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# Virtual Reality in Evidence - Based Psychotherapy

Aurora Szentágotai[1], David Opriş[1] and Daniel David[1,2]
[1]*Babeş-Bolyai University,*
[2]*Mount Sinai School of Medicine,*
[1]*Romania*
[2]*USA*

## 1. Introduction

In his 1957 *Annual Review of Psychology* article, Winder defines psychotherapy as an interpersonal relationship characterized by the following attributes (p. 309): (1) at least one of the participants (i.e., therapist) is an expert in human relationships; (2) at least one of the participants (i.e., client) displays intrapersonal or interpersonal adjustment problems; (3) the objective of the relationship is to change these maladaptive intrapersonal and interpersonal patterns. Psychotherapy thus circumscribes a group of psychological procedures that are applicable and delivered to individuals with emotional, behavioral and somatic pathology severe enough to be included in clinical diagnostic categories (e.g., the Diagnostic and Statistical Manual of Mental Disorders), and more generic strategies targeted at promoting growth and personal development (David, 2006; Huppert et al., 2006).

Based on their underlying theory of mental health and illness, and on theoretically derived treatment strategies, there are three major paradigms in psychotherapy: the cognitive-behavioral approach, the psychodynamic approach and the humanistic-existential approach; each of these paradigms, in its turn, encompasses a number of theoretically and procedurally individualized schools. Regardless of paradigm, the therapeutic process involves several distinct components, generally described as (David, 2006): (1) assessment; (2) conceptualization; (3) treatment (intervention); (4) therapeutic alliance (relationship).

Over the last years, there has been a dramatic interest in and expansion of psychotherapy research. A large number of studies have focused on the process and outcomes of psychotherapy, approaching them either from the point of view of theoretical and practical elements specific to a particular type of psychotherapy (e.g., cognitive-behavioral psychotherapy) (see Butler et al., 2005) or from a "common factors" view, looking at the non-specific ingredients which make psychotherapy, in general, work (Lambert, 1992; Lambert & Ogles, 2004).

This focus on research and its results have led to the justification of psychotherapy as a legitimate practice. Indeed, hundreds of studies show that psychotherapy works better than no intervention (Kopta et al., 1999), with some forms (e.g., cognitive-behavioral therapy) faring somewhat better than others (see, for example, the National Institute for Health and Clinical Excellence – NICE – guidelines for evidence-based treatments).

Despite the notable progress, research also systematically points to a segment of patients who are non-responsive, prompting professionals to advocate for improving the efficacy of treatments and for exploring and developing new efficient and cost-effective intervention strategies (David et al., 2008). One such direction has been the integration of new technological developments (e.g., computer technology) into the therapeutic process.
The current chapter discusses some of the main applications and advantages of virtual reality (VR) technologies in psychotherapy assessment, intervention and rehabilitation, using cognitive-behavioral therapy (CBT) as a case example. We have chosen to focus on CBT for at least two reasons: it is the best researched form of psychotherapy and it is (both in which research and intervention are concerned) the most likely and frequent "host" for VR intervention strategies.

## 2. Evidence-based psychotherapy

The number of available psychological treatments has grown exponentially during the last decades; in the field of psychotherapy only, there are over 200 distinct schools and hundreds of individual techniques (Bergin & Garfield, 1994). In a review of the scientific foundations of clinical work, published in 1966, Edward Bordin concluded that *"The present state of our knowledge is such that strong doubts can be expressed about virtually all psychological practices . . . none of them rest upon a firmly verified foundation of knowledge"* (p. 119).
Increasing criticism eventually led to a more firm commitment to research in psychotherapy. In this context, one of the significant changes in the field has been the development, validation and dissemination of evidence-based treatments for various clinical conditions. This movement is consistent with the past 20 years of work in evidence-based medicine, advocating for improved outcomes by informing clinical practice with research data (Woolf & Atkins, 2001). Among the factors that have converged in recent years resulting in the evidence-based movement are an increased understanding of the mechanisms of various disorders, leading to the need of developing interventions specifically targeted at these mechanisms, the improvement of clinical research methodologies, resulting in higher quality data, and the rising costs and inadequacies of health care, prompting governments to advocate for quality and evidence-based services (Huppert et al., 2006).
During the mid 1990s, the Task Force on the Promotion and Dissemination of Psychological Procedures (Society of Clinical Psychology, Division 12, American Psychological Association; APA) published specific guidelines to determine if a treatment was empirically validated (Anthony & Rowa, 2005). A decade later, the APA Presidential Task Force on Evidence-Based Practice defined Evidence-Based Practice in Psychology (EBPP) as *"the integration of the best available research with clinical expertise in the context of patient characteristics, culture and preferences"* and stated that *"the purpose of EBPP is to promote effective psychological practice and enhance public health by applying empirically supported principles of psychological assessment, case formulation, therapeutic relationship, and intervention."* (APA Presidential Task Force on Evidence-Based Practice, 2006). The definition of evidence-based practice argues for the importance of the harmonious integration of the three components (i.e., research, clinical expertise, patient characteristics). Many medical and psychological scientists, however, consider research to be the most important element of this partnership (Goodheart, 2006).
Although the need for data supporting the accountability, efficacy, effectiveness and cost-effectiveness of various assessment and intervention strategies is widely recognized, there

are differences in the extent to which professionals emphasize the importance of "evidence" in psychotherapy (Goodheart, 2006). One approach toward the movement (see Wampold and Bahti, 2004) cautions against an excessive focus on treatments, draws attention to the importance of not omitting the therapist and the subjective experience of the client from the equation, and recommends conceptualizations that focus on common factors in psychotherapy and broader research perspectives (Goodheart, 2006).

A different approach is illustrated by Barlow (2004) who, based on the recent advancements and the current status of the field, suggests that a terminological distinction should be made between "psychological treatments" (i.e., supported, manualized treatments, addressed to specific disorders) and "psychotherapy" (i.e., a more generic term that could be eventually dropped, or kept to refer to interventions directed at self-development, adjustment and living problems). David & his colleagues (David, 2004; David, 2006; David & Montgomery, in press) take this approach a step further, suggesting that for a psychotherapy to be considered "evidence-based" it would require a validation not only of its therapeutic package (by efficacy and effectiveness studies), but also of its underlying theory (i.e., the mechanisms of change it proposes).

