

# **Can virtual reality be useful to assess subjects with alcohol dependency? Development of a new assessment protocol for patients with alcoholism**

**Giulia Spagnoli, Elena Gatti, Rosanna Massari, Cinzia Sacchelli, Giuseppe Riva**

Giulia Spagnoli, Dr (corresponding author)

Department of Psychology

Catholic University

L.go Gemelli, 1

20123 – Milan, ITALY

Email: [giulia.spa@hotmail.it](mailto:giulia.spa@hotmail.it)

Elena Gatti, PhD

Department of Psychology

Catholic University

L.go Gemelli, 1

20123 – Milan, ITALY

Email: [elena.gatti@unicatt.it](mailto:elena.gatti@unicatt.it)

Rosanna Massari, MD

ASL National Health Service

Via Settembrini, 20

20123 – Milan, ITALY

Cinzia Sacchelli, MD

ASL National Health Service

Via Settembrini, 20

20123 – Milan, ITALY

Giuseppe Riva, Associate Professor

Department of Psychology

Catholic University

L.go Gemelli, 1

20123 – Milan, ITALY

Email: [giuseppe.riva@unicatt.it](mailto:giuseppe.riva@unicatt.it)

**Abstract**

*Virtual reality (VR) has been used in previous studies on alcohol addiction as a tool to assess cue reactivity and a tool for cue exposure therapy. Indeed the assessment is a crucial stage for patients with alcoholism. This study explores the VR use to evaluate the subject during the assessment comparing two groups of alcohol dependent diagnosed individuals entering a non-pharmacological outpatient treatment. The first group (25 patients - 10 females, 15 males) followed a traditional assessment (SCID- Structured Clinical Interview for DSM-IV Axis I Disorders), to), the second group (25 patients- 10 females, 15 males) were administered the SCID interview and the VR protocol to assess drinking behavior, interpersonal factors and intrapersonal factors. Analyses show the efficacy of VR assessment protocol: the experimental group shows a significant improvement in self- efficacy and motivation for change after the assessment. Implications of this study and suggestions for future researchers are discussed.*

**Keywords:** alcoholism, assessment, virtual reality, motivation to change, self- efficacy

**1. Introduction**

The Alcohol Dependence Syndrome presents itself as a complex and debilitating disease, characterized by “a mental and usually also physical state resulting from alcohol consumption, behavioral or other alterations which always include a compulsion to consume alcohol in a continuous or periodic way. The development of tolerance may be more or less serious” (Edwards, Gross, Keller, Moser and Room, 1977). This disease has major implications at physical, mental, and social levels and tends to encompass the entire life style of the subject (Allamani, Orlandini, Bardazzi, Quartini and Moret, 2000).

In Italy, it is estimated that 4.4% of deaths in males and 2.5% in females, particularly among young population, is linked to the consumption of alcohol, for a total of more than 20,000 annual deaths attributable partially or wholly to this substance (Istituto Superiore di Sanità [ISS] & WHO, 2011).

Within this framework, early diagnosis and deep assessment are extremely useful, in order to avoid a more severe clinical course, and also a treatment that, depending on the individual case, takes all the aspects involved that emerge from the initial assessment interview into consideration.

Therefore, the assessment is a crucial stage: it often influences the subsequent attitude of the alcohol-dependent subject regarding the drinking behavior and the commitment to the problem (Thom, Brown, Drummond, Edwards, Mullan and Taylor, 1992).

Within the initial screening patient’s motivation plays a critical role towards the process that a person goes through when making a behavioral change (Prochaska, Di Clemente and Norcross, 1992; Edwards, Marshall and Cook, 2006): it influences the patient’s progression through the stage of change- from considering change, to making the decision to change, to following the planned action into sustained recovery.

Some findings suggest that motivation influences the type of therapy selected, the compliance and, to some extent, the outcome of treatment (Connors, Donovan and Di Clemente, 2001; Demmel, Beck and Richter, 2004).

Alcohol- dependent subjects tend to deny the disease, feeling ashamed, judged or stigmatized and often show ambivalent feelings about their real motivation to change. So, during the assessment session, patients should be helped to open a “window of opportunity” so that they can actively make an effort to change and commit to concrete actions aimed at reaching the goals (Di Clemente and Bellini, 1999).

Currently, the most common instrument used to assess alcohol patients is the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID) (First, Spitzer, Robert, Gibbon, Williams and Janet, 1996). It explores

the circumstances that led to the first appointment being made and investigates the subject's symptoms' history.

This procedure is useful to collect a large number of information usually in one or two sessions, but at the same time it can be threatening to the patients who may be afraid of being demeaned by stranger (Edwards, Marshall and Cook, 2006).

Patients may therefore adopt defensive measures to minimize or deny their disease and the information obtained will be wrong and unsatisfactory. This process could damage the initial assessment phase and subsequently the engagement and commitment to the treatment (Thom et al., 1992; Edwards et al., 2006).

