

7 The use of VR in the treatment of Eating Disorders

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Abstract. In the treatment of eating disorders, the cognitive behavioral therapy (CBT) is still considered the best approach but could present different limitations related to costs of behavioural procedures (such as exposure and desensitization) or difficulty of cognitive techniques (such as imagination of daily scenarios). The major aim of this contribution is the description of a new Virtual Reality-enhanced treatment named Experiential Cognitive Therapy (ECT). Rationale and protocols about this new approach are explained. Moreover data about clinical trials, carried on with the VEPSY Project, are shown comparing different groups: experimental group (ECT), cognitive-behavioural therapy group (CBT), nutritional group and control group.

1. Introduction

In the past decade medical applications of virtual reality (VR) technology have been rapidly developing, and the technology has changed from a research curiosity to a commercially and clinically important area of medical informatics technology [1]. As noted by Szekely and Satava [1] “Computer modelling and simulation have become increasingly important in many scientific and technological disciplines owing to the wealth of computational power... Likewise, the development of techniques for acquiring data (for example, medical imaging) has enabled the easy generation of high resolution copies of real world objects from the computer's memory. The development of imaging technologies, such as magnetic resonance imaging, computed tomography, and ultrasound, has made the acquisition of highly detailed anatomical and partially functional models of three dimensional human anatomy a routine component of daily clinical practice” (p. 1305).

This lead to an increasing number of VR applications in medicine [2, 3]. Virtual Environments (VEs) for health care are being developed in the following areas: surgical procedures (remote surgery or telepresence [4, 5], augmented or enhanced surgery [6, 7], and planning and simulation of procedures before surgery) [8, 9]; medical therapy [10-15]; preventive medicine and patient education [16]; medical education and training [17, 18];

visualization of massive medical databases [19]; skill enhancement and rehabilitation [20]; and architectural design for health-care facilities [21].

However, there is a growing recognition that VR can play an important role in clinical psychology, too [22]. One of the main advantages of a virtual environment for clinical psychologists is that it can be used in a medical facility, thus avoiding the need to venture into public situations. Infact, in most of the previous studies, VEs are used to simulate the real world and to assure the researcher full control of all the parameters implied. VR constitutes a highly flexible tool which makes it possible to programme an enormous variety of procedures of intervention on psychological distress. The possibility of structuring a large amount of controlled stimuli and, simultaneously, of monitoring the possible responses generated by the user of the programme offers a considerable increase in the likelihood of therapeutic effectiveness, as compared to traditional procedures [23].

The possibilities offered by VR to clinicians are now improved by the diffusion of the Internet. Since the development of methods of electronic communication, clinicians have been using information and communication technologies for the exchange of health-related information. However, the emergence of new shared media, such as the Internet and virtual reality are changing the ways in which people relate, communicate, and live.

Health care is one of the areas that could be most dramatically reshaped by these new technologies. Distributed communication media could become a significant enabler of consumer health initiatives. In fact, they provide an increasingly accessible communication channel for a growing part of the population. Moreover, in comparison with traditional communication technologies, shared media offer greater interactivity and better tailoring of information to individual needs.

E-health, the integration of and telehealth technologies with the Internet and shared virtual reality is the next logical step. Although e-health is a branch of telehealth, it is differentiated in several important ways. As noted by Allen [24] telehealth to date has been largely non-Internet based and has been characterized by point-to-point (e.g., T1) and dial-up (e.g., telephone, ISDN) information exchange. E-health, on the other hand, is more accessible because of its increasingly affordable ability to communicate through a common set of standards and across operating systems.

This Section presents a promising combined use of VEs and telemedicine in the assessment and treatment of eating disorders [25-29]. Specifically it describes the characteristics of the Experiential Cognitive Therapy (ECT) - a VR and telemedicine based treatment to be used in eating disorders' assessment and treatment - by systematic analysis of its rationale and different phases.

