

3 Virtual Reality and Psychotherapy

Cristina BOTELLA, Ph.D.¹, Soledad QUERO, Ph.D.¹,
Rosa M. BAÑOS, Ph.D.², Conxa PERPIÑÁ, Ph.D.²,
Azucena GARCÍA PALACIOS, Ph.D.¹
and Giuseppe RIVA, Ph.D.³⁻⁴

¹ *Universitat Jaume I, Castellón, Spain*

² *Universidad de Valencia, Valencia, Spain*

³ *Istituto Auxologico Italiano, Milan, Italy*

⁴ *Catholic University, Milan, Italy*

Abstract

Virtual Reality (VR) is a new technology consisting on a graphic environment in which the user, not only has the feeling of being physically present in a virtual world, but he/she can interact with it. The first VR workstations were designed for big companies in order to create environments that simulate certain situations to train professionals. However, at this moment a great expansion of this technology is taking place in several fields, including the area of health. Especially interesting for us is the use of VR as a therapeutic tool in the treatment of psychological disorders. Compared to the “traditional” treatments, VR has many advantages (e.g., it is a protected environment for the patient, he/she can re-experience many times the feared situation, etc.). There are already data on the effectiveness of this technology in the treatment of different psychological disorders; here anxiety disorders, eating disorders and sexual disorders are reviewed. Finally, this chapter ends with some words about the limitations of VR and future perspectives.

1. Introduction

The term Virtual Reality (VR) is quite recent, indeed Jaron Lanier proposed it only a few more than one decade ago. However, in these few years its use has been notably extended and now it can be affirmed that it is a part of our daily vocabulary. This new technology is “getting into” our lives, although we cannot see with clarity yet to which extent it will become important. The only thing we can state by now is that its progress is being dizzy and its possibilities of application are getting more numerous as we will see later in this chapter.

We have already said that the term of VR is a new term, but it cannot be said the same about the tool. Since 30 years ago the scientist community is working on its development. In the sixties its foundations were laid and with no doubt the work carried out by Sutherland in those moments was determinant, pointing out in his doctoral thesis entitled “*Sketchpad: a man-machine graphical communication system*” how computers could be used for making interactive graphics. A few later, this same author [1] published “*A head-mounted three dimensional display*” and showed how graphics generated by a

computer could be combined with visualizations mounted in the user's head. Since the beginning, the tool demonstrated a great usefulness, although the cost was too high being only available for the governments of powerful nations and for very sophisticated development and research programs. Indeed, variants and/or elements of this tool were part of Russian and American spatial programs and helped the astronauts to train systematically and to practice many skills without having to appeal to real situations.

At the beginning of the eighties the tool was still expensive, but the use of images generation systems in real time started to be common in the aeronautical field.¹ The pilots could receive many hours of training in virtual contexts and they could acquire a high degree of mastery in many diverse circumstances. Many of us do not worry about this, but when someone explain it to us, we feel really calmed knowing the fact that any airport and any aeroplane can be digitalized and that pilots can practice taking off and landing in these systems as many times as they want. The same can be said about other situations that imply more or less difficulty or risk. Many of us would also agree in that is better that the pilot has practiced what to do when coping with difficult situations due to fog, wind, technical problems (landing gear, engine failure, etc.) or any other circumstance.

In short, a long time and much effort have been necessary for the technology of computers could develop virtual realities that are useful from a cost-benefit perspective.

The first generation of VR platforms, really immersive, had to be limited to industries and/or research centres where the high cost of the hardware and software development was justified: the aero spatial world, the design world, the building world, etc.

However, at the beginning of the eighties VR is ready to be acknowledged as a feasible technology, and in the end of the decade the first VR commercial systems are available. As Vince points out [2], this can make us to believe that future has arrived. In fact, the topic traps many of us and remains in the imagination of each one of us to delimit what VR might be. In the nineties VR has notably matured. Better and more sophisticated virtual environments and worlds have been generated which can work in much more simple and economical systems and, thereby, they are available for many more users. There are still things to do for this technology to be available for everyone, but in the same way that has happened with computers, as the technological developments progress and costs decrease VR workstations will be available at work, at home in a few time. These workstations will allow us virtual transactions, shopping, games, trips, adventures and meetings [3]. For anyone who gets into this field future possibilities seem not to have limits. Indeed, it has been stated that VR has been during quite a long time an important technology looking for an application [4]. At this moment, we believe that this statement would have to be changed and insist on numerous applications looking for VR.

It is difficult to delimit a general concept of VR that includes all the applications that have been designed up to now under such designation. Nevertheless, it is possible to define VR by the basic concepts that characterize it. One of the first definition of the term that can be useful is given by Burdea, pioneering researcher in this field and with a wide experience in real applications: "*Virtual Reality is a complex user interface that includes simulations in real time through multiple sensorial channels. These sensorial modalities are visual, auditory, tactile, olfactory, etc.*" [5].

From the aforementioned definition, it clearly derives that VR is both immersive and interactive. Immersive because through special devices it is achieved that the user has

¹ Before these systems were developed, in the simulators rigid models on the airports and the surrounding environment scale were used with all the difficulties derived from this: the necessity of a big space due to its size, the enormous costs and, therefore, the difficulty of having available separate models of different airports (a generic model was used), in addition to the impossibility of simulating different weather conditions [2].

the sense of being physically present in the virtual or cybernetic world modelled in the system. Interactive due to the fact that VR does not imply a passive visualization of the virtual world, but the user can interact with the virtual world (e.g., he/she can touch and/or move objects) and, what is more important, the virtual world responds in real time to those actions. Interaction and Immersion form the two most important “Is” of VR. However, there exists a third “I” defining VR but to which less weight is given than it actually has.

Such “I” refers to the term Imagination and responds to the fact that VR is not only a good interface, but also offers applications that imply solutions to real problems in so different fields as Engineering, Medicine, Psychology, etc. [6]

2. VR advantages for Psychotherapy

VR is having a great acceptance by clinical community given the enormous potential that offers. Moreover, several research groups have already pointed out its benefits and its possible applications. VR potential makes possible that in a very near future virtually all the clinical disciplines will be able to get benefit of this human-computer interface. The advances carried out since the first works by Sutherland [1] are giving their results and their impact in the health field is going to be more than notable, as is being revealed by the celebration of congresses and scientific meetings specifically addressed to this topic and the publication of new specialised journals in the last years.

From different forums is being revealed, on one hand, the great possibilities that VR can have for health and, on the other, what all this implies with regard to the interchange of knowledge and joint work projects between professionals of very different areas. Basically, engineers and programmers working together with doctors, psychologists and different specialists of the health field with the common aim of developing procedures that might be useful and solve the problems showed by different persons. It is a very important interdisciplinary effort that we think is going to give numerous results.

As for the possible applications of VR to the psychological field, and more specifically to the psychological treatments area, two main reasons for the use of this new tool could be stated. On one hand, VR provides us an incomparable setting for therapy since in this new tool come together many aspects that, traditionally, have been considered central for a good therapeutic process. The “new sense” that is incorporated in “our mechanism to know the world”, if Konrad Lorenz’s terminology is used [7], provokes that all those aspects that Korchin and Sands [8] contemplate as “essential ingredients for therapy” are started or activated. On the other hand, it is possible to take advantage of VR versatility in order to optimise therapy itself [9-11].

A few years ago, we already highlighted VR potential in the field of psychological therapies [6, 9] and the facts occurred until now show that said potential was real. All works, carried out in the field of psychological therapies, prove that in less than a decade this new tool has shown a remarkable utility for the treatment of many psychological disorders, as we will show later. Indeed, nowadays VR is of remarkable use, from the point of view of Axis I of the Clinical Guide of the empirically validated therapies, that is, the axis of efficacy or internal validity [12, 13]. However, we think that the great potential of virtual reality is to be considered from the perspective of Axis II of the Clinical Guide or axis of effectiveness. That is, VR has a series of advantages when we compare it with the traditional therapies [6, 14-17]. Let see in more detail the advantages of VR for the psychological treatments field.