Nowadays, there are not tools trying to overcome these risks during the initial assessment phase and to facilitate the taking on of patient in therapy.

Conversely, interventions and programs to enhance patients' motivation within the treatment process have been designed and used by clinicians and include a wide range of approaches such as brief motivation intervention, motivational interviewing, motivational enhancement therapy (Miller and Rollnick, 1991; Bien, Miller and Tonigan, 1993; Miller, 2000).

In the present study we want to explore the possibility to use virtual reality (VR) as an instrument to improve the standard assessment process with alcohol dependent patients.

VR technology is being recognized as a useful tool for assessment and treatment of different psychological diseases (North, North and Coble, 1997; Moline, 1997). It creates dynamic, immersive, enriched environments where behavior can be recorded and offers assessment and treatment options that are not available using traditional face to face methods (Riva and Gaggioli, 2009; Riva, 2005; Vincelli, Molinari and Riva, 2001). VR makes the patients "emotionally present" inside virtual environments (VEs): they have "the sense of being there" and act as they were in the real world (Hoffman, Richards, Coda, Richards and Sharar 2003; Riva, Mantovani and Capideville, 2007).

Furthermore, in addictions, VR can provide a realistic environment to study complex naturalistic behaviors in addicted subjects (Riva, Botella, Légeron and Optale, 2004).

In previous studies, VR has been used to assess cue reactivity in controlled simulated tasks with nicotine-dependent patients or in drug dependent patients (Kuntze, Stoermer, Mager, Roessler, Mueller and Bullinger, 2001; Saladin, Brady, Graap and Rothbaum, 2006; Lee, Ku and Kim, 2003; Bordnick, Graap, Coop, Brooks, Ferrer and Logue, 2004; Bordnick, Traylor, Graap, Coop and Brooks, 2005; Bordnick, Graap, Copp, Brooks and Ferrer, 2005). These researches have shown that VR is able to induce greater craving compared to traditional methods, providing complex and multisensory stimuli, and allows a valid method to test the subjects' responses and to clearly identify the stimuli triggered.

Only a few studies (Bordnick, Traylor, Copp, Graap, Carter, Ferrer and Walton, 2008; Cho, Ku and Park, 2008; Lee, Kwon, Choi and Yang, 2007) have been carried out on VR use in alcohol dependence subjects focusing on cue reactivity assessment and cues exposure therapy. The results have shown that is possible to model social pressure situations using VEs with avatars (Cho et al., 2008) and have demonstrated the effectiveness of VR exposure therapy (Lee, Kwon, Choi and Yang, 2007).

However, these studies focused on therapy processes and not on the assessment phase; furthermore, they did not take advantage of VR's other striking features that may be useful to enhance the assessment process and related motivation to change aspects.

VR can produce a perception of self- efficacy and expertise since the patients are able to control events that occur during the interaction experience through their actions, receiving multisensory feedback in real time and they are able to observe and immediately assess the effects that their actions produce (Riva et al., 2009; Riva, 2005; Bandura, 2001; Riva, Castelnuovo and Mantovani, 2006). In fact, patients can monitor their behavior and emotions, learning new ways to behave and new forms of emotional control (Vincelli et al.,

2001). The capacity to control emotions and actions is the first step towards improving the sense of self-efficacy preceding change (Bandura, 2001). Therefore, VR could be used for triggering a broad empowerment process within an experience characterized by a high sense of presence (Riva and Gaggioli, 2009).

A preliminary and explorative study based on the creation of a VR protocol aimed to assess the alcohol dependent patients' behaviors has given good results (Gatti E., Massari, Sacchelli, Lops, Gatti R. and Riva, 2008). VR seems to be an accurate and exhaustive tool to complete the traditional assessment and to overcome the potential issues encountered in alcohol-dependent patients in this crucial phase; furthermore, a significant improvement of motivation for change was found in VR group.

In this study we want to broaden the previous research with a revised VR protocol (experimental group: SCID + VR) in a wider sample, in order to determine whether there is a change in self-efficacy and motivation improvement before and after the protocol session, compared with the standard assessment process (control group: SCID) without VR's use.

According to the preliminary study (Gatti et al., 2008), the VR protocol investigates case history and symptoms, intrapersonal factors and interpersonal factors in order to obtain a complete patient's assessment. As seen previously, alcohol-dependent subjects' real motivations for entering a treatment are often confused; they may not be ready to change their drinking behavior and may not actively participate in the assessment and in the treatment.

The motivation process is influenced by the awareness of the need/desire to change, expectations and the level of self-efficacy perceived by the patient. The latter is considered a very important predictive factor in substance related problems (Prochaska and Di Clemente, 1984; Prochaska et al., 1992; Bandura, 1997).