2. Cognitive Behavioral Therapy in Eating Disorders: some challenges for the future

Cognitive-behavioral therapy (CBT) for eating disorders can be described as "a symptom-oriented approach that focuses on the beliefs, values, and cognitive processes that maintain the eating disordered behavior" [30, p. 436]. This approach is based on the theory that certain cognitive characteristics such as low self-esteem, distorted beliefs about the "meaning" of weight, shape, and appearance, dichotomous logic and perfectionism lead to an over concern about one's body size [31, 32]. This preoccupation leads to the use of compensatory behaviors, such as self-induced vomiting, fasting, excessive exercise and abuse of diuretics or laxatives [33].

The widespread use of CBT derives directly from Fairburn's publication of a detailed treatment manual for the treatment of Bulimia Nervosa [34, 35]. As described by Fairburn and Cooper [36], CBT consists of 19 sessions of individual treatment lasting about 20 weeks. The treatment has three stages. The phase one incorporates the use of

psycho-educational principles and behavioral techniques designed to disrupt the cycle of binge eating and purging and help the individual normalize their eating patterns. Self-monitoring, through the use of daily food journals, is firmly established during this phase of treatment. In phase two, cognitive restructuring and problem solving are used to help the individual identify and challenge distorted thoughts, beliefs, and values that are maintaining the eating disorder. Interpersonal and environmental stressors that trigger bulimic episodes are explored and alternative methods of coping are identified. The final phase of treatment focuses on relapse prevention strategies and the maintenance of progress.

In the cognitive-behavioral approach to the treatment of anorexia nervosa, the therapist focuses on using cognitive restructuring to change distorted beliefs and attitudes [31]. Targets of the treatment are the "meaning" of weight, shape and appearance, which are believed to underlie dieting and fear of weight gain [37]. Recovery from anorexia nervosa is achieved by coupling the use of specific behavioral techniques, which address the normalization of eating patterns and weight restoration (e.g., the use of food diaries, meal plans incremental weight gain), with the use of cognitive techniques (e.g., cognitive restructuring, problem solving, identification and expression of affect), designed to improve self-esteem and develop a sense of personal effectiveness [30].

However, as noted by Mizes [38], some aspects of the actual practice guidelines for CBT "...are based on a combination of research-based recommendations and clinical consensus because of significant gaps in the extant research" (p. 387). In particular there are at least four themes that are somehow neglected by current guidelines for eating disorders: body experience disturbances [39, 40], self efficacy and motivation for change [41], interpersonal relationships [42-44] and the integration between all the different professional figures involved in the treatment [45].

Even if all these themes are widely discussed in literature, the recommended clinical practice for them are more based on "expert consensus" than on scientific data. Infact, little empirical work has been done to point out the content of clinical guidelines and to validate their efficacy in treatment.

It is well known that few eating disordered patients are not over concerned with their physical body [46]. It is also known that for most patients, changing the body experience is the hardest part of their recovery [47]. However, standard eating disorder programs provide less therapy and have a smaller treatment effect for body image compared with eating behavior [40, 48].

The same happens when clinicians have to face the lack of motivation for change.

The denial of the disorder and resistance to treatment are two of the most vexing clinical problems in these pathologies [41]. Given the importance of managing resistance for successful treatment, it is surprising that so little research has been done in this area [38].

Moreover, clinical observations of eating disordered patients have described their difficulty engaging in and deriving gratification from non-food-related activities. Following this point Lehman and Rodin [49] suggest that food can be viewed as a primary source of psychological nurturance by these individuals: they use food to compensate for their inability to get gratification from non-food-related activities. As recently found in a research by Cooley and Toray [50] symptoms of eating pathology were associated with figure dissatisfaction, ineffectiveness, self-efficacy to control eating when experiencing negative feelings, and reward conditions.

It is also well known that the other widespread approaches to the treatment of eating disorders - Interpersonal Therapy, Psychodynamic approach and Family Therapy – have their focus on the patient's interpersonal relationships [42-44]. The stated rationale of Interpersonal Therapy was that the eating disorder occurs as a response to interpersonal

disturbances (e.g., social isolation, fears of rejection) and consequent negative moods. So, the treatment aims at encouraging mastery of current social roles and adaptation to interpersonal situations.

Moreover, according to psychodynamic and family systems theorists an eating disorder can be considered a reflection or symptom of a deeper, more pervasive problem in the family's role structure, affective expression, relationship dynamic, and style of interacting [51-53]]. As a result, the anorexic or bulimic child has difficulty separating from the family and consolidating an individual identity.