## 3. Cognitive-behavioral psychotherapy as a model of evidence-based psychotherapy

Based on the APA established criteria, psychological treatments have been classified into "well-established treatments", "probably efficacious treatments" and "experimental treatments". Cognitive-behavioral psychotherapy is well-represented as a standard treatment for many disorders in the APA list of empirically validated treatments. Although there are several different schools of CBT, they all share the same basic assumptions (Hollon, 1998).

Cognitive-behavioral therapies are based on Albert Ellis' ABCDE model (Ellis, 1962). According to this model, people experience undesirable activating events (A) about which they have rational (i.e., adaptive, healthy or functional) and irrational (i.e., maladaptive, unhealthy or dysfunctional) beliefs (B). These beliefs lead to emotional, behavioral and cognitive consequences (C). Rational beliefs lead to functional consequences, while irrational beliefs lead to dysfunctional consequences. Clients who engage in therapy are encouraged to actively dispute (D) their irrational beliefs and to assimilate more efficient (E) rational beliefs, with a positive impact on their emotional, cognitive, and behavioral responses (Ellis, 1994; David & Szentagotai, 2006).

CBT is an approach to mental health promotion and the treatment of psychological disorders based on the idea that the way an individual thinks about an event determines, to a large extent, the way he or she responds to that event, both in terms of emotions and behavior. According to cognitive theory, dysfunctional beliefs and maladaptive information processing styles are at the heart of emotional disorders, and the therapeutic process is focused on helping the patient learn to identify and correct them in order to reduce unhealthy emotions and behaviors (Hollon, 1998).

The cognitive approach is linked to research in cognitive science, which suggests that information processes are dominated by strategies and heuristics that are conservative in nature and structured to maintain existing beliefs, even in the absence of motivation; the patient therefore suffers as a consequence of these misperceptions, with no underlying motivation of maintaining them (Hollon, 1998). CBT also assumes that most complex human

responses (e.g., emotional, cognitive, behavioral) are cognitively penetrable. Cognitive penetrability refers to two things: that a response (e.g., behavior) is an outcome of cognitive processing, be it conscious or unconscious, and that a change in cognition, by various procedures, will induce a change in the expressed response. It is important to note that the limits of cognitive penetrability are the limitations of CBT. In other words, because some basic human responses are not cognitively penetrable (some basic behaviors are genetically determined), they are not typically considered within the realm of CBT (David & Szentagotai, 2006).

CBT is an active, directive, collaborative, structured, problem-oriented, solution-focused and psychoeducational model of treatment (Freeman et al., 2004). Since its development, (Beck, 1972; Ellis, 1962) hundreds of papers examining the theory and practice have been published. Some of these studies have confirmed the main aspects of the original theory, while others have made critical contributions to its evolution. Furthermore, meta-analytic studies substantiate the conclusion that CBT is an empirically supported form of psychotherapy (Butler et al., 2005). Thus, CBT appears to be a gold standard for psychological treatments, as it has a well-defined theory and a well-supported effectiveness (David & Szentagotai, 2006).

Similar to most psychotherapy interventions, CBT involves an assessment (diagnostic) component, a conceptualization component, and an intervention component, all unfolding on the background of the therapeutic alliance (David, 2006).

### 3.1 Assesment and conceptualization

Psychological formulations view medical and psychological diagnostic reasoning as a process of hypothesis testing; solutions to diagnostic problems are found by generating a successive number of hypotheses and using them to guide subsequent data collection within a complex problem-solving process (Elstein & Scwartz, 2002).

The therapeutic process in CBT begins by an assessment phase that provides a diagnosis and an initial conceptualization, used for treatment planning and clinical decision making. Data is collected from multiple sources, including the clinical interview, structured clinical interviews (e.g., Structured Clinical Interview for DSM Disorders; SCID) self-report scales, self-monitoring forms, reports from family members and other mental health professionals (Pearson, 2008). Diagnosis is important for various reasons, including establishing a common language among scientists and practitioners and the fact that most evidence-based treatments are linked to a diagnosis.

Once a diagnosis has been established, however, the assessment shifts form nomothetic to ideographic, exploring the way a certain diagnosis is manifested in the case of a particular client. The role of the therapist is to translate a nomothetic model (e.g., Beck's cognitive theory of depression) into an individualized one. This process includes the development of a problems list, the evaluation of the patient's environment and characteristics, an individualized analysis of specific problems (e.g., functional analysis of behaviors), of their origins and of the individual's coping strategies. The information is used to develop the case conceptualization, a hypothesis about the psychological mechanisms and other factors that are causing and maintaining the patient's problems. A complete case formulation ties the following elements into a coherent whole (David, 2006; Pearson, 2008):

- clinical diagnosis and specific symptoms and problems
- hypothesized mechanisms causing the symptoms and problems

- recent precipitants of current challenges
- the origins of these mechanisms
- intervention strategies to overcome the disorder.

### 3.2 Treatment / intervention

One of the main functions of the first phase of therapy is to guide effective treatment by establishing the targets of intervention, which are generally the mechanisms that the conceptualization proposes as causing the symptoms (Pearson, 2008). In the case of CBT, these mechanisms are usually cognitive (e.g., maladaptive schemas, irrational beliefs) or behavioral (e.g., conditioning processes) in nature.

Cognitive techniques are intended at modifying maladaptive thinking patterns that cause dysfunctional emotions and behaviors. They address several dimensions of this process: (1) identification of maladaptive thinking patterns; (2) interrupting automatic information processing which contains the dysfunctional, habitual and uncritically accepted negative thoughts; (3) challenging and replacing dysfunctional/irrational cognitions (e.g., self-downing); (4) altering maladaptive information processing (e.g., overgeneralization).