In psychological literature (Menon, 1999), empowerment is considered a multi-faceted construct, conceived of as a positive additive function in three dimensions: perceived control, perceived competence and goal internalization. All these aspects can be fostered by VR technology (North et al., 1997; Riva et al., 2009).

This leads to our research question:

RQ: Could the new VR protocol be considered an "empowering environment" for alcohol dependent subjects and enhance the entire process?

We proposed the following hypotheses:

H1: Patients who experienced the new VR protocol will report a greater level of self-efficacy than those non experienced the VR session.

H2: Patients who experienced the new VR protocol will report a greater motivation for change than those non experienced the VR session.

## 2. Method

### 2.1 Participants

The sample was composed of 50 patients (30 male, 20 female,  $M_{age} = 43.48$ ,  $SD = 10.88$ , range = 24- 65) who requested treatment from the Italian National Health Care Authority. They signed informed consent statements and were assigned randomly to the two assessment protocols (25 experimental group; 25 control group). The two groups were balanced by gender and did not show any personality disorder, measured through the Italian version of the Eysenck Personality Inventory (Eysenck H. and Heysenck S., 1976; Dazzi, Pietrabissi and Santinello, 2004). It measured three personality dimensions with 69 dichotomized items: Neuroticism, Extroversion, Psychoticism. It showed a good internal consistency ( $\alpha = 0.78$ ).

Participants met the following inclusion criteria: (a) subjects aged 18 to 65 years; (b) no other concurrent severe psychiatric disturbances (psychosis, depression with suicidal risk, or drug abuse); (c) no concurrent unrelated medical condition.

Conformity to the Italian ethical standards for research was granted by the ethical board of the university.

## 2.2 Assessment tool

### 2.2.1 SCID- Structured Clinical Interview for DSM-IV Axis I Disorders (First et al., 1996)

SCID is used for making DSM-IV Axis I diagnoses. It is administered in a single face to face setting and it takes usually 45- 90 minutes. It is divided into six self contained modules administered in a sequence: mood episodes (A module); psychotic symptoms (B module); psychotic disorders (C module); mood disorders (D module); substance use disorders (E module); and anxiety and other disorders (F module). It is possible to customize the sequence according to the patient's specific disorder.

In our study, at the beginning the researcher obtained a brief description of the patient's disease and previous psychopathology, before moving on to questions about specific symptoms and diagnostic criteria for each disorder.

Since the sample did not present concurrent severe psychiatric disorders, just E, A and F modules were administered; responses were reported on the protocol of data collection.

### 2.2.2 VR protocol

VR protocol is based on four different VEs presented in chronological order- the pool (Fig.1), the apartment (Fig.2), the office (Fig.3), restaurant (Fig.4) - developed using NeuroVR software (<http://www.neurovr.org>), a cost-free virtual reality platform based on open-source software. It allows non expert to easily modify VEs, best suiting the clinical setting's needs. For the hardware requirements see Table 1.

The main goal of the protocol was to investigate patient's drinking behavior, intrapersonal factors (management of emotions and self esteem) and interpersonal factors (relational competence and social pressure on drinking behavior) in different daily life contexts in order to obtain a deep assessment of a pervasive disease such as alcoholism.

The scenarios were presented through a head mounted display while the researcher could see it through the pc monitor. Patient's answers and any problems with the devices (head mounted display, gamepad) were reported into the protocol.

The first scene, the pool, showed a lawn, lawn chairs, a gazebo around the pool and a staircase leading to a beach. The whole environment was contained within a designated area between the pool on one side and the sea on the other, with mountains that the patient can not see beyond.

The patient was asked to explore freely the scene and to look for a place to relax.

The main interaction goals in the first scenario were: teaching the user how to move in the virtual environment; relaxing in order to make a preliminary evaluation of both emotional and relational dimensions without a direct link to the use of alcohol. It provided a neutral, emotionally non-significant environment for use as baseline. Examples of questions were "How do you feel in this place?"; "Is there anyone that you would like with you at this moment? Who?"

After the pool session, the researcher presented to the patient the alcoholic apartment scenario with alcohol-related stimuli such as wine bottles, beers and spirits. It included a flat with bedroom, corridor, bathroom, dining room and kitchen.

The main goal of these environments was to explore patient's habits and living conditions focusing on the nature and strength of the family and social links, the drinking history and the emotional arousal when subject interacted with significant others (such as partner) or objects (such as wine bottles and drinks).

The subject could move freely within the environment and then was asked to remain in the living room and kitchen, where there were possibly trigger stimuli. The researcher focused the patient's attention on drink bottles and asked questions such as "What emotions do you feel when you see these bottles?"; "Would you like to take one of these?" If the patient usually drinks at home, the researcher investigated the emotional management proposing a bad situation and a pleasant situation: "Imagine you have just drunk a glass of wine, how do you feel? Would you call anyone from your family?"; "How long have you been drinking for?"

Afterwards the researcher proposed a job interview scenario. The scenario consisted of an office where the patient would sustain a job interview and a waiting room where there were other people, her future colleagues.