However, standard CBT therapy is more focused on addressing food related cognitions and behaviors than on the development of an empowerment process producing enhanced feelings of self-efficacy, perceived competence and a better approach to interpersonal situations.

Finally, based on current knowledge, a comprehensive program involving different approaches is likely to be needed for obtaining and maintaining results in therapy [54].

3. A new VR and Telemedicine based approach: Experiential Cognitive Therapy

For many years, research and practice in eating disorders and weight management have been based largely on a unidimensional, simplistic, weight-loss/weight-gain paradigm because of the common assumption that the major cause of obesity is overeating [55]. In spite of this widespread assumption, however, a review of the literature does not support the notion that fat individuals consume more calories than their lean counterparts. A review of 20 studies by Wooley and colleagues [56] and the findings of two more reviews [57, 58] suggest that, generally, fat people probably do not consume more calories than people who are not overweight. Thus, if fat people do not necessarily eat any more than thinner people, the prescription of a diet may not be warranted or reasonable. This is probably why the long-term success rate for persons using this paradigm has been low [59]. Moreover, more recent follow-up studies after a weight-loss intervention have shown how frequent dieters usually have significantly more weight regain than less frequent dieters [60, 61].

To overcome this unsuccessful approach, our work follows some new thinking in this area of weight and eating disorders treatment [62, 63] that recognizes the dangers of chronic dieting and proposes a focus on body image, motivation for change, self-efficacy, self-acceptance and better nutrition. Specifically our program stresses the following: (a) understanding the origins and reinforcement of negative attitudes toward body image; (b) redefining beauty with regard to fatness and thinness; (c) examining, treating, and decreasing the restriction in activities and negative feelings many eating disordered patients experience; (d) teaching clients empowerment techniques to support motivation to change and self-efficacy, and (e) developing individualized treatment plans regarding eating behaviors and exercise. We hypothesize that the proposed approach would be effective in increasing the number and variety of clients' daily activities, decreasing their fat phobic attitudes and depression, and increasing their self-esteem.

Experiential-Cognitive Therapy for eating disorders is a relatively short-term, integrated, patient oriented approach that focuses on individual discovery [64]. The treatment lasts about 28 weeks - 4-week inpatient/outpatient treatment and 24-week telemedicine (Internet based) treatment - and it is administered by therapists having a cognitive-behavioral orientation who work in conjunction with a psychiatrist as far as the pharmacological component is concerned.

When a multidisciplinary treatment is mandatory (e.g., a suicidal patient), Experiential CT is conducted on an inpatient basis. However, Experiential CT can be profitably applied also to non hospitalized patients. In this case the treatment has to include

nutritional counselling and physical activity to help patients learn to regulate their eating and cope with specific high-risk situations (i.e., increased availability of food or limited control) that cannot be adequately addressed during outpatient therapy.

During the first phase (see Table 1), the different therapists carry out one *step* of the psychological process, both with individual and group sessions. The individual work regards assessment by means of psychometric tests, weekly supportive psychological talks, sessions for assessment and therapy carried out using Virtual Reality (VR), and psychopharmacological assessment and control. The psychological group therapy is based on weekly group meetings (“closed” group of 5/6 persons) of two hours each. The work group