Behavioral techniques have always been an important part of CBT – change can not be considered complete unless the person's behavioral patterns are modified (Freeman & Oster, 1998). These techniques include: exposure (in vivo and imaginary), relaxation training, behavioral rehearsal, contingency management, graded task assignment, assertiveness training and so on. Although behavioral in nature, the cognitive aspects of these techniques (e.g., attributions, expectancies) are highlighted and exploited by the cognitive-behavioral therapist (Freeman & Oster, 1998). For example, in vivo exposure for phobias is regarded not only as a way of altering conditioning processes that might have led to the problem, but also as an opportunity of testing, challenging and restructuring the patient's catastrophic interpretations of the feared situation (David, 2006).

Another cluster of strategies employed in CBT – rehabilitation strategies – is particularly worth mentioning in the context of this discussion of virtual reality and psychotherapy. Over the last few decades, this field has undergone substantial growth and development (Sohlberg & Mateer, 2001), with cognitive-behavioral interventions being among the most widely used and accepted treatments in rehabilitation psychology (Elliot & Jackson, 2004). There is significant evidence supporting the fact that people who have social and cognitive adaptive skills experience better adjustment following disability (Frank & Elliot, 2000), justifying the need for intervention in the case of patients and their families. The range of beneficiaries of such interventions is very broad (Elliot & Jackson, 2004), including individuals with central neurological conditions (e.g., stroke), peripheral neurological conditions (e.g., spinal cord injury), orthopedic conditions (e.g., fractures), medical conditions (e.g., major surgery) and psychiatric illnesses (e.g., schizophrenia, dementia, mental retardation).

Cognitive rehabilitation approaches can be broadly classified into two categories (Rizzo et al., 2001): *restorative* approaches, which focus on the retraining of individual cognitive processes (e. g., attention, memory) and *functional* approaches, which emphasize the stepwise training of skills and behaviors. Developments in this field rely significantly on research in cognitive science, which helps understand cognitive processes at a computational level and has shown that the brain is a far more plastic organ than it was thought to be, capable of considerable reorganization following damage and injury

(Sohlberg & Mateer, 2001). On the other hand, rehabilitation psychology has been profoundly influenced by the technological advancements of the last years, with increasingly complex technologies available for individuals with cognitive and physical limitations.

### 3.3 Therapeutic alliance

The idea that the relationship between the therapist and the client has an important effect on the therapeutic process can be traced back to Sigmund Freud's writings. Although his understanding of the therapeutic alliance has been dramatically challenged and modified over the years by other developments in psychotherapy (e.g., CBT), the interest in it remains and a variety of ideas have been advanced regarding the essential components of this relationship and about the mechanisms through which it actually works (Horvath, 2006).

The empirical testing of these ideas has shown that alliance is indeed a predictor of treatment outcome (Horvath & Luborsky, 1993; Shrik & Carver, 2003). In fact, alliance has been found to be one of the most robust predictors of positive psychotherapy outcome, regardless of the type of therapy used or whether assessed by therapist, client or independent observers (Horvath, 2001). Early alliance is particularly predictive of the results, and attrition from therapy can also be predicted by the quality of therapist-client interaction as early as the end of the first session (Robins et al, 2003). These associations are also consistent across therapies (e.g., cognitive-behavioral, psychodynamic) (Creed & Kendall, 2005). A recent analysis by Hilsenroth and Cromer (2007) of "evidence-based" clinician behaviors useful in the initial phase of alliance building, lists several elements traditionally considered key aspects of the CBT approach: adopting a collaborative stance toward the client, speaking with emotional and cognitive content, actively exploring problem issues, maintaining active focus on topic, offering psychoeducation on symptoms and treatment process, collaboratively developing treatment goals and tasks.

## 4. Virtual reality and psychotherapy

Despite the obvious strengths and the notable progresses made by psychotherapy during the last decades, research also systematically points to a segment of patients who are non-responsive to interventions, prompting professionals to advocate for improving the efficacy of treatments and for exploring and developing new efficient and cost-effective intervention strategies (David et al., 2008). Virtual reality (VR) has lately emerged as a promising tool in several areas of psychological intervention (Rizzo & Kim, 2005).

The first computer programs for CBT were developed in the 1980s in the United Kingdom and the United States. They relied on written text, checklists, and multiple-choice questions for communication with the patient (Wright & Small, 2004). Among the benefits of using computer programs in psychotherapy and the factors motivating the continued development of computer-assisted cognitive-behavioral therapy (CCBT) are the possibility of providing unique learning experiences to clients, leading to a faster attainment of treatment goals, the reduction of therapy costs and increased access to psychological treatments for people who are unable or unwilling to attend traditional treatment (Wright & Small, 2004).

Based on the assessment of available data, the National Institute for Health and Clinical Excellence (NICE) has included computer-based anxiety (i.e., panic, phobia,) and depression interventions among its recommended treatments (NICE, 2006; 2009).

More recently developed computer tools for CBT have incorporated virtual reality, and continuing advances in the field have led to the development of VR systems that are uniquely suited for targeting a variety of psychological conditions. Their main advantage resides in the potential of creating cost-effective, systematic assessment, training and treatment environments that allow for the precise control of complex, immersive and dynamic 3D stimulus presentations and for sophisticated interaction, behavior tracking and performance recording (Rizzo & Kim, 2005).

VR uses complex computer graphics and a variety of input and output devices to construct a virtual environment where the observer feels immersed (Peck, 2007). Thus, the person is no longer mere external observer of the images on the computer screen, but an active participant in the computer-generated three-dimensional world (Rothbaum, 2000). This three-dimensional interaction is what generates presence. Presence refers to the interpretation of the virtual environment as if it were real (Lee, 2004; Price & Anderson, 2006). Although the individual is conscious of his or her experience being produced by the technology, perception to a certain extent overlooks this aspect and interprets the environment as if technology were not involved (Krijn et al., 2004).

The main strategies used to immerse subjects into virtual environments and generate presence are head mounted displays (HMD) and computer automatic virtual environments (CAVE). HMD systems are for individual use; they are image display systems worn on the head that remain optically coupled to the user's eyes as he or she turns or moves (Schultheis & Rizzo, 2001). They are often used in combination with tracking systems, earphones, gesture-sensing gloves and haptic-feedback devices (Schultheis & Rizzo, 2001). The HMD is typically connected to a computer operated by the therapist, who guides the process. The CAVE is a multiuser, projection-based VR system. The patient and therapist are surrounded by computer generated images projected on more sides. Glasses are worn and a tracking system is attached to them, to generate a correct perspective (Krijn et al., 2004).