The sense of self- efficacy, coping skills, locus of control and decision-making of patient were explored with questions such as "How do you feel before the interview?"; "Do you think you will be calm during the interview?", "Would drinking help you now?"

The main goals were to investigate emotional management in a performance task and to understand if alcohol played a role for the subject in performance situations.

If the patient was a student, the protocol provided a student version in which the subject had to take an exam at the university.

The last environment was the restaurant where there were two rooms: a bar and a dining room.

The patient was asked to imagine being invited to dinner with some colleagues.

Before dinner, the patient was invited to wait in the bar area, where there was a counter behind which bottles of alcoholic drinks (spirits, beers, cocktails, liqueurs) usually used as aperitifs were visible. However, the dining room consisted of a buffet with food and alcoholic drinks, a few tables occupied by customers who were having dinner and a waitress and the chef passing among the tables.

The behaviors of patient in a social context were observed and the researcher asked questions such as "What do you like to drink if your friend suggest you to order an alcoholic drink?"; "How you do feel after drinking?"

The main goal was to explore the influence of social pressure on patient's drinking behavior and to evaluate emotional arousal when the subject interacted with significant others, not related to the family.

At the end of the session, the patient could take off the head mounted display and the researcher proposed a debriefing to comment on the experience. In particular, the focus was on emotional management, level of arousal when patient sees trigger stimuli, family links and management of drinking behavior.

### *2.3 Procedure*

Patients' medical history and clinical record were first collected by the researcher and patients were given two questionnaires to assess initial motivation for change and sense of self- efficacy.

After one week the SCID (2.2.1) and the new VR assessment protocol (2.2.2) were applied to experimental group by a psychologist. The VEs were presented individually and patients visited all the scenarios in a single session.

The procedure was single blind that is the subjects did not know their score or the aim of the research. Before starting the session, patients were told they would be shown a series of VEs simulating four different contexts of daily life.

The control group's patients were submitted only to the SCID.

Approximately one week after the assessment session, all patients were given a briefing of the assessment procedure and treatment options. Motivation to change and self- efficacy level were assessed again.

## 2.4 Measures

### 2.4.1 Perceived self- efficacy

Patients' level self- efficacy was measure using the Italian version of the Generalized Self- Efficacy Questionnaire (GSE) (Schwarzer and Jerusalem, 1996), a self report measure with a 10 4- point Likert Scale items ranging from 0 (not true) to 4 (really true). Each item (e.g. "I can solve most problems if I invest the necessary effort", "It is easy for me to stick to my aims and accomplish my goals") refers to successful coping and implies an internal-stable attribution of success. The construct of perceived self- efficacy reflects an optimistic self-belief and facilitates goal-setting, effort investment and recovery from setbacks. The final score with a range from 10 to 40 is obtained. Internal consistency is good ( $\alpha=0.86$ ).

### 2.4.2 Motivation for change

Patients' motivation for change was measured using the Italian version of the Motivation assessment of change Questionnaire- Alcoholism version (MAC2-A) (Spiller, Zavan and Guelfi, 2006), based on Transtheoretical Model (Prochaska et al., 1984; Prochaska et al., 1992).

It measures the six stages of change (18 items), "discrepancy", the painful perception on the contradiction between what one is and what one would like to be (12 items), "self- efficacy" (12 items) and "help seeking" (6 items). Each item is rated on a 0- to 6- point Likert scale (from false to true). At the end six final statements used to validate the key concept measured use a 100- point visual analogue scale (VAS) response format and each item is assessed on a 0-100 scale from "not at all" to "extremely". The six change phases are: Precontemplation (not yet considering change), Contemplation (considering change but not taking action), Determination (planning to change), Action (making changes in one's behavior), Maintenance (consolidating gains attained during action), Termination (changing one's lifestyle to maintain new behavior).

Discrepancy and self- efficacy are important factors affecting the movement through the six phases.

The test provides a profile of readiness to change (RTC) that includes the score of the six scales and in which it is possible to identify the prevalent stage. Internal consistency of the scales is good for all scales.

## 2.5 Data analysis

Descriptive statistics were conducted on the variables of interest in the study. The standard scoring was used for GSE and MAC2-A.

A repeated-measure ANOVA (pre-post test conditions  $\times$  2 groups) was performed to investigate the differences in the GSE total score and the MAC2-A total score and subscales between the two groups of subjects before and after the assessment session.

SPSS 19 was used for the data analyses. A P value of .05 was used as a test significance.

To assess a first level of interaction with the technology, the frequency of any problems of VR group's patients with the devices (i.e., the patient is unable to move using the gamepad and asks for help to the researcher more than twice during the session; the patient takes off the head mounted display) was counted.