Table 1. Experiential-Cognitive Treatment: In-Patient/Out-patient Phase

FIRST WEEK	
PSYCHOMETRIC TEST (test)	
PSYCHODIAGNOSTIC INTERVIEW	PRELIMINARY GROUP (motivation to treatment and definition of rehabilitative protocol)
SESSION 1 VR ASSESSMENT + BODY IMAGE (Virtual balance + sitting room)	NUTRITIONAL ASSESSMENT
SECOND WEEK	
SESSION 2 VR EATING CONTROL + INTERPERSONAL REFRAME (Kitchen + bathroom + bedroom)	NUTRITIONAL GROUP (2/3 sessions)
SESSION 3 VR BODY IMAGE (BIVRS)	PSYCHOLOGICAL GROUP (1 session)
SESSION 4 VR EATING CONTROL (Supermarket)	PHYSICAL ACTIVITY
THIRD WEEK	
SESSION 5 VR BODY IMAGE + INTERPERSONAL REFRAME (Gymnasium)	NUTRITIONAL GROUP (2/3sessions)
SESSION 6 VR EATING CONTROL+ INTERPERSONAL REFRAME (Pub)	PSYCHOLOGICAL GROUP (1 session)
SESSION 7 VR BODY IMAGE+ INTERPERSONAL REFRAME (Clothes shop)	PHYSICAL ACTIVITY
FOURTH WEEK	
SESSION 8 VR EATING CONTROL+ INTERPERSONAL REFRAME (Restaurant)	
SESSION 9 VR BODY IMAGE + INTERPERSONAL REFRAME (Swimming pool + beach)	PSYCHOLOGICAL GROUP (1 session)
SESSION 10 VR EATING CONTROL + BODY IMAGE (Kitchen + BIVRS + 9 doors room)	PHYSICAL ACTIVITY
	FINAL GROUP (motivation to out-patient phase)
PSYCHOMETRIC TESTS (Re-test)	

aims both at training for development and acquisition of assertive skills, and at training for assessment and consolidation of motivation.

Moreover, during the first phase of the treatment the subjects participate to both bi-weekly psycho-nutritional groups held by nutritionists and to daily group sessions of physical activity. The provided physical activities are:

- Postural gymnastics (in the gymnasium), based on:
- Warm-up
- Abdominal exercises, floor exercises, stretching, agility iter, etc. (60 minutes).
- Aerobic activity through the use of cycloergometers (30 minutes).
- Walks in the open with different levels of difficulty (30 minutes).

During the telemedicine phase (see Table 2) the patient has periodical individual contacts - through text, audio or video chat depending on the technologies at patient's disposal - with the therapist who followed him/her during the inpatient/outpatient stage. These contacts will be fortnightly during the first two months and monthly during the third and fourth months. Six month after dismissal, there will be a final individual face-to-face session held in our day-hospital. Each patients is also given the possibly of contacting the therapist by e-mail in case of urgencies or emergencies for a maximum of two added contacts each month. The therapist decides, according to the characteristics of the request, the most suitable modality of response among e-mail, chat or telephone. The family of the patient, too, can have a monthly contact by e-mail with the therapist.

During the telemedicine phase are also scheduled six monthly group meetings based on 1-hour text based chat sessions. The groups are composed by the same patients who took part in the group sessions of the inpatient/outpatient phase. In this way the patients already know each other and can discuss with the therapist both on pre-defined subjects concerning assertiveness, self esteem, motivation to change, prevention of relapses, and on other specific individual problems faced during this phase. The patients are also allowed to keep in touch after the group sessions. This reciprocal support (self-help group) can be very useful especially in the early phases of the outpatient stage: they can feel stronger and less alone in facing the difficulties and the problems of daily life.

Finally, during the telemedicine phase, the patients have to download from Internet at monthly intervals specific text based (booklets) or video based (educational videos) material to be used both for exercises and for the preparation of the individual and group sessions. The topics discussed include assertiveness, self-esteem, body image disturbances, motivation to change and prevention of relapses.

Probably the key novelty of this approach is the use of VR and telemedicine sessions in therapy. [64]. As we have seen in the Introduction, VR is widely used in the treatment of phobias [65-69]. However, it seems likely that VR can be more than a tool to provide exposure and desensitization [70]. As noted by Glantz *et al.*, "VR technology may create enough capabilities to profoundly influence the shape of therapy" [71, p.92]. In particular, they expect that VR may enhance cognitive therapy. VR can in fact be described as a "cognitive technology", a technology created to influence cognitive operations [72].

Also, the emergence of e-health could have a strong effect on health care. As we have seen, the key characteristic of e-health is the use of shared media. Using the Internet, therapists can present, from a remote site, a wide variety of stimuli and to measure and monitor a wide variety of responses made by the user.

Recently, some researchers have tried to use telehealth in the treatment of eating disorders. Particularly, an American group examined *Student Bodies*, an Internet-delivered computer-assisted health education program designed to improve body satisfaction and reduce weight/shape concerns [73-75]. In a controlled study they evaluated whether an 8-

week program offered over the Internet was able to target body image dissatisfaction, disordered eating patterns, and preoccupation with shape/weight among women at high risk for developing an eating disorder. The results suggest that technological interventions may be helpful for reducing disordered eating patterns and cognitions among high-risk women [75].