1- VR allows structuring therapy like a special and protected environment. The virtual environment is, in fact, a “safe” environment. This aspect of “as if” from VR is of

great importance, as it can be considered to be an intermediate key step between the consulting room (completely protected) and the real environment (totally threatening).

Multiple situations, difficulties, unforeseen events, errors, dramatic consequences can be practiced; although, “in fact”, nothing happens. In short, the patient feels safe in the virtual situation and, supported by the therapist, can face the feared context at his own pace and without risks. The fact of understanding therapy as a special and protected environment where the patient can start exploring, experiencing and, in short, acting has a great tradition and a manifest acknowledgement by all therapy orientations and, with no doubt, is part of those “special ingredients” either we call them “myths and rituals” in Frank’s terminology [18] or “therapeutic climate and specific therapeutic processes” in Korchin and Sands’s words [8].

The inclusion of the virtual environment does not alter anything of what Korchin considers essential for psychotherapy, that is, the belief in the possibility of change, the faith in the therapist as an expert, the positive expectations towards therapy and the motivation to change, the therapist’s qualities as a person who inspires reliance and safety, communicates respect and desire for helping, who is able, in short, to get the patient’s complete cooperation. However, such scenario adds something new. In our opinion, it can be part of the “therapeutic alliance”, and become a third element that has to be relied on. It would mean to include in therapy a difficult world (but still fitting the patient’s possibilities) and, little by little, to make the patient able to cope and control the real world from the knowledge and domain of the interactions with several parts of the virtual world.

That “new fitting world” gives also cause for starting or activating what Korchin thinks as specific therapeutic processes: emotional arousal, learning and over learning, self exploration and understanding, reality testing, practice and rehearsal, mastery and successful experiences.

2- In close connection with the aforementioned, is fundamental the fact of acting without feeling threatened (neither by the external world nor by oneself). A good example of this would be the Kelly’s “as if” [19]. This point is so important that it is also contemplated, although from a different perspective, in the “safe base” proposed by Bowlby [20], which becomes a central aspect for the configuration of different cognitive structures about the attributes of the self and the world [21]. The therapist can make the patient to understand that the virtual scenario allows him/her to know the situation that he/she has always considered threatening and, moreover, it allows to do it in the way he/she wants, at his/her pace, the time he/she wants... with absolute security of being protected since nothing he/she fears can occur. The virtual scenario is, actually, a “safe base” that therapy offers to the patient and from which he/she can freely explore, experience, feel, live, revive feelings and/or thoughts being these either current or past. Nothing prevents him/her now to become to know the world and him/herself in other way and, in consequence, to start understanding that he/she can function in that new world in different ways than those used until now. Undoubtedly, the assumption of this new perspective generates a great sense of freedom. The person realises that the world and the self that he/she assumed as something absolutely given, fixed, ended, actually (from numerous and important life perspectives) is not more than a simulation, an interpretation that can be altered [22].

3- A basic strategy used, likewise, in all therapy orientations is role-playing. Good examples of this are: Moreno’s psychodrama, Wolpe and Lazarus’ behavioural role-playing or Kelly’s fixed role therapy [19]. The fact of being able to get out of one’s own skin and place in some other’s person skin or some “other self” (and here we would add some other

context) seems essential to achieve a change of beliefs, or said from Watzlawick's perspective [23], to be able to change an event from one class to another. However, here it is a role-playing version with a special character. They can still be two or more participants (let think, for instance, in a software designed for the treatment of social phobia). One of the participants, the patient, fits classical statements; the other is quite newer, since it implies including the world in the role-playing. The patient has not found a satisfactory way of functioning yet and here he/she is offered the possibility to explore, analyse and try; and, moreover, to feel him/herself doing it. He/she receives non-threatening feedback about his/her performance and experiences it in a clear facilitating and helping environment. In short, it is possible to make the world to assume a new role, which the patient can interact with and, in turn, he/she is going to shape it.

4- It is also necessary to remember how important is for any therapy orientation that the patient copes with (overcomes, assimilates, process, absorbs, etc.) his/her fears. VR allows to grade the situation in such a way that the patient can move forward from the easiest performances to the most difficult ones. Little by little, starting from the knowledge and domain of the interactions with the different parts of the virtual world, he/she will be able to cope with and control the real world. The therapist can make the patient to understand that the virtual scenario allows him/her to know deeply the situation that has always been considered threatening. VR becomes, therefore, a tool to be used for the patient to start knowing and interacting with the feared situation.

5- In close connection with the aforementioned, it has to be pointed out that, from all possible sources of personal efficacy that are contemplated by Bandura [24] in his theory, performance achievements are specially useful. From our point of view, VR is an excellent source of information concerning personal efficacy in the performance achievements ambit, since within the consulting room, numerous contexts for practically assuring the success to the patient in each of his/her "virtual adventures" can be designed and, moreover, difficulties, challenges or occasional failures to be overcome later on by the patient can be planned. According to Bandura, once strong expectations of efficacy have been established through repeated success, the probable negative impact of occasional failures will be reduced. Now then, failures that are overcome with the patient's effort will strengthen his/her persistence and involvement. Obviously, the aim is to achieve the patient discovers through his/her own experience that even the most difficult obstacles disappear by means of a constant and maintained effort. That is, it is of great importance that the patient experiences him/herself as competent, efficacious and with domain. In the same way, it is central to achieve the patient assigns appropriately his/her personal competence to internal factors such as constancy and effort, which will give rise to a larger sense of strength and power on the interaction with the environment [25].

Self-efficacy theory also predicts that, once established, self-efficacy tends to generalize to other situations. Therefore, any advance in the personal functioning can transfer to not only similar situations, but to others that differ essentially from those on which the treatment was focused. As much different and numerous are the circumstances in which the person confronts and dominates any threat, the probability that success experiences give rise to an increase in the sense of personal self-efficacy will be major. It is interesting to underline here that VR is enough flexible to permit the design of different scenarios in which the patient can develop personal efficacy expectations of highest magnitude (including from easy performances to very difficult ones) generalization (referred to very different domains) and, strength (difficult to extinguish, to achieve the patient perseveres regardless of difficulties).

6- It is also necessary to mention the undeniable utility that the use of humour sense can have for therapy. This point has been insistently emphasised by Victor Frankl. The fact that VR allows to construct contexts “as if”, that is, less threatening, also involves a higher probability of persuading the patient to “go into” action and to wish with strength, from deep down in his/her heart, that what is so scared of actually happens. If we really manage to convince him/her, we are achieving to set in motion the basic resources that, according to Frankl [26,27], underlie the paradoxical intention: the capacity of spacing out external situations, taking an attitude towards them (self-isolation) and, the capacity of getting ahead of oneself (self transcendence). Moreover, following the recommendations of logotherapy, it would be central to try that the patient experiences the performance of the action, as an interesting adventure in which laugh is possible. That it, to use the unique potentiality for self-isolation inherent to the sense of humour, a potentiality specifically human which can help to attain the “correct passivity” [26], that is, the patient being able to be ironic about his/her problem, instead of escaping from or avoiding it. From a logotherapeutic perspective, the virtual scenario can also facilitate the “perception of meaning”, that is, to realise the existing possibilities in the reality setting, or said in other way, to realise what a person can do in relation to a given situation.