## 3. Results

Three patients needed the researcher's intervention to move within the first two scenarios more than twice (e.g., "I cannot go on within the VEs") and no one asked to take off the head mounted display. Patients learn how to move with the gamepad within the VEs after a few time, as found in Gatti et al. (2008).

The research question asked whether self- efficacy and motivation for change differ as a result of the use of VEs in the assessment phase. Hypothesis 1 predicted that levels of self- efficacy would be greater for those who were submitted to SCID and to VR than for those who were submitted only to SCID.

The analysis revealed no significant difference between the two groups at pre test for self- efficacy and motivation for change. Before the assessment session, patients assigned to the two assessment conditions did not present any significant difference on both measures.

As expected, a main effect was found at the post test ( $F_{(1,49)} = 11.120$ ;  $p = .002$ ), indicating that the levels of self- efficacy was higher in the experimental group ( $M = 31.32$ ;  $S.D. = 4.741$ ) than in the control group ( $M = 27.04$ ;  $S.D. = 4.325$ ).

Hypothesis 2 predicted that the motivation for change would be greater for those who were submitted to SCID and to VR than for those who were submitted only to SCID.

Regarding the six stage of change, a main effect was found for the Termination phase scale ( $F_{(1,47)} = 7.367$ ;  $p = .009$ ), with the experimental group reporting a higher score ( $M = 8.32$ ;  $S.D. = 5.786$ ) than the control group ( $M = 4.43$ ;  $S.D. = 3.847$ ).

A main effect was found also in the Contemplation phase scale ( $F_{(1, 49)} = 3.984$ ;  $p = .052$ ), with the control group reporting a higher score ( $M = 14.20$ ;  $S.D. = 3.452$ ) than the experimental group ( $M = 12.40$ ;  $S.D. = 2.901$ ).

These results suggest that patients submitted only to SCID increase contemplation related aspects: they may feel more ambivalent and uncertain about a possible change after the assessment session.

On the contrary, patients submitted both to SCID and RV feel more confident about their coping abilities and resources and show a strong commitment to resolve their drinking behavior problems.

Regarding the RTC profile, the Determination phase is the prevalent stage in both groups before and after the assessment; this finding is consistent with the fact that patient are in the initial phase where they increase their commitment to change and plan to take action, requesting a treatment from the Italian National Health Care Authority.

The readiness to change profiles of the two groups can be found in Fig. 5 (before the assessment) and in Fig.6 (after the assessment).

No one effect on discrepancy was found. This aspect suggest that RV do not affect the concerns and dissatisfactions for the current situation as well as the importance of change related to expectations but it only affect the self- efficacy factor.

These results suggest that patients submitted both to SCID and RV assessment increase partially motivation for change as an effect of the improvement of only self- efficacy.

#### 4. Discussion

Addictions are among the most frustrating forms of psychopathology because they involve the whole person and all aspects of his/her life, affections, relationship and work (Allamani et al., 2000). Traditional instruments for evaluating this disease are well known and used in every National Health Care Service, but alcohol- dependent subjects are difficult to engage in treatment and create an internal motivation to change (Thom et al., 1992; Edwards et al., 2006). The assessment phase is thus a crucial factor in influencing the subject's attitude towards drinking and commitment to the problem (Miller et al., 1991).

The current investigation suggests that VEs in addition to traditional tool may improve the assessment process with alcohol- dependent subjects.

In accordance with the preliminary study (Gatti et al., 2008), patients are collocated in an immersive environment where their behavior can be easily observed. The protocol allows the collection of both intra personal factors such as management of emotions, self esteem and causal attributions (especially in the apartment and in the office scenarios), and inter personal factors such as relationship skills and the effect of

pressure on drinking behavior (especially in the office and in the restaurant scenarios). Moreover the technology is easy to use and no one had big problems during the session.

Based on the literature (Vincelli et al., 2001; Riva et al., 2009), we hypothesized that VEs would increase self- efficacy and consequent motivation to change in patients requesting a treatment.

According with the results of the analyses, the VR protocol leads to a significant improvement in patients' self- efficacy. Patients express greater confidence in their capacities and the possibility to cope effectively, relying on their resources, in problematic situations that arise in daily life. The increase of self- efficacy in alcohol dependent patients facilitates the determination to face the obstacles and recovery after relapse (Prochaska et al., 1992; Miller et al., 1991).

Moreover, the use of VR seems to have a greater impact on aspects related to advanced stages of change, especially Termination stage, where the subjects are considered actively engaged and believe they have the necessary skills to undertake, carry out and maintain the process of change. Patients seem to show greater acquired and stabilized readiness and motivation in engaging actively regarding the issue also in a future stage. The data are in line with the improvement in the Stability scale found by Gatti et al. (2008) in the experimental group.

These results corroborated the findings of Bandura (1997) who found a positive relationship between the motivation to change and the opportunity given by the subject to achieve the goal: the greater the conviction to achieve the goal, relying on the resources available, the greater the intrinsic motivation to change.