VR basically brings "the outside world" into the clinician's office, and allows for a higher level of control and the appropriate tailoring of the therapeutic process to the individual needs of the client, making a valuable addition to all components of the therapeutic process.

### 4.1 Virtual reality contributions to assessment

An accurate and comprehensive assessment is essential to a coherent conceptualization and treatment planning. A variety of combined strategies (e.g., clinical interviews, scales, observation) are typically used by clinicians to get a clear picture of the client's circumstances and problems before starting intervention. For example, in order to get an accurate image of the client's specific emotional and behavioral reactions in a given situation, the therapist can rely on psychological tests/interviews or try to gather the information by exposing the client to the situation, either imaginary or in vivo. While all these strategies can lead to valuable information, they also have their downsides.

Clinical tests are employed to measure various constructs (e.g., irrational beliefs, maladaptive schemas), and their results used to make predictions about the individual's behaviors and emotions in certain situations (e.g., speaking in front of an audience). Thus, a particular measure – the predictor – is used to make predictions of a specific outcome – the criterion. The limitations of this method are related to two factors (Sechrest et al., 1998): (1) the reliability of the test for the particular population to which the individual belongs and (2) the fact that predictions are based on a relationship between predictor and criterion, and

are limited by the validity of the predictor to the context in question (Sechrest et al., 1998). Another problem with clinical tests is their lack of ecological validity, for some situations. Interviews, on the other hand, are post-factum and often biased by memory processes.

Imaginary and in vivo exposure offer direct access to the client's thoughts, emotions and behaviors in a given context. However, they are not without limitations: while imaginary exposure may be affected by the inability of the client to recall and relive relevant aspects of the situation, in vivo exposure may often prove difficult, expensive or impractical to conduct.

A discussion of these assessment-related challenges gives us a picture of where virtual reality fits in into the puzzle. VR offers the therapist the opportunity of observing and recording cognitive, behavioral, subjective and physiological patterns in environments that are very much like the real world or where the person acts as in the real world, while retaining control and eliminating potential confounded variables (Rizzo et al., 2004). This provides an understanding of human behavior and human cognition that is challenging to achieve in any other fashion (David, 2010). While the possibility of conducting assessment as the patient interacts with a relevant environment is important in all cases, it becomes all the more valuable in situations where exposure to real-life contexts is impossible or impractical (e.g., due to high costs). For example, VR fear of flying programs are not only useful for intervention, but also for the assessment of the cognitive, emotional, behavioral, and physiological responses of patients in a context very similar to the one they fear, and that is significantly more difficult to access.

One such VR assessment tool, called Virtual Classroom, has been developed by a group of researchers at the University of Southern California in collaboration with Digital MediaWorks Inc., Canada (Rizzo et al., 2000). The system is specifically aimed at the assessment of attentional processes. The scenario consists of a classroom environment, containing objects (desks, blackboard) and persons (teacher, children) that are normally found in this context. A window on a side wall looks out onto a playground, and at each end of opposite walls there is a door through which activity occurs (Schultheis & Rizzo, 2001). The child sits at a desk in the virtual classroom and is given a task to complete. Attention can be assessed while a series of typical classroom distracters (e.g., noise, people moving, activity on the playground and at the doors) are controlled and manipulated by the therapist (Schultheis & Rizzo, 2001).

Virtual environments have also been used to evaluate cognitive functioning in individuals with various limitations. In a recent study, Josman and colleagues (Josman et al., 2009) employed VR to evaluate executive functioning in patients diagnosed with schizophrenia. The VR environment simulated shopping activity, and the authors found it highly suitable for the assessment of executive function deficits in schizophrenia. Although these deficits are well documented in the literature, they are generally assessed by neuropsychological tests, which provide important information, but consist of isolated, artificial tasks, with a fairly limited ability to predict the daily functioning of the patient (Chaytor et al., 2006; Josman et al., 2009). VR environments, on the other hand, have high ecological validity and cue habitual responses, thus giving the clinician more insight into the day-to-day behavior of the patient.

With VR technologies becoming more accessible as their price decreases, they can definitely develop into a valuable addition to the assessment process, providing the therapist information and an understanding of the client's emotions and behavior that would be otherwise difficult to access.

### 4.2 VR contributions to intervention and to the understanding of underlying mechanisms of psychological disorders

It is interesting to note that the technical (r)evolution in psychotherapy was anticipated by the results of a poll conducted by Norcross and colleagues in 2002, published in an article entitled *"The face of 2010: A Delphi poll on the future of psychotherapy"*. A panel of 62 psychotherapy experts involved in the poll predicted trends in the field for the following decade. Among the future scenarios that they considered most likely was the expansion of evidence-based interventions, of practice guidelines and of technology in psychotherapy (Norcross et al., 2002). These predictions have turned out to be accurate, both in which the evidence-based movement and computer-based interventions are concerned.

The nature of VR-based interventions makes them highly suitable for integration into CBT treatment programs. Over the last decade, applications have expanded as costs have dropped and hardware has improved. VR interventions have been developed for a variety of clinical conditions ranging from anxiety to eating disorders. In addition to generating presence, there are other features of VR that make it so appealing to psychotherapy (Glantz et al., 2003, p. 56): the possibility to precisely control what is presented to the client, the ability to tailor the treatment to the needs of the patient and the ability to expose the client to a wide range of conditions that would otherwise be unsafe or unpractical.

In addition, and just as important, recent research points to the potential of VR-based studies to clarify the mechanisms underlying various psychological disorders, which will eventually pay off in the development of increasingly efficient treatment packages. To give just one example, recent studies of acrophobia have pointed out that motion combined with simulated height, rather that height per se, lead to the phobic response (Coelho et al., 2006; Coelho et al., 2008), suggesting the need to also explore visuo-vestibular and motion mechanisms as possible diathesis factors in this disorder (Coelho et al., 2009). Similar progresses are being anticipated in the case of substance abuse (e.g., the association of environmental and personal factors leading to drug abuse; Culbertson et al., 2010) and psychotic disorders (e.g., mechanisms leading to symptom generation; Fornells-Ambrojo et al., 2008).