7- VR allows a remarkable control of the situation. On one hand, there is no need to wait for the events to be produced in the real world (up to now we could only resort to imagination and role playing) since they can be generated in the software in an increasingly routine way. On the other hand, VR offers enormous possibilities of training, the person can explore and face the feared situations at the pace and speed that he/she requires, and this, will probably potentate treatment results. In addition, VR can help to generalize advances that are achieved in therapy, since it is possible to work in very different scenarios related to the person’s problem and also to practice as many times as he/she requires, that is to say, over learning is achievable.

8- Finally, another important advantage of VR is that allows the person to go beyond reality. On one hand, it gives the possibility of changing, altering or modifying the feared context at our convenience. That is VR is enough flexible to permit the designing of a series of contexts in which the patient can affront virtually, not only what he/she fears, but different aspects much more threatening that can be created by means of VR and which would be totally impossible to achieve and control in the real world. For instance, one of our claustrophobia scenarios consists of a wall that moves forwards making a lot of noise and shuts the person in a smaller space. The coping and interaction with the environment can be carried out in many different degrees and in multiple ways until a good domain and over learning is achieved. That is, we can manage the patient to go beyond the feared situation. On the other hand, the goal of VR does not necessarily have to “recreate” the reality. Instead we should worry about delimiting contexts that prove to be therapeutic, that is, “to create” aspects and/or conditions of the environment (which include life information to the patient) to which, by now, the patient does not have access or has lost access [4]

The fact of being able to work repeatedly and at one’s pace a certain part of the interaction with the world implies the possibility of “reexperiencing” the implications and consequences of that interaction many times. It is the same that occurs with one of the first and most known applications of VR: flight simulators. Multiple situations, difficulties, incidentals, errors, dramatic consequences can be practiced; although “actually” nothing happens. Progress produced in patient’s experience in an always feared (virtual) environment, will help him/her feel, live “the reality” in other way. The main thing is that everything is worked and practised with simulations of the reality which permit generating

new internal models about the world and about the patient's possibilities in his/her interaction with that world [22, 28]. These internal models will help the patient to conform a new level of self-evolution that allows him/her to perceive him/herself and the world from a new perspective.

Apart from all these general advantages of VR, we would like to add some other advantages that VR has when we compare it with traditional exposure therapies [15]. On one hand, compared to imagery exposure, VR exposure is more immersive since VR stimulates several sensorial modalities (e.g., auditory, visual). This might be very helpful for those persons who have difficulties to imagine the feared scenes. Moreover, the therapist can know at any time what the patient is seeing and, thereby he can know more easily what is causing distress or anxiety to the patient. On the other hand, and most significant, compared to in vivo exposure (one of the most effective techniques at the moment), VR exposure can help to surpass many of the limitations this technique has. First, VR can create environments difficult to be accessed in vivo. Second, virtual exposure can also be an alternative for those patients who are reluctant to start and/or complete an in vivo exposure program because they find it too aversive (an aspect related to the Axis II of the Clinical Guide or axis of effectiveness). And finally, VR exposure is also useful from an ethical point of view, offering to the patient a higher degree of confidentiality. This is the case, for instance, of treating an agoraphobic in a public transport, where the public can see the patient getting treated. VR treatment is applied in the therapist's consulting room so the person does not have to be afraid of losing control in front of others or to be worried about someone knowing his/her problem.

3. VR applications in Psychotherapy

The use of VR as a therapeutic tool, in the psychological field, has made a big impact in the last five years. The desire to improve people's quality of life has meant, at the same time, an evolution regarding the instruments used compared to the traditional tools in psychology. And this is not strange, because VR (as we have already seen) can facilitate several tasks that are very important for psychological therapy. Very recently, Hoorn, Konijn and Van der Veer [29] have stated some functions of VR (most of them have been largely mentioned in the anterior paragraph) that we think are translatable to the clinical field: a) VR can be helpful to explore dangerous or impossible events; b) in VR people can explore personal truths to experience their own emotions and comprehend unclear aspects of them relative to contexts in which emotions occur; c) VR helps to re-experience or re-live the past as with family photographs and home videos; d) mediated persons (avatars) in VR fulfil a modelling function in that one learns how to behave in specific circumstances. Furthermore VR may be also useful for entertaining and relaxing, and can satisfy the need for emotional experiences to recompense tedium and listless mess, and which motivate our behaviours [29].

In the revision made for this chapter we will only refer to the most important lines of work in psychological disorders, specifically we will present different works, in which authors have used VR technology for the treatment of anxiety disorders, eating disorders and sexual disorders. However, it is important to point out that relevant interventions have been carried out in other fields related to health with the purpose of improving the quality of life in those people who suffer from certain diseases and illnesses. Examples of this line of work are studies made with patients suffering from cancer both adults [e.g., 30, 31] and children [e.g., 32, 33] and people who suffer from pain and burns of different degrees [e.g., 34, 35].

3.1 Anxiety Disorders

The use of VR as an exposure technique for the treatment of anxiety disorders has been an important line of research that has received a great attention in the last years. As first *antecedents* it should be pointed out, on one hand, a work in which the efficacy of a very rudimentary tool (specifically some special glasses that altered the perception of depth) used by Schneider [36] to magnify the sense of height during in vivo exposure process was tested. On the other hand, deserve mention the first works that recommend the possible usefulness of VR for psychological treatments in general [24] and for the treatment of students' performance anxiety [41].

In the following lines specific advances in VR for the treatment of different anxiety disorders is presented.

- *Acrophobia*. The Kaiser-Permanente Medical Group of California developed a tests system to test the utility of VR in the treatment of acrophobia. In this system the patient has to pass through a depth gully crossing over a suspension bridge and a narrow board. The use of this system in 32 patients gave as a result a 90 per cent of success. Dr. Lamson, the person in charge of this project, stated that patients had the feeling of having coping with this fear and having overcome it, in his own words "it is an excellent tool to get a strong feeling of trust" [37]. Rothbaum and North's group at the University of Clark Atlanta published the first reports (a case report and a controlled study) on the usefulness of a software designed for the treatment of acrophobia in the mid 90s, [38-42]. In 1992 they developed the VREAM (Virtual reality development software package and libraries) by means of which they generated a virtual environment for the treatment of acrophobia. They created a scenario with an exterior elevator that reached to different heights and the patient could lean out of a balcony in every floor. The patient reported feeling a high degree of immersion in the virtual environment and in 8 sessions he could feel relaxed in a height level similar to a 15th floor. Recently, Emmelkamp's group has proved in a controlled study that VR is as effective as the most commonly used choosing method for the treatment of phobias, that is, in vivo exposure [43].
- *Spider phobia*. Firstly, the group at the University of Nottingham and the Institute of Psychiatry has developed a VR system for the treatment of arachnophobia. Patients wear a Head Mounted Display by means of which a virtual spider can be visualized. Its realism is gradually increasing until the patient's tolerance level allows him/her to face the spider in the real world [4]. More recently, Hoffman's group has proved the utility of VR applications for the treatment of arachnophobia using it jointly with augmented reality techniques. These authors have reported on the success obtained in a case report [44] and a controlled study [45].
- *Flying phobia*. Rothbaum's group has designed a software for the treatment of fear of flying. In a case report, this group informed on the utility of this procedure applied along 6 sessions with a duration of approximately 35-45 min. to a woman of 42 years old suffering from a severe fear of flying [46]. More recently, Rothbaum's group has tested the efficacy of virtual exposure therapy versus in vivo exposure in a controlled study [47]. Two years later, this group has published the first year-long follow-up of patients having been treated with VR exposure and results indicate that short-term treatment can have lasting effects [48]. Many other authors have also obtained good results using VR for the treatment of this phobia [49, 50, 42, 51]. Our

group has also developed a software for the treatment of flying phobia [52] and has demonstrated the utility of the procedure [53, 54].