Moreover, the findings of the next research coming from the same group showed that an Internet intervention with limited face-to-face contact was more effective in improving body image and reducing disordered attitudes and behaviors than a purely face-to-face psychoeducational intervention [73].

As we have just seen, there are different key topics that are neglected by current CBT guidelines: body experience disturbances, motivation for change, empowerment and the integration between all the different professional figures involved in the treatment. We think that VR and telemedicine have enough capabilities to profound influence the shape of therapy by offering new approaches that can match the topics discussed above. In the next paragraphs is detailed the rationale for such assumption.

3.1 VR and body experience

It is no secret that thinness and fitness are in fashion. During the past few decades, Americans have plunged headlong into the pursuit of losing weight to fit an ideal body image [55]. Nevertheless, body-image disturbance and its link with eating behaviors are still two poorly understood and controversial phenomena. Some researchers have asserted that the disturbance should be considered as a key feature of the eating disorders [76].

However, other authors strongly disagree: Hsu and Sobkiewicz [77] have suggested that it may be time for the concept to be abandoned as an etiological determinant of eating disorders.

Probably this current state of controversy is due, in large part, to problems with the way body image has been conceptualised and studied [78]. As underlined by Thompson [79] the construct of body image has been used to describe various phenomena that vary widely in their specific characteristics. Moreover, the frequent study of only one aspect of body image, implicitly assuming that the disturbance is unidimensional, has hindered the advancement of knowledge in this area [80]. Actually, researchers are studying body-image as a multidimensional phenomenon composed by perceptual and affective dimensions [54, 81], the former referring to apparent perceptual overestimation and the latter referring to the feelings an individual has about his or her body.

Current studies have also underlined the existence of some form of connection between body image and eating behavior. It is well known that few eating disordered patients are not over concerned with their physical body [46]. It is also known that for most of them, changing the body experience is the hardest part of their recovery [47]. Cash [82] recently proposed a general model in which the casual processes in the development of body image and eating disturbances are analyzed. The core features of the model are a separation of historical and proximal influences and the link between body image emotions and adjustive, emotion regulating actions [81]. Such actions include avoiding and concealment behaviors, appearance-correcting rituals, social reassurance seeking, and compensatory actions. Cash's model, has received a recent empirical testing: using a series of different confirmatory factor analysis models (LISREL 7) Riva et al. [83] found a significant causal link between body image dissatisfaction and eating restraint. Specifically, both general and specific body site dissatisfaction appear to have a direct influence on eating restraint. These results seem to confirm that the desire to improve body image is a significant motivation to embark on weight reduction attempts [76].

Generally, the disturbances of body image associated with the eating disorders can be conceptualised as a type of *cognitive bias* [84-86]. The essence of this cognitive perspective is that the central psychopathological concerns of an individual bias the manner in which information is processed. Usually, it is presumed that this biased information processing happens automatically. Also, it is generally presumed that the process happens more or less outside the person's awareness unless the person consciously reflects upon his or her thought processes (as in cognitive therapy). Mineka and Sutton [87] have identified four common types of cognitive bias in research related to depression and anxiety disorders: attentional bias, memory bias, judgmental bias, and associative bias. Three of these four types of cognitive bias have been the focus of research related to eating disorders: preoccupation with body size, body dysphoria, and connected problems.

According to Williamson [86], body size overestimation can be considered as a complex judgement bias, strictly linked to attentional and memory biases for body related information: "If information related to body is selectively processed and recalled more easily, it is apparent how the self-schema becomes so highly associated with body-related information... If the memories related to body are also associated with negative emotion, activation of negative emotion should sensitise the person to body-related stimuli causing even greater body size overestimation" (pp.49-50).