Most of the data that is currently available on VR interventions and their efficacy comes from studies of anxiety. Anxiety disorders are among the most common and frequently occurring mental disorders and they have been shown to be responsive to both medication and psychological interventions, CBT being widely employed in their management (Bush, 2008). While for the vast majority of other disorders data regarding VR interventions are based on case studies and uncontrolled studies, several randomized controlled trials have already been published for anxiety. This is not surprising considering the importance of exposure in the treatment of anxiety and the fact that VR environments provide a safe and controllable way of confronting the patient with the feared stimuli and situations. The first VR applications for psychotherapy were in fact designed to treat specific phobias (North & North, 1994; Rothbaum et al., 1995). To date, virtual reality exposure therapy (VRET) applications have been developed and used for a variety of anxiety disorders including panic disorder with agoraphobia, acrophobia, spider phobia (arachnophobia), fear of flying, claustrophobia, fear of driving, social phobia and post traumatic stress disorder (PTSD).

Two recent quantitative meta-analyses (both published in 2008) summarize the results of these studies. One was conducted by Parsons and Rizzo and included 21 studies, based on the following criteria (Parsons & Rizzo, 2008, p. 252): (1) report of interval or ratio data; (2) anxiety symptom data presented before and after VRET; (3) use of at least one affect

assessment instrument; (4) sufficient report of study results to allow effect size computation. Effect sizes were calculated for 6 affective domains: PTSD, social phobia, spider phobia, acrophobia, panic disorder with agoraphobia, fear of flying. An overall effect size across affective domains was also computed. Results indicated statistically significant large effects (Cohen's ds ranging between 0.87-1.79,) on all affective domains, with the largest effect sizes for fear of flying (1.59) and panic with agoraphobia (1.79). The overall effect size was also large (0.95). These are important findings in support of the potential benefits of VR exposure despite the somewhat limited number of subjects (particularly for certain affective domains) and the inclusion of uncontrolled studies in the analysis (Parsons & Rizzo, 2008).

Similar results were reported in the meta-analysis of Powers and Emmelkamp, which included 13 studies, meeting the following criteria (Powers & Emmelkamp, 2008, p. 563): (1) at least one virtual reality exposure therapy condition; (2) random assignment or matched condition; (3) either an active or inactive control group. Patients in these studies met the criteria for various types of specific phobia, social phobia, panic disorder and PTSD. Results indicated a large overall effect for VRET (assessed by domain specific measures) compared to control conditions, and medium to large effects for VRET on several other outcome categories (i.e., general subjective distress, cognitive, behavioral, psychophysiological). An interesting finding of this study was that, while both VR and in vivo exposure were more effective than no treatment, VR slightly outperformed in vivo exposure (small effect). The authors interpret these results as reflecting the higher credibility and expectancy for VRET and by the patients progressing more rapidly through the hierarchy due to a higher perception of control and safety (Powers & Emmelkamp, 2008).

The few studies combining VR treatments with cognitive techniques were excluded from this meta-analysis, due to procedural aspects that precluded the accurate evaluation of the independent effects of cognitive restructuring. One recent study, not included in this meta-analysis (Krijn et al., 2007), compared VRET alone to VRET combined with cognitive self-statements, and found no difference between the two conditions in patients with acrophobia. It is interesting to mention, however, that the meta-analysis indicated a very large effect size of VRET for cognitive outcome measures (g=1.30; Powers & Emmelkamp, 2008). This result supports the idea that behavioral techniques, such as exposure, also lead to cognitive change, affecting the patients' attributions and expectancies (David, 2006; Freeman & Oster, 1998). We believe that studies evaluating the added value of integrating VR techniques into already established CBT treatment protocols are quite important in order to clarify the most effective ways of delivering interventions to patients.

The majority of studies addressing VR applications for psychotherapy have focused on anxiety disorders. However, VR interventions for other psychological conditions have also been proposed. It is not the scope of this chapter to offer a comprehensive review of these applications, but we mention some of them as follows (but see Glantz et al., 2003 and Krijn et al., 2004 for reviews).

Experiential Cognitive Therapy was developed by Giuseppe Riva and his colleagues (Riva, 1998; Riva et al., 1999; Riva et al., 2002) to address obesity and eating disorders, particularly body image disturbance and the negative emotions associated with it. The VR component is integrated into a CBT approach and it consists of exposing patients to critical contexts and stimuli (e.g., kitchen, restaurant, commercials) and helping them deal with their emotional reactions and develop adaptive coping strategies. Patients' false assumptions about their own body are also confronted in the virtual environment. The authors report positive results

of this strategy, particularly in which body dissatisfaction and self-efficacy are concerned (Riva et al., 2002).

More recently, it has been suggested that VR application could be developed not only for the assessment (see above), but also for the treatment of patients diagnosed with psychotic disorders. In a study published in 2008, Fornells-Ambrojo and colleagues used a socially relevant environment to evaluate the acceptability and safety of using VR with individuals with persecutory delusions. Their results indicate that brief experiences in VR are both safe and acceptable to people with psychosis, and that they are also relevant from the point of view of presence and of eliciting delusional thoughts (Fornells-Ambrojo, 2008). Acceptability and lack of side effects of VR exposure were also reported by Stinson and colleagues (Stinson et al., 2010). Future studies are needed, but these data suggest the potential of VR strategies to be integrated into cognitive behavioral interventions for psychosis (Fornells-Ambrojo, 2008).

VR technologies have also been explored as potential skills training instruments for individuals with autistic spectrum disorders (ASD). A series of studies have discussed the viability and utility of VR in developing the social skills of people diagnosed with ASD (Cobb et al., 2002; Parsons & Mitchell, 2003; Parsons et al., 2004; Parsons et al., 2006). Virtual environments are considered to be fit for this task, as they can depict complex social contexts, but they are at the same time controllable and predictable, eliminating the anxiety that social interactions often elicit in people with ASD (Parsons et al., 2006). As in the case of psychotic disorders, research on this topic is still at the beginning, but the results so far are encouraging.