- *Claustrophobia.* Our group has designed a software for the treatment of claustrophobia [55]. Results obtained in a case report have shown the utility of this procedure applied along 8 individual VR graded exposure sessions [56]. In other work, changes in other phobic behaviors not specifically treated were also obtained by using the same procedure [57]. Moreover, these results have been supported in other two studies; a case study [58] and a controlled multiple baseline design [59]. Therefore, we can already state that the claustrophobic virtual context is able to produce a remarkable amount of anxiety in patients, who can overcome the phobia with this virtual exposure treatment.
- *Post-traumatic stress disorder.* VR has also been used for the treatment of post-traumatic stress disorder. Hodges and Rothbaum have developed the first software and Vietnam War veterans are being treated by means of virtual scenarios that reproduce war images. They have already presented the results of a case study, where the first Vietnam combat veteran with post-traumatic stress disorder is treated with VR exposure [60], and a clinical trial [61] both with including 6-month follow-up data. The authors conclude that VR exposure therapy holds promise for treating post-traumatic stress disorders in Vietnam veterans. VR is also being used with people affected by the September 11 attacks.
- *Social phobia.* North's group at the University of Clark Atlanta is studying the usefulness of VR for the treatment of fear of public speaking. The person is immersed in a virtual scenario and while he/she is giving his/her speech the audience in front of him/her becomes gradually clearer resembling to a real audience. Rothbaum's group has also developed a procedure for treating this specific phobia and, in England, Slater [62] has been working on a software designed for this problem and on its validation [63]. On the other hand, Lee, Ku, Jang, Kim, Choi, Kim and Kim [64], have designed a virtual environment more realistic for the treatment of fear of public speaking by using image-based rendering and chroma keying simultaneously. With image-based rendering, images are stitched panoramically with the photos taken from a digital camera and the use of chroma keying allows a virtual audience to be controlled individually. Our group has developed a self-applied program that uses self-help tactics and telepsychology techniques for treating public speaking phobia. This program can be entirely self-applied by internet (<http://www.Internetmeayuda.com>) and has been clinically validated obtaining very good results [65-67]. On the other hand, Legeron's group has developed a VR program for the treatment of social phobia in the Telemedicine and Portable Virtual Environment in Clinical Psychology (VEPSY Updated) research project. A detailed description of this program is presented in a chapter of this book.
- *Driving phobia.* Preliminary studies have been done for treating driving phobia [68]. A case report has proved that VR can also be useful for the treatment of this disorder [69].
- *Panic Disorder and Agoraphobia.* North's group developed a software for treating agoraphobia and put it into practice in a subclinical population [42]. The results

showed that students in the virtual exposure condition improved in a significant way compared to a control group. However, the software developed by this group does not cover appropriately the whole cluster of fears that characterizes panic and agoraphobia disorders and the participants in this study were subclinical population. More recently, Jang, Ku, Shin, Choi, and Kim [70] have used a VR scene in seven patients in order to tackle the situations that people (who suffer agoraphobia) fear the most, but patients had difficulties with feeling immersed in the virtual world. Maybe the virtual environment could not activate user's anxiety. Moore, Wiederhold, Wiederhold and Riva [71] have used panic and agoraphobia virtual environments to determinate the physiological responses of nonphobics. According to these authors, it will be useful to explore differences between immersion, physiological responses, and self-report responses in nonphobics versus phobics. Our group has been working during the last years on designing a procedure that may prove useful for this important disorder in the setting of the VEPSY-Updated research project. We have developed and tested a software that covers nearly all the typical situations of the following cluster of phobias: panic attacks and agoraphobia. The program also gives an additional advantage since it is possible to simulate many physical sensations that people feel during their panic attacks (such as shortness of breath, blurred vision or tunnel vision) by using sounds and optical effects and, therefore, it is possible to use interceptive exposure, while exposure to external stimuli is taking place. The program has shown similar effectiveness to that achieved by in vivo exposure [72, 73]. In a chapter of this book more information about this program is offered.

3.2 Eating Disorders

Eating disorders (anorexia, bulimia and compulsive eating disorder) make up a complex diagnostic category that usually entails a serious state. One of the most serious psychological problems, present in the vulnerability, in the maintenance and in the relapses of these disorders, refers to perceptual distortions of the body image. This is an aspect that proves difficult to evaluate and to treat with the traditional psychological techniques. VR has become a new therapeutic tool that is being used more and more in these types of disorders. Riva, Bacchetta, Baruffi, Rinaldi and Molinari [74] presented a treatment for changing body image disturbances in persons with distortion and problems of not accepting their body, but without suffering the disorder. They used VEBIM (Virtual Environments for Body Image Modification), an immersive virtual environment that incorporates a cognitive behavioural therapy (in order to have an influence on the sensations of dissatisfaction) and a visual-motor therapy (to intervene in body perception levels). Later works [75-80] have confirmed the effectiveness of this therapeutic tool in eating habits with excellent results. Nevertheless, other psychological techniques have been proposed in conjunction with these technologies. Neubeck and Neubeck (1998) point to VR as one more support system, along with the psychodynamic treatment. It is used in anorexia nervosa cases and they combine VR, in the area of psychodrama, with psychodynamic theory obtaining good and more stable results.

This evaluation system was later compared to the VREPAR2 project, directed by Riva, Bacchetta, Baruffi, Defrance, Gatti, Galimberti, Nuges, Ferretti and Tonci [81], which includes a cognitive behavioural therapy aimed at exercising an influence on the sensations of body non acceptance and a methodology that joins the videorecording of particular gestures and movements that try to have an influence on the body perception level. The authors highlight the fact that in comparison to the traditional therapy, in which a

longer treatment is needed, VREPAR2 obtains effective results in a very short period of time. Later, Riva, Bacchetta, Cesa, Conti, Molinari [82] betted on the joint use of VR, telemedicine and experimental cognitive therapy (ECT) aimed at eating disorders, being effective for the motivation of body change. Former studies back these therapeutic tools for this psychological problem. Nevertheless, Murray and Gordon [83] obtained different results in similar studies to those of Riva, they did research on the body perception changes induced by the immersive VR, and they compared immersive and non-immersive environments. The results showed significant effects in both states, but there were no differences in sex or the condition of presentation. The results showed that immersive VR users showed a smaller level of conscious body self-perception. Nonetheless, it is necessary to point out the fact that Riva usually worked with VR cognitive therapy, thus the methodology used is different. The VR program for the treatment of eating disorders developed by Riva's group in the setting of the VEPSY-Updated project is fully described in a chapter of this book.

VR environments have also been used in the evaluation process. Riva [84] created a scale for the psychological evaluation of the body image, called *Body Image Virtual Reality Scale* (BIVRS). This scale is aimed at making people value their actual body obesity while they are immersed in the virtual environment and then choose the ideal body combining the discrepancy levels of non acceptance of their body.

In spite of the results reached by Murray and Gordon [83], other studies have obtained very beneficial therapy results for the treatment of eating disorders with VR.

Specifically, our group has designed a VR software composed by several scenarios for the treatment of body image disturbance in eating disorders [85, 86]. We have carried out a controlled study conducted in a clinical population, which consisted of a comparison of the efficacy of a VR component versus the traditional body image techniques [87].

Results showed, once again, the effectiveness of VR therapy for eating disorders.

Differences in the measures of eating disorders were no found; however, patients treated with VR showed a notable improvement both in depression and anxiety and a greater satisfaction with their bodies. Therefore, it was concluded that these results reveal that VR therapy is more effective than other traditional techniques for treating body image distortion in eating disorders.