In contrast to the great number of publications on body image, only a few papers focus on the treatment of a disturbed body image in eating disorders [54, 79]. Although some general intervention programs for the treatment of anorexia nervosa and bulimia nervosa have included a component that dealt with body image disturbances, in many of these treatments, this aspect of treatment has been virtually ignored. For example, in a review of cognitive-behavioral treatments of bulimia nervosa, Garner, Fairburn, and Davis [88] catalogued 22 treatment components of the 19 available treatment studies. The treatment of body image disturbance was not listed as one of the 22 intervention procedures. Rosen [48] found that the overwhelming majority of studies either did not target body image dysfunction or failed to measure changes following treatment.

There are two different approaches to the treatment of body image disturbances that are actually used from leading researchers and clinicians: cognitive-behavioral and feminist methodologies [81].

Cash and Rosen are the leading figure in the development of cognitive-behavioral strategies for the treatment of body image in eating disorders [48, 76, 89, 90]. Their approach is based on assessment, education, exposure and change of body image. The therapy identifies appearance assumptions, challenges them and modifies self-defeating body image behaviors. Moreover, the approach involves the development of body image enhancement activities used to support relapse prevention and maintenance of changes, and the integration with weight reduction programs [76, 89, 90].

The feminist approach tries to help women to accept and celebrate the body they have [91, 92]. However, feminist therapy generally varies from traditional forms of therapy in number of ways. Feminists believe that traditional therapy perpetuates the central role of man in the form of the doctor-patient relationship [93]. So, this approach places the therapist and client in equitable roles. Moreover, feminist therapists usually include more experiential techniques, such as guided imagery, movement exercises, and art and dance therapy [93, 94]. Other experiential techniques include free-associative writing regarding a problematic body part, stage performance, or psychodrama [93, 95].

Even if both methods are actually used by many therapists, the treatment of body image disturbance is moving "in the area of multicomponent intervention methods" [81, p. 322]. A recent model proposed by Thompson and colleagues [81] underlines the complexity behind the development of body image disturbances. In the proposed model, self-esteem and depression mediate between the three formative influences (peers, parents

and media) and the frequency of comparison and internalization in the development of the disturbance. In this sense this model suggests that “individuals low in self esteem and high in depression are more vulnerable to factors that produce an awareness of appearance pressures and thus are more likely to engage in social comparison and internalization, leading to body dissatisfaction” [81, p. 315].

An interesting possibility that ECT tries to address is the integration of the different methods commonly used in the treatment of body experience disturbances within a virtual environment [96]. In particular ECT integrates the cognitive methods of Countering, Alternative Interpretation, Label Shifting and Deactivating, the behavioural method of Temptation Exposure with Response Prevention and the visual motorial approach (see Table 3) using the virtual environment in the same way as images in the well-known method of guided imagery [97]. According to this method the therapist, after introducing a selected image, encourages the patient to associate to it in pictures, rather than in word, and to give a detailed description of them.

A choice of this type would not only make it possible to evoke latent feelings, but also to use the psycho-physiological effects provoked by the experience for therapeutic purposes [25, 96]. In practically all VR systems the human operator's normal sensorimotor loops are altered by the presence of distortions, time delays and noise [98]. Such alterations that are introduced unintentionally and usually degrade performance, affect body perceptions, too. The somesthetic system has a proprioceptive subsystem that senses the body's internal state, such the position of limbs and joints and the tension of the muscles and tendons. Mismatches between the signals from the proprioceptive system and the external signals of a virtual environment alter body perceptions and can cause discomfort or simulator sickness [99].

It is also well known that key biases can distort perception of the location and orientation of objects and surfaces in virtual environments. While virtual environment interfaces may be argued to be "natural" in principle, there are many features that can disrupt or distort the natural coupling of actual reaching and walking, to create problems of stability and disorientation, lessons that have been well learned in the flight community [100, 101]. Five critical issues relate to gain, time delay order, travel-view decoupling, and field of view [102].

In a recent study, Cioffi [103] analysed these effects and found that, in VR, the self-perception of one's own body undergoes profound changes that are similar to those achieved in the 1960s by many psychologists in their studies of perceptual distortion.

Particularly, about 40% of the subjects felt as if they had "dematerialised" or as if they were without gravity; 44% of the men and 60% of the women claimed not to feel their bodies. Perceptual distortions, leading to a few seconds of instability and a mild sense of confusion, were also observed in the period immediately following the virtual experience.