VEs based assessment increases patients' ability to control their emotions and actions and makes subjects feel like an active protagonist in what they are experiencing, thus contributing to increase the sense of self- efficacy and, partially, the readiness to change.

The principal study limitations are the lack of multi-sensory stimulation and the small sample size.

First of all, haptic output was not used nor was there olfactory system simulation. Furthermore, within VEs, interaction with the avatars was not expected. It would be useful to develop this aspect in future research to investigate alcohol-dependent patients' relational skills in real- time more in depth.

Secondly, there would be useful to widen the sample, then distinguishing patients who have already attended previous treatments from patients who are at their first treatment request. Motivation aspects and commitment may be different.

Even if it is beyond the scope of this study, an analysis of qualitative data would be useful to detect other possible motivation sources (external and internal) during the VR assessment session.

Further research may improve this study by testing the initial results in the medium- long term verifying the effective usefulness of the new protocol in patients also undergoing treatment or follow-up and by including social interaction within VEs.

In spite of the limitations, this study suggests the possibility of using VR protocol for the assessment of alcohol-dependent subjects. The VR experience leads to a significant improvement in self- efficacy and partially in the motivation for change and makes the patient more active and involved in the processes of introspection and change.

This finding suggests that the combined use of VR and SCID in clinical practice may improve patients' confidence in their capabilities and their coping skills to drinking related problems.

The required instruments are low cost and easy to use even in the absence of specific skills, so it is possible to customize the environment according to individual case requirements.

It also may have a beneficial impact on the costs of the patient within the national Health Care System and may ensure a more positive prognosis for the alcohol- dependent subject.

**Table and Figures**



Fig.1: Pool, a view



Fig.2: Apartment, dining room

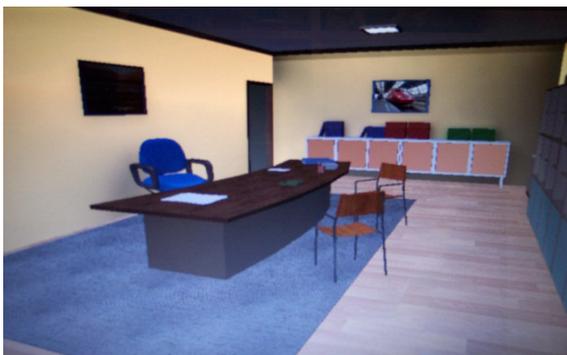


Fig.3: Office, job interview room

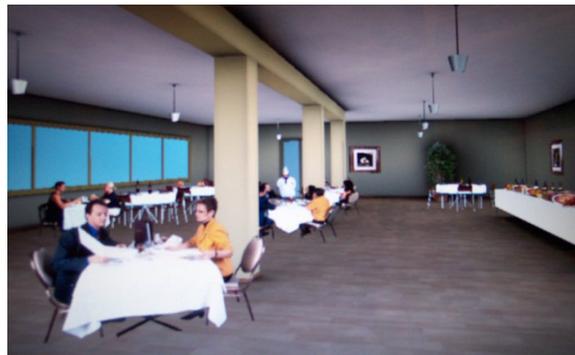


Fig.4: Restaurant, dining room

Personal computer Acer T5450	Intel Core Duo Processor 1.66 Ghz, Ram 2,99 GB, 980 MHz, NVIDIA GeForce graphics card 8600M GT 1 Gb
Vuzix IWear VR920 video eyewear with tracker	Resolution of 920.000 pixels (640H X 480V x 3 colors) and a visual field in diagonal of 32°, connected to a Tracker 3-DOF (degrees of freedom) which measured the position and movement of the head
Gamepad Logitech F510 with two joystick	