Later, new methods have been suggested, but following the guidelines of other previously mentioned experiences. Alcañiz, Botella, Perpiñá, Baños, Lozano, Montesa, García-Palacios and Villa [88] presented a deformed model of a human body in 3D which they used with eating disorder patients. Patients were able to express how they perceived their own body with this method. Finally, very recently we have published a work where a pilot study in the area of body image disturbance and binge eating disorder using VR technology is described [89].

3.3 Sexual Disorders

Virtual environments have also been used for sexual disorders. Optale, Munari, Nasta, Pianon, Baldaro and Viggiano [90] carried out a treatment study on VR for treating impotence and premature ejaculation. The patients, who had benefits from the technique informed on a lasting improvement after a six-month therapy. In another study on sexual therapy, Optale, Chierichetti, Munari, Nasta, Pianon, Viggiano and Ferlin [91] studied the psychodynamic therapy along with the study of brain connections through a PET (Positron Emission Tomography). Results showed alterations in the metabolic function of the brain, in the frontal cortex and in the thalamus, the researchers also achieved a sexual satisfaction after therapy. These authors indicated that these brain areas seem to answer the combined

therapy of VR and psychotherapy. The VR program developed by Optale's group for the treatment of impotence and premature ejaculation in the setting of VEPSY Updated project is described in a chapter of this book.

On the other hand, it is necessary to point out in this section the fact that new technologies are favouring the appearance of new disorders in sexual behaviour. We are referring to what is usually known as cybersex since cases of "virtual sex" addiction are already being registered. In this sense, Delmonico and Carnes [92], who did research on this subject, recommend the use of a psychological test, the Internet Sex Screening Test, with the aim of evaluating if some people need help due to this addiction.

4. VR shortcomings

We do not want to finish this work without making a prudent attempt of "back to reality" as we already did in a past work about virtual reality and psychotherapy some years ago [6].

We defended then and we do now (and will keep defending in the future) the possible contributions that VR can have for the psychological treatments field.

Nevertheless, as we pointed out in that work, it is important not to confuse facts with fiction and the available facts reveal the convenience of indicating the shortcomings that this new tool has for the moment. We will see that some of the limitations indicated in 1998 have been improved or overcome.

- *The virtual world is still rudimentary.* The first virtual scenarios made of very simple textures and still quite artificial remember the cinema industry at the beginning with those fast movies of a unique shot and without sound. Nevertheless, nowadays this cannot be stated since in these few years a number of researchers are working in order to get a higher degree of realism and, it can be said that the very fast development of technology is allowing to construct more and more realistic environments which are being more efficacious to immerse the self in the virtual world. Moreover, other line of work that is receiving attention is trying to determine what psychological factors (or other kind) could be influencing the sense of presence and the reality judgement the person makes of the virtual environment. As for clinical population, results obtained by Baños, Botella, García-Palacios, Perpiñá, Quero and Gallardo [93] point out that in the VR application for clinical psychology, emotion seems to play an important role in the sense of presence and the reality attributions of users. Indeed, our group is currently developing a research project on the relation between emotion and presence, funded by the European Commission (EMMA: Engaging Media for Mental Health Applications) (<http://www.emma.upv.es>). Anyway, more research is needed about these issues bearing in mind that the main thing probably is to develop virtual environments clinically significant to the patients.
- *VR has clear limits.* Although the person can "live" the virtual experience many times, it is only an "adventure" from which he/she comes back to reality or from which it might be difficult to come back. Related to this, it is necessary to delimit the probable prejudicial effects stemmed from a misuse of VR.
- *VR can produce secondary effects.* In connection with the anterior point, it has been pointed out that virtual walks can produce secondary effects, basically disorientation and neural-vegetative symptoms (e.g., dizziness, nausea ...) and, in a lesser extent,

some ocular-motor disturbance. However, studies where it is indicated how to minimise and control these disturbances or prevent them have been carried out [94]. Nevertheless, these problems are not always produced and, besides it has been reported about the lack of these negative effects and, therefore, about the possibility of using VR techniques with clinical samples suffering from severe disorders such as anorexia or bulimia nervosa [95]. Hopefully these efforts give rise in a few time to systems which can be considered “safe” for future users. As clinicians we keep alert to the possible collateral effects that might be produced, although results obtained up to now reveal that these effects are very infrequent.

- *More data regarding VR efficacy are needed.* As can be derived from the literature revision of the applications and effectiveness of VR for anxiety disorders, eating disorders and sexual disorders presented in the anterior point of this chapter, this statement has changed after five years. Studies carried out up to now are finding that VR is not only an efficacious technique for the treatment of several anxiety disorders and central clinical aspects (specifically the body image distortion) of more severe disorders such as eating disorders, but VR techniques are obtaining better results compared to other traditional techniques of wide use (e.g., in vivo exposure). However, more controlled research is still needed to draw more firm conclusions, especially with regard to the great potential that VR might have from the perspective of Axis II of the Clinical Guide or axis of effectiveness.
- *VR is a new tool and a great part of the work remains to be done.* Although as we have already pointed out, the use of VR as a therapeutic tool in the psychological field has made a big impact in the last five years, we think this statement is still right. We cannot forget that this so interesting line of research has started only a few more than a decade ago, thereby many things remain to be done. A fundamental aspect of this work, still non-existent, is to structure a theoretical framework from which predictions can be made and results can be organised.

5. Future perspectives

In our view, VR has a great future and the applications appeared up till now are the beginning of a huge development that will take place in the coming years. As we have already pointed out, it is difficult to think of an application that cannot be created by using the technology currently existing; the problem of doing it is just a matter of time and money. The main point then changes to: in which fields to work?, what applications can have more sense or be more useful, have more impact to benefit more people? [96]. This challenge about what psychological cyberspace is convenient to be created affects all of us.

Although it is being made a lot of research on VR, many things remain to be done.

This becomes very obvious when, for instance, psychological applications are compared to those of medicine and surgery. However, the applications of VR to psychological treatments field are increasingly developing with its own identity and presence in the health area. And this is due to the fact that VR provides the possibility of adding, removing or emphasising details that help the clinical psychologist to perform his/her basic duties in a better way. These characteristics of VR can provide the patient specialised and safer assessment and treatment techniques for problems which up till now were very costly or even impossible to be evaluated or treated by means of traditional methods. For these reasons, VR is producing a great interest and is being given a great attention from Clinical Psychology.

Nevertheless, this interest and attention must be guided. We must avoid an excessive and useless growth that might take us into unproductive grounds. Indeed, one of the big problems we might find is to start designing or developing products that become “a solution looking for a problem”. We never must forget that there are no answers by themselves, but there are answers to questions and that VR maybe cannot offer us the way of making questions. The psychologist will always must do this, or at least in the world how we understand it currently.

Therefore, to create a useful application for Clinical Psychology at present, we first would have to ask ourselves: what can be it used for? It has to be emphasised that technical characteristics of virtual worlds change very rapidly, but what does not change and will never change is the user of virtual reality. For that, it is important that before starting designing VR applications we make to ourselves the following basic questions: It can be achieved the same objective by using a more simple approach? And how VR approach can be fitted to the features of the target clinical population?

In conclusion, at present VR has shown that it can be very useful in the treatment of many psychological problems. And, most important is the fact that VR can be effective with relatively cheap hardware and software on stand-alone computers currently on the market [e.g., 43]. So we think that in the next years VR can turn into a key tool and not only because of its effectiveness, which is very important, but also because of the advantages it offers in comparison to other therapies. If the VR field keeps up the development speed it has had up to now, in a few years VR can be in all clinical consulting rooms. Indeed, we expect to happen in Clinical Psychology the same thing that has happened during the past fifty years in Medicine. It is now unthinkable that for many problems medicine does not have a series of sophisticated and expensive tools that enable doctors a more precise diagnosis and intervention. It is true that VR implies an economical investment. But if benefits obtained with VR are adequate, from a cost-benefit perspective, VR will be cost-effective. With VR, the new technologies have definitely entered the field of psychological therapies.