Another promising line of research is related to addictions. Several studies have already looked at the potential of VR environments to elicit craving and at the possibility of using these environments as assessment (e.g., Saladin et al., 2006**;** Culbertson et al., 2010) and intervention tools (Lee at al., 2007). Saladin and colleagues (2006) evaluated the ability of a VR environment to generate craving and emotional reactivity in cocaine dependent individuals. Their results showed that scenes related to cocaine use, compared to neutral scenes, elicited craving, physiological reactivity (e.g., increased heart rate) and emotional responses (e.g., anticipatory anxiety and a reduction in positive affect). Similar results were reported by Culbertson and colleagues (2010) in a group of methamphetamine users. VR drug cueing systems have also been developed for tobacco, cannabis and heroin (Baumann & Sayette, 2006; Bordnick et al., 2009; Kuntze et al., 2001). These systems allow an accurate and individual assessment of factors that induce craving and drug-use behavior and provide the opportunity of designing and testing treatments for drug addiction (Culbertson et al., 2010). In which intervention is concerned, exposure to cues eliciting craving (cue-exposure therapy) has already been assessed and proposed as a strategy of extinguishing the association between the substance and substance-related cues and contexts (e.g., Lee et al., 2007).

### 4.3 VR contributions to rehabilitation

Recent research also points to the broad usability of VR in targeting a range of physical, cognitive and behavioral rehabilitation issues. Beginning with the early 1990, there has been an increased interest in the study and promotion of these strategies. According to Rizzo and Kim (2005) ecological validity, stimulus control and repetitive delivery, real-time feedback,

self-guided exploration, the safe environment and the opportunity to tailor the interface to the individual's impairment are just some of the factors that make VR a feasible intervention tool in rehabilitation.

Several research teams have already integrated VR in the assessment and rehabilitation protocols of cognitive processes in patients suffering from developmental disorders, neurological conditions (e.g., traumatic brain injury) and psychiatric conditions (e.g., schizophrenia). VR applications have been developed and tested for attention processes (e.g., Rizzo et al., 2000; Rizzo et al., 2001), spatial abilities (e.g., Rizzo et al., 1998), memory (e.g., Brooks, 1999) and executive functions (e.g., Costa & Carvalho, 2004; Pugnetti et al., 1998). VR scenarios have also been designed to teach patients daily activities such as meal preparation (e.g., Christiansen et al., 1998), use of public transportation (e.g., Lam et al., 2005), street crossing (Josman et al., 2008) and shopping (Tam et al., 2005)

The focus of CBT on promoting adjustment, well being and personal health among individuals with disabling conditions has led to it becoming one of the most widely accepted treatments in rehabilitation psychology (Elliot & Jackson, 2004). Although clinical data on VR rehabilitation strategies is still insufficient (particularly in which controlled studies are concerned), their integration into CBT packages holds significant promise, considering the documented adequate match between the two (Wright & Small, 2004). Moreover, CBT rehabilitation protocols are usually complex interventions that, depending on the patient's condition, not only address issues of cognitive and behavioral skills (re)training and development, but also aspects of coping with the disorder, treatment adherence, vocational reintegration, lifestyle change, patient and family education (Elliot & Jackson, 2004).

### 4.4 VR and the therapeutic alliance

While there are some studies that have looked at the limits (e.g., side effects, costs) and acceptability of VR strategies by various categories of patients, little attention has been given to their effects on the therapeutic alliance. A typical VR-related concern regarding alliance has to do with the reduction of face to face interaction between therapist and client (Chu et al., 2004). Future research must address this issue in a systematic manner and reconcile the apparently conflicting data on the importance of the therapeutic alliance on the one hand, and the effectiveness of treatments that involve limited therapist input on the other hand (Peck, 2007). According to Chu et al. (2004), technological developments and their inclusion in therapy challenge the traditional conceptualization of the clinician's role, and the study of alliance must be extended to take into account a variety of new therapeutic relationship forms.

However, a difference must be made here between entirely computer-based psychotherapy interventions, where the process takes place without a therapist being involved, and the integration of VR strategies into traditional CBT protocols. In this latter situation, the four basic components of the therapeutic process (i.e., assessment, conceptualization, intervention, alliance) are not altered. In other words, VR strategies are a valuable addition to the therapy process, which retains and strengthens all its other active ingredients. This assumption seems to be confirmed by studies that have found high levels of acceptability, involvement and preference of patients for VR technologies.

## 5. A virtual reality cognitive-behavioral environment and treatment protocol for attention-deficit and hyperactivity disorder (ADHD) (Based on Anton et al., 2009a)

Attention-deficit and hyperactivity disorder (ADHD) is among the most prevalent psychiatric childhood disorders, affecting 8% to 10% of children (Baren, 2002). Although it persists into adolescence in up to 80% of cases (Schubiner et al., 2002), it is considered a childhood disorder, and largely diagnosed during childhood. The accurate diagnosis and treatment of ADHD is of significant importance, considering that, when left untreated, it can lead to school underachievement, affect professional prospects and cause relational problems (Baren, 2002). Adolescents with ADHD are more likely to display risk-taking behaviors such as reckless driving, risky sexual activities, substance abuse and criminal behavior (Barkley et al., 1990).

Over the past few years, clinical research and consensus guidelines have established the most effective treatment approaches for ADHD. A recent review of evidence-based psychosocial treatments for children and adolescents with ADHD identifies behavioral parent training and behavioral school interventions as empirically validated interventions (Chronis et al., 2006). Both approaches involve teaching parents and educators to use behavior modification strategies such as praise, positive attention and rewards to increase positive behavior, and ignoring, time-out and response-cost to decrease unwanted behavior.