Table 1: Hardware requirements

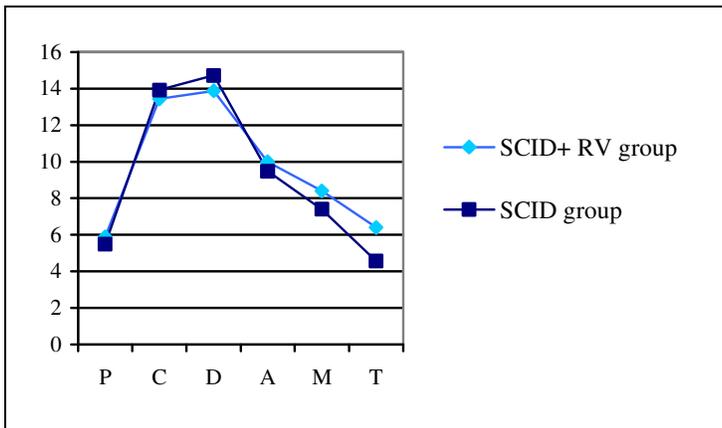


Fig. 5: RTC profiles of the two groups before the assessment phase

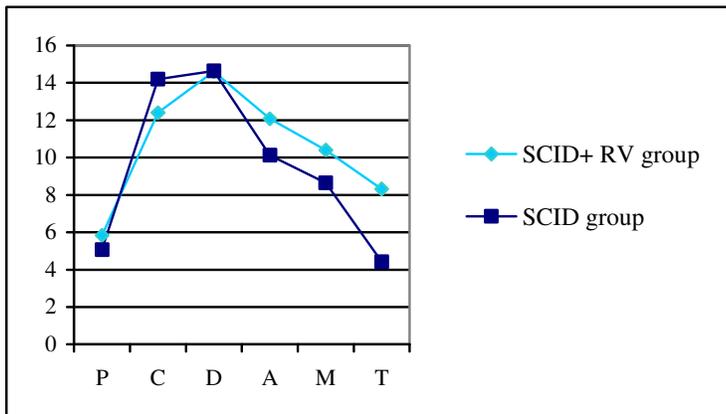


Fig. 6: RTC profiles of the two groups after the assessment phase

## References

- Allamani A., Orlandini D., Bardazzi G., Quartini A., & Moret P. (2000). *Libro italiano di Alcolologia, Vol. 1- Alcool e patologie correlate*. Firenze: SEE.
- Bandura A. (1997). *Self- efficacy: the exercise of control*. New York: W.H. Freeman
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1-26.
- Bien, T.H., Miller, W.R., & Tonigan, J.S. (1993). Brief interventions for alcohol problems: A review. *Addiction*, 88(3), 315- 336.
- Bordnick P., Graap K., Copp H., Brooks J., Ferrer M., & Logue B. (2004). Utilizing virtual reality to standardize nicotine craving research: a pilot study. *Addictive Behavior*, 29, 1889- 94.
- Bordnick P., Graap K., Copp H., Brooks J., & Ferrer M. (2005). Virtual reality cue reactivity assessment in cigarette smokers. *Cyberpsychology and Behaviors*, 8(5), 487- 92.
- Bordnick P., Traylor A., Copp H., Graap K., Carter B., & Ferrer M., Walton A. (2008). Assessing reactivity to virtual reality alcohol based cues. *Addictive Behaviour*, 33(6), 743- 56.
- Bordnick P., Traylor A., Graap K., Copp H., & Brooks J. (2005). Virtual reality cue reactivity assessment: A case study in a teen smoker. *Applied Psychophysiology and Biofeedback*, 30(3), 187- 93.

- Cho S., Ku J., Park J., Han K, Lee H, & Choi YK. (2008). Development and verification of an alcohol craving- induction tool using virtual reality: craving characteristics in social pressure situation. *Cyberpsychology and Behaviour*, 11(3), 302- 09.
- Connors, J.G., Donovan, D.M. & Di Clemente, C.C. (2001). *Substance abuse treatment and the stages of change*. The Guilford Press, NY/London.
- Dazzi, C., Pedrabissi, L., & Santinello, M. (2004). *Scale di Personalità Eysenck per adulti*. Firenze: Organizzazioni Speciali.
- Demmel, R., Beck, B., Richter D, & Reker T. (2004). Readiness to change in a clinical sample of problem drinkers: relation to alcohol use, self efficacy and treatment outcome. *European Addiction Research*, 10, 133- 138.
- Di Clemente C., Bellini L., & Neavins T. (1999). Motivation for change and alcoholism treatment. *Alcohol Research and Health*, 23(2), 86- 92.
- Edwards G., Gross M.M., Keller M., Moser J., & Room R. (1977). Alcohol- related disabilities (WHO Offset Publication. No.32). Geneva. World Health Organization. [Online] Available: [http://whqlibdoc.who.int/offset/WHO\\_OFFSET\\_32\\_\(part1\).pdf](http://whqlibdoc.who.int/offset/WHO_OFFSET_32_(part1).pdf) (accessed December 2013).
- Edwards G., Marshall E.J., & Cook C.C.H. (2006). *The treatment of drinking problems. A guide for helping professions*. (3<sup>rd</sup> ed.). Cambridge University Press.
- Eysenck H., & Eysenck S. (1976). *Eysenck Personality Inventory- EPI*. London: University of London Press.
- First M.B., Spitzer, Robert L, Gibbon Miriam, Williams, & Janet B.W. (1996). *Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV)*. Washington, D.C.: American Psychiatric Press, Inc.
- Gatti E., Massari R., Sacchelli C., Lops T., Gatti R., & Riva G. (2008). Why do you drink? Virtual reality as an experiential medium for the assessment of alcohol dependent individuals. *Studies in Health Technologies and Informatics*, 132, 132- 7.
- Hoffmann HG, Richards T, Coda B, Richards, A. and Sharar, S.R.. (2003). The illusion of presence in immersive virtual reality during an fMRI brain scan. *CyberPsychology and Behavior*, 127- 131.
- Istituto Superiore di Sanità & World Health Organization. (2011). La mortalità alcol- attribuibile: quanto incide il consumo di alcol sulla mortalità italiana? Rome, Italy.[Online] Available: [http://www.epicentro.iss.it/alcol/apd2011/Apd2011\\_factsheetMORTALITA.pdf](http://www.epicentro.iss.it/alcol/apd2011/Apd2011_factsheetMORTALITA.pdf) (last access: December 2013).
- Kuntze M., Stoermer R., Mager R., Roessler A., Mueller Spahn F., & Bullinger A. (2001). Immersive virtual environments in cue exposure. *Cyberpsychology and Behaviour*, 4(4), 497- 501.
- Lee J., Ku J., Kim K., Kim, I., Yang B., Wiederhold B., Wiederhold M., Park D., Lim I., & Kim S. (2003). Experimental application of virtual reality for nicotine craving through cue exposure. *Cyberpsychology and Behaviour*, 6(3), 275- 80.
- Lee J., Kwon H., Choi J., & Yang B. (2007). Cue exposure therapy to decrease alcohol craving virtual environment. *Cyberpsychology and Behaviour*, 10(5), 617- 23.
- Menon S.T. (1999). Psychological empowerment: definition, measurement and validation. *Canadian Journal of Behavioral Science*, 31, 161- 164.
- Miller W.R., & Rollnick S. (1991). *Motivational interviewing: preparing people to change addictive behavior*. New York: Guilford Press.
- Miller, W. R. (2000). Motivational Enhancement Therapy: Description of Counseling Approach. In Boren, J. J. Onken, L. S., & Carroll, K. M. (Eds.), *Approaches to Drug Abuse Counseling*, US Department of Health and Human Services; NIH Publication No. 00-4151.