References

- [1] I. Sutherland, *A head-mounted three dimensional display*, FCCC, 33, **1968**, pp. 757-764.
- [2] J. Vince, *Virtual reality systems*, ACM Press, Cambridge, **1995**.
- [3] C. Grimsdale, *Foreword*, in: J. Vince, *Virtual reality systems*, ACM Press, Cambridge, **1995**.
- [4] J. Wann, S. Rushton, M. Smyth, and D. Jones, Rehabilitative environments for attention and movements disorders, *Communications of the ACM*, 40, **1997**, pp. 49-52.
- [5] G. Burdea, Virtual Reality Systems and Applications, *Electro'93 International Conference, Short Course*, NJ: Edison, **1993**.
- [6] C. Botella, R. Baños, C. Perpiñá, and R. Ballester, Realidad virtual y tratamientos psicológicos, *Análisis y Modificación de Conducta*, 24, **1998**, pp. 5-26.
- [7] K. Lorenz, *La otra cara del espejo*, Plaza y Janés, Madrid, **1974**.
- [8] S. Korshin and S. Sands, *Principles common to all psychotherapies*, in C. E. Walker (ed.), *The handbook of clinical psychology*, Dow Jones-Irwin, New York, **1983**.
- [9] C. Botella, R., Baños and C. Perpiñá, Realidad Virtual y Psicoterapia: La aventura de superar el problema, *V Congreso Internacional Sobre Constructivismo En Psicoterapia*, Santa Cruz de Tenerife, Spain, **1996**.
- [10] C. Botella, Realidad virtual y tratamientos psicológicos, *III Congreso Internacional de Psicología Conductual*, Granada, Spain, **1997**.
- [11] C. Botella, El tratamiento de la claustrofobia por medio de la realidad virtual, *I Congreso de la Asociación Española de Psicología Clínica y Psicopatología*, Madrid, Spain, **1997**.
- [12] P.E. Nathan and J.M. Gorman, *A Guide to Treatments That Work*, Oxford University Press Inc., New York, **1998**.

- [13] P.E. Nathan and J.M. Gorman, *A Guide to Treatments That Work (2nd Edition)*, Oxford University Press Inc., New York, **2002**.
- [14] C. Perpiñá, C. Botella and R. Baños, Realidad Virtual y psicología: Un heurístico en ambas direcciones, *Psicologemas*, 11, **1997**, pp. 127-146.
- [15] C. Botella, R.M. Baños, C. Perpiñá, M. Alcañiz, H. Villa and A. Rey, Virtual reality treatment of claustrophobia: A case report, *Behaviour Research and Therapy*, 6, **1998**, pp. 239-246.
- [16] R.M. Baños, C. Botella and C. Perpiñá, Virtual reality and psychopathology, *CyberPsychology and Behavior*, 2, **1999**, pp. 283-292.
- [17] B.K. Wiederhold, Preface, in: G. Riva, B.K. Wiederhold, and E. Molinari (Eds), *Virtual environments in clinical psychology and neuroscience*, IOS Press, Amsterdam, **1998**.
- [18] J. Frank, *Persuasion and cure*, John Hopkins Press, Baltimore, **1974**.
- [19] G. A. Kelly, *The Psychology of personal constructs*, Norton, New York, **1955**.
- [20] J. Bowlby, *Attachment and loss, Vol. 2: Separation, anxiety and anger*, Basic Books, New York, **1973**.
- [21] V. Guidano and G. Liotti, *Cognitive processes and emotional disorders*, Guilford Press, New York, **1983**.
- [22] C. T. Tart, Multiple personality, altered states and virtual reality: the world simulation process approach, *Dissociation*, 3, **1991**, pp. 222-233.
- [23] P. Watzlawick, J.H. Weakland and R. Fisch, *Change, principles of problem formation and problem resolution*, Norton, New York., **1974**.
- [24] A. Bandura, Self-efficacy: Toward a unifying theory of behavior change, *Psychological Review*, **1977**, 84, pp. 191-215.
- [25] D.J. Bem, Self-perception theory: An alternative interpretation of cognitive dissonance phenomena, *Psychological Review*, 74, 1972, pp. 183-200.
- [26] V. Frankl, Paradoxical intention. A logotherapeutic Technique. *American Journal of Psychotherapy*, **1960**, 14, pp. 520-535.
- [27] V. Frankl, *Logos, paradoja y la búsqueda de significado*. In M.J. Mahoney and A. Freeman, eds., *Cognición y Psicoterapia*, Paidós, Barcelona (original edition, 1985), **1988**.
- [28] A. Korzybski, *Science and sanity: An introduction to non-Aristotelian systems and general semantics*, The International Non-Aristotelian Publishing Company, Lakeville, Connecticut, **1958**.
- [29] J.F. Hoorn, E. Konijn and G.C. Van der Veer, Virtual Reality: Do Not Augment Realism, Augment Relevance, *UPGRADE - The European Online Magazine for the IT Professional*, Available on line: <http://www.upgrade-cepis.org>, IV(1), **2003**, pp 18-26.
- [30] H. Oyama, Virtual Reality for the Palliative Care of Cancer, in: G. Riva (Ed), *Virtual Reality in Neuro-Psycho-Physiology*, IOS Press, Amsterdam, **1998**, pp. 87-94.
- [31] D.D. Greene, Personal Stories within Virtual Environments: Creating three Experiences in Cancer Information Software, in: G. Riva, B. K.Widerhold and E. Molinari (Eds.), *Virtual Environment in Clinical Psychology and Neuroscience*, IOS Press, Amsterdam, **1998**, pp. 151-160.
- [32] S.M. Schneider and M.L. Workman, Effects of virtual reality on symptom distress in children receiving chemotherapy, *CyberPsychology and Behavior*, 2, **1999**, pp. 125-134.
- [33] G. Holden, D.J. Bearison, D.C. Rode, G. Rosenberg and M. Fishman, Evaluating the effects of a virtual environment with hospitalised children, *Research on Social Work Practice*, 9, **1999**, pp. 365-382.
- [34] H.G. Hoffman, A. Garcia-Palacios, D.R. Patterson, M. Jensen, T.A. Furness and W.F. Jr. Ammons, The effectiveness of virtual reality for dental pain control: a case study, *Cyberpsychology & Behavior*, 4, **2001**, pp. 527-535.
- [35] H.G. Hoffman, D.R. Patterson, G.J. Carrougher, D. Nakamura, M. Moore, A. Garcia-Palacios and T.A. Furness, The effectiveness of virtual reality pain control with multiple treatments of longer duration: A case study, *International Journal of Human Computer Interaction*, 13, **2001**, pp. 1-12.
- [36] J. Schneider, Lens-assisted in vivo desensitisation to heights. *Journal of Behaviour Therapy and Experimental Psychiatry*, 13, **1982**, pp. 333-336.
- [37] D. Knox, C. Schacht and J. Turner, Virtual reality: A proposal for treating test anxiety in college students, *College Student Journal*, 27, **1993**, pp. 294-296.
- [38] B. Rothbaum, L. Hodges, R. Kooper, D. Opdyke, J. Williford and M. North, Effectiveness of computer generated (Virtual reality) graded exposure in the treatment of acrophobia, *American Journal of Psychiatry*, 152, **1995**, pp. 626-628.
- [39] V.O. Rothbaum, L.F. Hodges, R. Kooper, D. Opdyke, J.S. Williford and M. North, Virtual-Reality Graded Exposure in the Treatment of Acrophobia - A Case Report, *Behaviour Therapy*, 26, **1995**, pp. 547-554.