Overall, medication and behavioral approaches have been shown to be effective in the clinical management of ADHD, but they do have limitations that advocate for the need of developing additional intervention strategies (Anton et al., 2009a). To some extent, the limitations of behavioral approaches overlap with those of medication as: (1) effects appear to be short-term; (2) not all children respond to treatment; and (3) data do not support the long-term benefits of these interventions (Waschbusch & Hill, 2003). Multimodal programs, such as the one proposed by Dopfner and colleagues (Dopfner et al., 2006) are considered to be the best alternative (Anton et al., 2009a). Multilevel programs involve work on the cognitions and behaviors of the child, using a combination of parent training and child-focused cognitive behavioral intervention. The CBT component of multimodal programs includes: (1) reinforcement techniques (e.g., positive reinforcement, guidance, shaping) (2) techniques for eliminating maladaptive behavior (e.g., extinction, response-cost) and (3) cognitive restructuring techniques (e.g., disputation, hypothesis testing)

### 5.1 From assessment to treatment - Development of a VR treatment tool for ADHD

The goal of the research project we describe bellow was to develop a VR intervention tool that could be integrated into a traditional CBT approach for ADHD (Anton et al., 2009a). Our intention was to create a high ecological validity instrument that would allow us to conduct intervention in a context simulating the everyday environment of the child. This instrument is being developed, in collaboration, by the members of the Department of Clinical Psychology and Psychotherapy, Babeş-Bolyai University, Cluj-Napoca Romania, Dr. Albert "Skip" Rizzo from the Institute for Creative Technologies, University of Southern California, San Diego and Digital Media Works (DMW) Canada. The team at Babeş-Bolyai University is led by Dr. Daniel David and its members are Raluca Anton (MA), Anca Dobrean (PhD), David Opris (MA), and Aurora Szentagotai (PhD).

Our starting point was the Virtual Classroom program, developed by Rizzo and colleagues (Rizzo et al., 2000). The Virtual Classroom was intended and tested as a study and

assessment tool, but its creators had envisioned the possibility of the system being used for treatment (Rizzo et al., 2000). It is a head mounted display (HMD) system, and the scenario consists of a classroom environment, containing objects (desks, blackboard) and persons (teacher, children) that are normally found in this context. A window on a side wall looks out onto a playground, and at each end of opposite walls there is a door through which activity occurs (Schultheis & Rizzo, 2001). The child sits at a desk in the virtual classroom and is given a task to complete. Attention can be assessed through tasks of various difficulties, while a series of typical classroom distracters are controlled and manipulated by the therapist (for detailed descriptions see Rizzo et al., 2000; Rizzo et al., 2006).

This objective and reliable evaluation strategy addresses and eliminates some of the problems of traditional assessment techniques in ADHD (e.g., issues related to low ecological validity) (Rizzo et al., 2006). An initial clinical trial comparing 6-12 years old children diagnosed with ADHD (n=8) and non-diagnosed children (n=10) has shown significant differences between the two groups on a number of variables such as reaction times under distracting conditions, number of omission and commission errors and levels of motor activity. No negative side-effects were reported by the participants (Rizzo et al., 2006).

Our aim was to transfer the advantages of using VR with children diagnosed with ADHD from the assessment to the intervention level. Based on the literature showing that multimodal interventions are the most efficient in the clinical management of the disorder, we decided to build on this approach (Dopfner et al., 2006) by implementing some of its components into a virtual environment. In other words, the program relies on established behavioral and cognitive techniques, but they are used in a virtual school context.

Focus on school behavior is an important aspect of the program, as it allows clinical work to be conducted in an environment that normally raises multiple challenges to children with ADHD. Given the ecological nature of the intervention, our expectation was that skills acquired during therapy would be easier transferred into the real classroom, improving the child's functioning in this important area of everyday life. While most parents support the implementation of newly learned skills at home, this is often not the case at school. Our intervention was designed to address this problem and give children the opportunity of practicing new behaviors in the (virtual) classroom as well.

It is important to mention that we do not propose a new therapeutic paradigm. We instead "relocate" the intervention from the clinician's office into the virtual classroom. As far as we know, this is the first VR program that allows the clinician to use relevant CBT techniques in the treatment of ADHD. A number of features were introduced in the program to support the CBT intervention:

- Graphic display of child performance
- Pause button
- Self-talk event recording
- Distracters/environment control
- Reward/punishment system
- Feedback component
- Tasks difficulty grading component
- Head movement tracking.

These features are designed to serve several purposes, such as: (1) give the therapist control of the virtual environment (pause button; distracters control); (2) offer the therapist information regarding the child's performance and behavior (graphic display of child

performance; head movement tracking); (3) support the application of cognitive (self-talk event recording; feedback component) and behavioral (reward/punishment system; task difficulty grading) techniques.

From a technical point of view, the system consists of two computers connected through a wired or wireless network. One computer (the patient's computer) is running the ClinicaVR$^{tm}$ Classroom, while the other one (the therapist's computer) is running the School Master. An eMagin Z800 head mounted display is used for presenting the virtual environment to the patient. Using a graphical control interface, the therapist controls the ClinicaVR$^{tm}$ Classroom and gets real-time feedback on the patient's performance.



Fig. 1. ClinicaVR$^{tm}$ Classroom adapted for intervention. Patient interface copyright © 2010 Digital MediaWorks Inc.

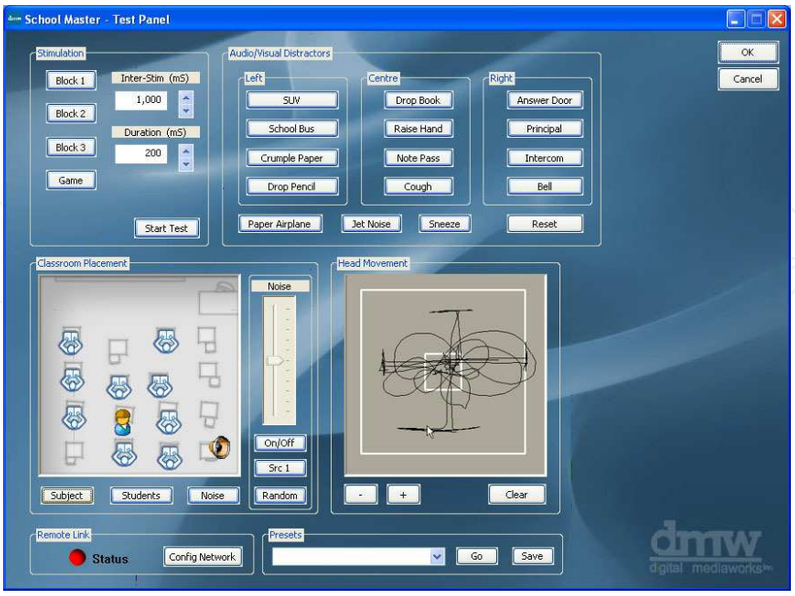



Fig. 2. ClinicaVR$^{tm}$ Classroom adapted for intervention. Therapist interface copyright © 2010 Digital MediaWorks Inc.