- Moline J. (1997). Virtual reality for health care: a survey. *Studies in health technologies and informatics*, 44, 3- 14.
- North M. M., North S.M., & Coble J.R. (1997). Virtual reality therapy: an effective treatment for psychological disorders. In: Riva G., ed. *Psycho- neuro- physiological assessment and rehabilitation in virtual environments: cognitive and human factors in advanced human computer interactions*. Amsterdam: IOS Press, pp.59-70.
- Prochaska J., & Di Clemente C. (1984). *The Transtheoretical Approach: Crossing Traditional Boundaries of Therapy*. New York: Daw Jones Ireven.
- Prochaska J., Di Clemente C., & Norcross J. (1992). In search of how people change. *American Psychologist*, 47(9), 1102- 114.
- Riva G. Virtual reality in psychotherapy: review. (2005). *CyberPsychology and Behavior*, 8(3), 220- 240.
- Riva G., Botella C., Légeron P., & Optale G. (2004). *Cybertherapy: internet and virtual reality as assessment and rehabilitation tools for clinical psychology and neuroscience*. Amsterdam: IOS Press.
- Riva G., Castelnuovo G., Mantovani F. (2006). Transformation of flow in rehabilitation: the role of advanced communication technologies. *Behavior Research Methods*, 38(2), 3- 16.
- Riva G., & Gaggioli A. (2009). Rehabilitation as Empowerment: the Role of Advanced Technologies. In: Gaggioli A., Keshner A., Patrice L., Weiss T., Riva G., eds. *Advanced Technologies in Rehabilitation. Empowering cognitive, physical, social and communicative skills through virtual reality, robots, wearable system and brain- computer interfaces*. Amsterdam: IOS Press.
- Riva G., Mantovani F, Capideville CS, Preziosa, A., Morganti, F., Villani, D., Gaggioli, A., Botella, C., Alcaniz, M. (2007). Affective interactions using virtual reality: the link between presence and emotions, *CyberPsychology and Behavior*, 10, 45- 56.
- Saladin M., Brady K., Graap K., & Rothbaum B. (2006). A preliminary report on the use of virtual reality technology to elicit craving and cue reactivity in cocaine dependent individuals. *Addictive Behaviours*, 31, 1881- 94.
- Schwarzer R., Jerusalem M. (1995). The generalized perceived self- efficacy scale. In: Weinman J., Wright S., Johnston M., eds. *Measures in health psychology. A user's portfolio, Causal and control beliefs*. Windsor, UK: NFER- Nelson, pp. 35-37.
- Spiller V., Zavan V., & Guelfi G. (2006). Assessing motivation for change in subjects with alcohol problems: the MAC2-A questionnaire. *Alcohol and Alcoholism*, 41(6), 616- 623.
- Thom B., Brown D., Drummond C., Edwards G., Mullan M., & Taylor C. (1992). Engaging patients with alcohol problems in treatment: the first consultation. *British Journal of Addiction*, 87, 601- 611.
- Vincelli, F., Molinari, E., & Riva, G. (2001). Virtual reality as clinical tool: immersion and three-dimensionality in the relationship between patient and therapist. *Studies in Health Technology and Informatics*, 81, 551- 553.