- [40] M. North and S. North, Virtual environments and psychological disorders, *Electric Journal of Virtual Culture*, 2, **1994**, pp. 25-34.
- [41] M. North and S. North, Virtual reality psychotherapy, *The Journal of Medicine and Virtual Reality*, 1, **1996**, pp. 28-32.
- [42] M. North, S. North and J. Coble, *Virtual reality therapy*, I.P.I. Press, Ann Arbor, Michigan, **1997**.
- [43] P.M.G. Emmelkamp, M. Krijn, A.M. Hulsbosch, S. de Vries, M.J. Schuemie and C.A.P.G. van der Mast, Virtual reality treatment versus exposure in vivo: a comparative evaluation in acrophobia, *Behaviour Research and Therapy*, 40, **2002**, pp. 509-516.
- [44] A.S. Carlin, H.G. Hoffman and S. Weghorst, Virtual reality and tactile augmentation in the treatment of spider phobia: a case report, *Behaviour Research and Therapy*, 35, **1997**, pp. 153-158.
- [45] A. García-Palacios, H.G. Hoffman, A. Carlin, T.A. Furness and C. Botella, Virtual Reality in the treatment of spider phobia: A controlled study, *Behaviour Research & Therapy*, 40, **2002**, pp. 983-993.
- [46] V.O. Rothbaum, L. Hodges, B.A. Watson, G.D. Kessler and D. Opdyke, Virtual-Reality Exposure Therapy in the Treatment of Fear of Flying - A Case-Report, *Behaviour Research and Therapy*, 34, **1996**, pp. 477-481.
- [47] B.O. Rothbaum, L.F. Hodges, S. Smith, J.H. Lee and L. Price, A Controlled Study of Virtual Reality Exposure Therapy for the Fear of Flying, *Journal of Consulting and Clinical Psychology*, 68, **2000**, pp. 1020-1026.
- [48] B. O. Rothbaum, L.F. Hodges, P.L. Anderson, L. Price and S. Smith, Twelve-Month Follow-Up of Virtual Reality and Standard Exposure Therapies for the Fear of Flying, *Journal of Consulting and Clinical Psychology*, 70, **2002**, pp. 428-432.
- [49] M. Kahan, J. Tanzer, D. Darvin and F. Borer, Virtual reality-assisted cognitive-behavioral treatment for fear of flying: Acute treatment and follow-up, *CyberPsychology and Behavior*, 3, **2000**, pp. 387-392.
- [50] N. Maltby, I. Kirsch, M. Mayers and G.J. Allen, Virtual Reality Exposure Therapy for the Treatment of Fear of Flying: A Controlled Investigation, *Journal of Consulting and Clinical Psychology*, 70, **2002**, pp. 1112-1118.
- [51] A. Müehlberger, M.J. Herrmann, G. Wiedemann, H. Ellgring and P. Pauli, Repeated exposure of flight phobics to flights in virtual reality, *Behaviour Research and Therapy*. 39, **2001**, pp. 1033-1050.
- [52] J. Osma, *Tratamiento de la fobia a volar mediante Realidad Virtual*, Dissertation, **2002** (unpublished manuscript).
- [53] R. Baños, C. Botella, C. Perpiñá and S. Quero, Tratamiento mediante realidad virtual para la fobia a volar: un estudio de caso, *Clínica y Salud*, 12, **2001**, pp. 391-404.
- [54] R.M., Baños, C. Botella, C. Perpiñá, M. Alcañiz, J.A. Lozano, J. Osma and M. Gallardo, Virtual Reality Treatment of Flying Phobia, *IEE- Transacción on information technology in BioMedicine*, 6, **2002**, pp. 206-211.
- [55] C. Botella, S. Quero, C. Perpiñá, R.M. Baños, M. Alcañiz, J.A. Lozano and A. Rey, Virtual environments for the treatment of claustrophobia, *International Journal of Virtual Reality*, 3, **1998**, pp. 8-13.
- [56] C. Botella, R.M. Baños, C. Perpiñá, H. Villa, M. Alcañiz and A. Rey, Virtual reality treatment of claustrophobia: a case report, *Behaviour Research and Therapy*, 36, **1998**, pp. 239-246.
- [57] C. Botella, H. Villa, R. Baños, C. Perpiñá and A. García-Palacios, The Treatment of Claustrophobia with Virtual Reality: Changes in Other Phobic Behaviors Not Specifically Treated, *CyberPsychology & Behavior*, 2, **1999**, 135-141.
- [58] C. Botella, R.M. Baños, C. Perpiñá, S. Quero, H. Villa, A. García-Palacios and S. Fabregat, El tratamiento de la claustrofobia por medio de RV, *Análisis y Modificación de Conducta*, 28, **2002**, pp. 110-127.
- [59] C. Botella, R.M. Baños, H.Villa, C. Perpiñá and A. García-Palacios, Virtual Reality in the treatment of claustrophobic fear: a controlled multiple baseline design, *Behavior Therapy*, 31, **2000**, pp. 583-595.
- [60] B.O., Rothbaum, L. Hodges, R. Alarcon, D. Ready, F. Shahr, K. Graap, J. Pair, P. Hebert, D. Gotz, B. Wills and D. Baltzell, Virtual reality exposure therapy for PTSD Vietnam veterans: A case study, *Journal of Traumatic Stress*, 12, **1999**, pp. 263-271.
- [61] B.O. Rothbaum, L.F. Hodges, D. Ready, K. Graap and R.D. Alarcon, Virtual reality exposure therapy for Vietnam veterans with posttraumatic stress disorder, *Journal of Clinical Psychiatry*, 62, **2001**, pp. 617-622.
- [62] M. Slater, D.P. Pertaud and A. Steed, Public speaking in virtual reality: Facing an audience of avatars, *IEEE Computer Graphics and Applications*, 19, **1999**, pp. 6-9.