### 5.2 Intervention protocol

The protocol designed to include this modified version of the ClinicaVR$^{tm}$ Classroom is based on the program proposed by Dopfner, Shurmann and Frolich (2006). This is a flexible, family-based program and the strategy varies from family to family and from child to child. Flexibility does not refer, however, to modifying cognitive or behavioral techniques but, for example, to skipping certain phases if they are not considered useful for the client.

A number of studies have shown that family-based interventions are quite efficient for managing children with defiant behavior (McMahon & Forehand, 1984) and that combining family intervention with self–education techniques significantly improves the child's behavior. However, one problem during therapy is related to the difficulties of exposing children and their families to real environments where they can practice newly acquired skills. We expect the learning and practice process to be much easier in a virtual environment that simulates real-life situations.

The intervention involves 16 weekly sessions (see Table 1; this protocol is based on Anton et al. 2009a, republished in Anton et al., 2009b). Each session focuses on teaching the child and the family cognitive and behavioral techniques that they are required to practice daily. One part of the intervention is addressed to the parent, and one part to the child. Each session a story of a boy with ADHD, named Peter, is red and discussed with the child. VR strategies are not used in all meetings, but only in sessions where they are considerer useful for the implementation of cognitive and behavioral strategies.

| Session number and objective | Session Content |
|---|---|
| Initial Assessment | Focused on:<br>behavioral assessment<br>cognitive abilities evaluation<br>family diagnostic |
| Session 1: Defining behavioral problems | Individualized description of child and family problems<br>Objectives in terms of behavioral change<br>Work on problems list<br>VR assessment I |
| Session 2: Case conceptualization I | Integration of material from child and parent into common conceptualization |
| Session 3: Case conceptualization II | Conceptualization at case (general) level and at the problems (specific) level (continued from Session 2) |
| Session 4: Intervention objectives | Specific objectives detailed<br>VR assessment II |
| Session 5: Focusing on positive interactions with the child | Discussion on positive and negative child-parent interactions<br>Parents helped to focus on positive interactions with their children<br>VR game to model positive interactions |
| Session 6: Building positive interactions through games | Games introduced as opportunities for positive interactions |
| Session 7: Family rules | Discussion and assessment of family rules<br>Formulation of efficient family rules |

| | |
|---|---|
| Session 8: Efficient requirements | Parents taught to formulate efficient requirements |
| Session 9: Social reinforcements when requests are followed | Parents taught how to use social reinforcements<br>Graded difficulty VR task (opportunity to model social reinforcements) |
| Session 10: Social reinforcements when child does not interrupt | Parents taught to give the child the attention he or she needs<br>Parents taught to involve the child in independent activities<br>Parents taught to reinforce the child when he or she does not interrupt |
| Session 11: Efficient monitoring (only if needed) | Assessment of problem behaviors when the child is on his or her own<br>Establishing rules<br>Reinforcing compliance with rules and managing non-compliance |
| Session 12: "Natural" negative consequences | Analysis of individual situations (if any) where established rules and principles do not work<br>Establishing negative consequences for individual situations<br>Graded difficulty VR task (opportunity to illustrate negative consequences) |
| Session 13: The "POINTS System" | Implementation of token economy principles for situations where social reinforcements do not work: points earned are exchanged for rewards<br>Graded difficulty VR task - points earned for each correct answer |
| Session 14: Awarding points | Establishing rules for awarding points<br>Graded difficulty VR task - feedback component is introduced to teach the child to cope with negative feedback – points earned for correct answers and points lost for incorrect answers |
| Session 15: Reinforcement withdrawal | Parents taught to withdraw benefits<br>Contest between parent and child started: child gains a point when he or she follows a rule and parent gains a point when the child does not follow an established rule<br>Graded difficulty VR task - points earned for correct answers and points lost in favor of opponent for incorrect answers |
| Session 16: Time-out | Time-out principles are discussed and introduced for managing highly resistant behavior |
| Session 17: Stabilizing gains | Overview of the sessions<br>Overview of gains<br>Rehearsal for future situations |

Table 1. ADHD intervention protocol illustrating the integration of VR strategies into a CBT treatment program

## 6. Conclusions

The goal of this chapter was to discuss the applications and advantages of VR technologies in psychotherapy assessment, intervention and rehabilitation, using CBT as a general example, and the development of a VR intervention technology for ADHD as a specific example. We feel it is important to end our endeavor by stressing that VR psychotherapy (interventions) do not constitute a (new) form of psychotherapy in and of themselves. Even when playing a key role in therapy, they are basically tools that extend and complement the skills of well-trained clinicians and lead to the improvement of all components of the therapy process (David, 2010). Their contribution to the advancement of the evidence-based movement, through the stimulation of high quality research, the increasing of clinical expertise, and the tailoring of interventions to patient characteristics and preferences, makes them highly valuable instruments in the mental health field. Nevertheless, in order to make the most of their advantages, thoroughly planned studies and careful consideration of research evidence are needed before recommending them as viable treatment options (Bush, 2008).

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Technological advancement in graphics and other human motion tracking hardware has promoted pushing "virtual reality" closer to "reality" and thus usage of virtual reality has been extended to various fields. The most typical fields for the application of virtual reality are medicine and engineering. The reviews in this book describe the latest virtual reality-related knowledge in these two fields such as: advanced human-computer interaction and virtual reality technologies, evaluation tools for cognition and behavior, medical and surgical treatment, neuroscience and neuro-rehabilitation, assistant tools for overcoming mental illnesses, educational and industrial uses In addition, the considerations for virtual worlds in human society are discussed. This book will serve as a state-of-the-art resource for researchers who are interested in developing a beneficial technology for human society.

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Phone: +86-21-62489820
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