR has become increasingly used as a cue exposure paradigm for substance users (Hersh, 2014). Furthermore, VR stands out in the acquisition of new skills in treatment (Hone-Blanchet et al., 2014).

Repeated exposure to drug cues during withdrawal has been proposed to reduce drug-related cue reactivity and thus reduce drug-seeking behaviour in treatment modality using VR technology (Martin et al., 2010).

## 1.2. Use of Virtual Reality in Special Populations

Therapies using virtual reality are successfully implemented in the treatment of specific diseases such as anxiety, post-traumatic stress disorder, and substance use. Substance use is a serious problem in offenders under the control of the criminal justice system and beyond the offenders under probation supervision, where substance use is much higher than in the normal population. The use of virtual reality therapy, which works together with psychotherapeutic approaches, has been reported to be effective in the treatment of most of the offender-related diseases. The use of VR allows offenders to acquire skills and to practice in a safe environment without having to be in high-risk environments. Offenders could be given therapeutic techniques such as aversion, exposure and cognitive behavioural therapy (Ticknor & Tillinghast, 2011).

The aim of this review is to investigate the applications of VR technology in the treatment and rehabilitation of substance abuse.

First of all and to explain how the study was conducted, we need to look to the study method and how the published studies were selected, in addition to the criteria for which they were included. The results of the studies included in the review were later evaluated. And finally, with the suggestions to be made for future studies, the study was finalized.

## 2. METHOD

After searching Pubmed, Science Direct, Proquest and EBSCOhost and Google Scholar databases, the searches were limited to the gap between 2001-2010 and to human studies published in English. Studies that were not written in English were not included in the review. Between 2001 and 2010, only 7 studies which include VR technology in drug addiction treatment were reached. During the research on databases; “exposure therapy”, “virtual reality”, “substance abuse”, “drug” and “addiction” keywords were used.

## 3. DISCUSSION

The aim of this study is to review published studies, to analyze applications which include the usage of VR technology in the treatment of drug addiction and to make recommendations for future studies.

In the present study, each research is briefly summarised on Table 1, and it represents studies that were using VR treatment and rehabilitation for people who were using cannabis, alcohol,

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nicotine, heroin, cocaine and methamphetamine. Information about which substance was studied, treatment conditions and the number of sessions, main findings, and limitations of the studies were given in Table 1. The main purpose of this review is to focus on studies about VR technology for treatment and rehabilitation of substance/drug users such as cannabis, heroin, cocaine, methamphetamine, alcohol and/or cigarettes etc..

When the results were examined it was observed that cannabis, alcohol, nicotine, heroin, cocaine and methamphetamine were studied with virtual reality therapy and 7 studies were conducted with small or very small sample sizes moreover, there were no studies with more than 22 participants, sessions were 1-time or 1-day treatment and Nicotine Cue Reactivity Assessment System (NCRAS) and Cue Exposure Treatment (CET) methodologies were used in addition to virtual reality in one of the studies.

Results of a study made the suggestion that a standardized and rich virtual reality environment significantly increases craving and physiological reactivity (Saladin et al., 2006). Virtual reality can have some ethical concerns such as the tendency of cue exposure to increase craving as if it were a television commercial for drug use and the tendency to minimize these risks by using cognitive therapy and progressive muscle relaxation techniques (Kuntze et al., 2001). According to the study of Culbertson et al., (2010), during VR therapy, low craving participants exhibited lower cardiovascular activity while higher heart rate was measured on high craving participants. Physiological differences between the two groups of participants show that online virtual reality cue models provide a new method that can increase craving in a laboratory (Culbertson et al., 2010). In the last study, it was stated that VR cannabis cue reactivity may be a new technology- based method in the development of addiction research and treatment (Bordnick et al., 2009).

Virtual reality therapy is a valuable tool for substance use disorders. On the other hand; the most important point that deserves our attention during the literature review is that there are very few studies on substance addiction treatment and rehabilitation by using virtual reality. 7 studies have been reached on the treatment and rehabilitation of substance abuse but most of the studies in the field of addiction are directed towards VR applications used in the treatment and rehabilitation of cigarette and alcohol addiction. The small number of studies reveals need for research in this field. In general, the limited number of samples is one of the most important limitations of the studies. Conducting researches to study larger sample groups in the future will provide statistically more significant results in field of virtual reality for substance use disorder and treatment/rehabilitation models by using virtual reality. The number of treatment/rehabilitation sessions may be considered as insufficient and that could be another important issue as a



limitation. In order to be able to refer more accurate data about the effectiveness of VR use, the number of sessions can be increased and it is also very important to conduct follow-up studies to measure long-term effectiveness and observing patients' basic skills, social adaptation etc.

#### **4. CONCLUSION**

Treatment and rehabilitation models which include virtual reality technology should be studied more with an interdisciplinary approach in different fields such as medical treatment, psychology, psychiatry, neurophysiology, toxicology and social work in the future. Therefore the effectiveness of virtual reality on rehabilitating people who have substance abuse disorder can be understandable and foreseen in long terms by following- up study models. Although there is evidence that the use of virtual reality is valuable in the treatment and rehabilitation of substance abuse disorders, is still an open area for improvement. There is a need to focus more and more on substance addiction by using virtual reality technology.

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#### **ABBREVIATIONS**

CET: Cue Exposure Treatment

IVR: Immersive Virtual Reality

NCRAS: Nicotine Cue Reactivity Assessment System

VR: Virtual Reality

VRT: Virtual Reality Technology

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**Table-1:** Search Results of Virtual Reality Methodology for Substance Use Disorder

Authors	Substance/ Drug	Number of Session s	Number of Participants (N)	Treatment Condition s	Main Findings	Limitations
Kuntze et al. (2001)	Heroin	1 – time	15	CET/IVR	Immersive Virtual Reality (IVR) is as good or even better in eliciting subjective and physiologi cal classical devices	Small sample size  No follow up
Saladin et al. (2006)	Cocaine	1- day session	12	VR	Virtual Reality Therapy has potential utility in exposure – based behavioral and pharmaco logical interventio ns	Small sample size

Authors	Substance/ Drug	Number of Session s	Number of Participants  (N)	Treatment  Condition s	Main Findings	Limitations
Bordnick et al. (2006)	Cannabis	1 session	20	VR	Offers a new technolog y – based method to advance addiction research and treatment	Small sample size
Bordnick et al. (2008)	Alcohol	1- day session	40	VR	“VR- ACRAS(Vir tual Reality- Alcohol Cue Reactivity Assessme nt System)  system increases in subjective alcohol craving when drinkers are exposed to VR alcohol	The potential cost to set up and operate a system

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Authors	Substance/ Drug	Number of Session s	Number of Participants (N)	Treatment Condition s	Main Findings	Limitations
					cues compared to neutral VR cues”	
Carter et al. (2008)	Nicotine	1 - day session	22	VR	“Multidimensional scaling models shows that smokers’ experience of craving is qualitatively, structurally different under VR smoking cue conditions versus neutral conditions.”	Small sample size  The sample consists of only adult smokers

Authors	Substance/ Drug	Number of Session s	Number of Participants  (N)	Treatment Condition s	Main Findings	Limitations
Traylor et al. (2008)	Nicotine	1- day Session	20	VR- NCRAS	“This study shows that young adults who smoke respond to increased	Small sample size
Culbertson et al. (2010)	Methamphetamine	1- day session	17	VR	Effective of a novel VR drug cue model created within an online virtual world	Small sample size  No follow up

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