- [63] D.P. Pertaub, M. Slater and C. Barker, An experiment on public speaking anxiety in response to three different types of virtual audiences, *Presence-Teleoperators and Virtual Environments*, 11, **2002**, pp. 6878.
- [64] J.M. Lee, J.H. Ku, D.P. Jang, D.H. Kim, Y.H. Choi, I.Y. Kim and S.I. Kim, Virtual reality system for treatment of the fear of public speaking using image-based rendering and moving pictures, *Cyberpsychology and Behavior*, 5, **2002**, pp. 191-195.
- [65] C. Botella, R.M. Baños, V. Guillén, C. Perpiñá, M. Alcañiz and A. Pons, Telepsychology: Public speaking fear treatment on the Internet, *CyberPsychology & Behavior*, 3, **2000**, pp. 959-968.
- [66] V. Guillén, *Miedo a Hablar en Público: Un tratamiento autoaplicado en Internet*, Dissertation, **2001** (unpublished manuscript).
- [67] C. Botella, R.M. Baños, V. Guillén, C. Perpiñá, M. Alcañiz, A. Pons and A. García Palacios, Telepsychology: Public Speaking Fear Treatment in Internet, *The 9th Annual Medicine Meets Virtual Reality Conference*, Newport Beach, California, **2001**.
- [68] D.P. Jong, I.Y. Kim, S.W. Nam, B.K. Wiederhold, M.D. Wiederhold and S.I. Kim, Analysis of psychological response to two virtual environments: Driving and flying simulations, *CyberPsychology & Behavior*, 5, **2002**, pp. 11-18.
- [69] J. Wald and S. Taylor, Efficacy of virtual reality exposure therapy to treat driving phobia: A case report, *Journal of Behavior Therapy and Experimental Psychiatry*, 31, **2000**, pp. 249-257.
- [70] D.P. Jang, J.H. Ku, M.B. Shin, Y.H., Choi and S.I. Kim, Objective validation of the effectiveness of virtual reality psychotherapy, *CyberPsychology and Behavior*, 3, **2000**, pp. 369-374.
- [71] K. Moore, B.K. Wiederhold, M.D. Wiederhold and G. Riva, Panic and agoraphobia in a virtual world, *Cyberpsychology and Behavior*, 5, **2002**, pp. 197-202.
- [72] C. Botella, R. Baños, S. Quero, C. Perpiñá, A. García-Palacios, H. Villa and V. Guillén, Virtual Reality Exposure versus in vivo exposure in the Treatment for Panic Disorder and Agoraphobia, *36th Annual Convention of Association for Advancement of Behavior Therapy*, Reno, USA, **2002**.
- [73] C. Botella, R.M., Baños, H., Villa, V. Guillén, M. Jorquera, S. Fabregat and M.J. Gallego, Effectiveness of Virtual Reality for the treatment of Panic Disorder and Agoraphobia, *Cybertherapy 2003*, San Diego, USA, **2003**.
- [74] G. Riva, M. Bacchetta, M. Baruffi, S. Rinaldi and E. Molinari, Experiential Cognitive Therapy: a VR Based Approach for the Assessment and Treatment of Eating Disorders, in: G. Riva, B. K. Wiederhold and E. Molinari (Eds.), *Virtual Environment in Clinical Psychology and Neuroscience*, IOS Press, Amsterdam, **1998**, pp. 120-135.
- [75] C. Perpiñá, R. Baños, C. Botella and J.H. Marco, La realidad virtual como herramienta terapéutica: un estudio de caso en alteraciones de la imagen corporal en los trastornos alimentarios, *Revista Argentina de Clínica Psicológica*, 10, **2001**, pp. 227-241.
- [76] G. Riva, M. Bacchetta, M. Baruffi, G. Cirillo and E. Molinari, Virtual reality environment for body image modification: A multidimensional therapy for the treatment of body image in obesity and related pathologies, *CyberPsychology and Behavior*, 3, **2000**, pp. 421-431.
- [77] G. Riva, M. Bacchetta, M. Baruffi, S. Rinaldi, F. Vincelli and E. Molinari, Realtà virtuale e trattamento dei disturbi del comportamento alimentare / Virtual reality and the treatment of eating disorders, *Psicoterapia Cognitiva e Comportamentale*, 16, **2000**, pp. 173-184.
- [78] G. Riva, M. Bacchetta, M. Baruffi and E. Molinari, Virtual reality-based multidimensional therapy for the treatment of body image disturbances in obesity: A controlled study, *CyberPsychology and Behavior*, 4, **2001**, pp. 511-526.
- [79] G. Riva, M. Bacchetta, M. Baruffi, S. Rinaldi and E. Molinari, Virtual reality based experiential cognitive treatment of anorexia nervosa, *Journal of Behavior Therapy and Experimental Psychiatry*, 30, **1999**, pp. 221-230.
- [80] G. Riva, M. Alcañiz, L. Anolli, M. Bacchetta, R. Baños, F. Beltrame, C. Botella, C. Galimberti, L. Gamberini, A. Gaggioli, E. Molinari, G. Mantovani, P. Nugues, G. Optale, G. Orsi, C. Perpiñá and R. Troiani, The VEPSY Updated Project: Virtual Reality in Clinical Psychology, *Cyberpsychology and Behavior*, 4, **2001**, pp. 449-456.
- [81] G. Riva, M. Bacchetta, M. Baruffi, C. Defrance, F. Gatti, C. Galimberti, P. Nugues, G.S. Ferretti and A. Tonci, VREPAR 2: VR in eating disorders, *CyberPsychology and Behavior*, 2, **1999**, pp. 77-79.
- [82] G. Riva, M. Bacchetta, G. Cesa, S. Conti and E. Molinari, Virtual reality and telemedicine based experiential cognitive therapy: Rationale and clinical protocol, in: G.Riva and C. Galimberti, (Eds.), *Towards cyberpsychology: Mind, cognition and society in the internet age*, IOS Press. XVIII, Amsterdam, Netherlands Antilles, **2001**, pp. 273-309.
- [83] C.D. Murray and M.S. Gordon, Changes in bodily awareness induced by immersive virtual reality, *CyberPsychology and Behavior*, 4, **2001**, pp. 365-371.

- [84] G. Riva, Virtual reality in psychological assessment: The Body Image Virtual Reality Scale, *CyberPsychology and Behavior*, 1, **1998**, pp. 37-44.
- [85] C. Perpiñá, C. Botella and R.M. Baños, Las nuevas tecnologías aplicadas a los trastornos alimentarios: la realidad virtual en las alteraciones de la imagen corporal, in: D. Kirszman and M.C. Salgueiro (Eds.), *El enemigo en el espejo*, TEA Ediciones, Madrid, Spain, **2002**.
- [86] C. Perpiñá, C. Botella and R. Baños, *Body image in eating disorders: Virtual reality assessment and treatment*, Promolibro, Valencia, Spain, **2002**.
- [87] C. Perpiñá, C. Botella, R.M. Baños, H. Marco, M. Alcañiz and S. Quero, Body image and virtual reality in eating disorders: exposure by virtual reality is more effective than the classical body image treatment?, *Cyberpsychology and Behavior*, 2, **1999**, pp. 149-159.
- [88] M. Alcañiz, C. Botella, C. Perpiñá, R. Baños, J.A. Lozano, J. Montesa, A. García- Palacios and H. Villa, A new realistic 3D body representation in virtual environments for the treatment of disturbed body image in eating disorders, *CyberPsychology and Behavior*, 3, **2000**, pp. 433-439.
- [89] C. Perpiñá, C. Botella and R.M. Baños, Virtual Reality in Eating Disorders, *European Eating Disorders Review*, 11, **2003**, pp. 261-278.
- [90] G. Optale, A. Munari, A. Nasta, C. Pianon, J.B. Baladro and G. Viggiano, A VR Based Therapy for the Treatment of Impotence and Premature Ejaculation, in: G. Riva, B. KWiderlhold and E. Molinari (Eds.), *Virtual Environment in Clinical Psychology and Neuroscience*, IOS Press, Amsterdam , **1998**, pp. 136-139.
- [91] G. Optale, F. Chierichetti, A. Munari, A. Nasta, C. Pianon, G. Viggiano, and G. Ferlin, PET supports the hypothesized existence of a male sexual brain algorithm that may respond to treatment combining psychotherapy with virtual reality, *CyberPsychology and Behavior*, 2, **1999**, pp. 157-159.
- [92] D.L. Delmonico and P.J. Carnes, Virtual sex addiction: When cybersex becomes the drug of choice, *CyberPsychology and Behavior*, 2, **1999**, 457-463.
- [93] R.M. Baños, C. Botella, A. García-Palacios, S. Quero and M. Gallardo, The role of reality judgement and presence in virtual environments in clinical psychology, *World Congress of Behavioral and Cognitive Therapies*, Vancouver, **2001**.
- [94] K. Stanney and R. Kennedy, The psychometrics of Cybersickness, *Communications of the ACM*, 40, **1997**, pp. 67-68.
- [95] G. Riva, L. Melis and M. Bolzoni, Treating Body-image disturbances, *Communications of the ACM*, 40, **1997**, pp. 69-71.
- [96] D. Inman, K. Loge and J. Leavens, Virtual reality and rehabilitation, *Communications of the ACM*, 40, **1997**, pp. 53-58.