Such effects, resulting from the reorganisational and reconstructive mechanisms needed to adapt the subjects to the qualitatively distorted world of VR, could be of great help during a therapy aimed at influencing the way the body is experienced [96], because they lead to a greater awareness of the perceptual and sensory/motorial processes associated with them.

As noted by Glantz [71], one of the main reasons it is so difficult to change patients' attitudes towards their body is that change often calls for a prior step - recognizing the distinction between an assumption and a perception: "Until revealed to be fallacious, assumptions constitute the world; they seem like perceptions, and as long as they do, they are resistant to change. We anticipate using VR to help people in distress make the distinction between assumptions and perceptions" (p.96).

This is particularly true for body experience. When a particular event or stimulus violates the information present in the body schema (as happens during a virtual

experience), the information itself becomes accessible at a conscious level [104]. This facilitates the process of change and, through the mediation of the self (which tries to integrate and maintain the consistency of the different representations of the body), also makes it possible to influence body image. In previous studies this approach was tested on non-clinical subjects [25, 27, 39]. The results showed that the virtual experience induced in the subjects a significantly more realistic view of their body.

3.2 VR in supporting motivation for change and empowerment

Eating disorders are some of the most frustrating and recalcitrant forms of psychopathology. This is mostly due to the strong resistance to change that characterises eating disorders patients, mainly anorectic ones. In fact, it has been hypothesized that treatment recidivism and dropout, commonly observed in this population, may be resulting from programmatic attempts to produce symptom reduction in individuals who are not yet ready to change [105]. In this sense, an effective eating disorders program has to deal with the ambivalent and fluctuating motivation to recovery common in these patients.

A framework for conceptualizing readiness for change in treatment-resistant individuals is provided in the transtheoretical model of change [106-108]. According to Prochaska and DiClemente [109] motivation cannot be considered as a trait or personality: motivation is not something one has but rather what one does. According to this approach, change happens along two interrelated dimensions: stage and process [105, 106]:

- *Stage* refers to an individual's readiness status at a particular moment in time, and
- *Process* refers to what an individual is doing to work on the problem and bring about change.

Based on their research with smokers [109], these authors identified five stages of change that people face in replacing problematic behaviour. These stages can be considered predictable and stable subprocesses within the therapeutic process. The five stages are:

- *precontemplation*: being unaware of or unwilling to change symptoms;
- *contemplation*: seriously thinking about change;
- *preparation*: having the intention of changing soon;
- *action*: actively modifying behavior and experiences to overcome a problem, and
- *maintenance*: working to prevent relapse.

Prochaska and DiClemente [107] hypothesize that dropouts occur when "therapists and clients are too far apart in their expectations on which stage of change they will be working" (p. 287). In fact, the problem behaviour doesn't mean the same thing to the client as it does to the therapist. Moreover, two stages of change are particularly critical for therapy: precontemplation and contemplation.

Patients in the precontemplation stage are not even thinking about modifying their behaviour. In fact, they do not believe their eating or restricting is a problem and, usually, take great pride in their level of self discipline. To move the patient to the next stage of change the therapist works with the client to determine if there is another complaint or goal on which the client wishes to work and for which she can become a customer [110]. VR can support the therapist in identifying possible complaints by immersing the patient in real-life situations not directly connected with the eating behaviours. Using the responses of the patients to the situation proposed; the therapist can help them in identifying a salient goals.

Contemplation is a paradoxical stage of change, since the patient is open to the possibility of change but is stopped by ambivalence. The characteristic style of the contemplator is, "yes, but . . .". Two key techniques are usually in facilitating a shift from the contemplation stage to the determination stage of change [110]. The first technique is the use of the *miracle question*, a typical approach used by the solution-focused brief therapy [110, 111].

The miracle question is used to help the client identify how her life would be different if her eating disorder were miraculously gone. The second technique is the *search for exceptions*: situations in which the patient has been able to manage the problematic eating behaviours more successfully. Using VR to experience the effects of the miracle and the successful situations, the patient is more likely not only to gain an awareness of her need to do something to create change but also to experience a greater sense of personal efficacy.

In general, these techniques are used as triggers for a broader empowerment process. In psychological literature *empowerment* is considered a multi-faceted construct reflecting the different dimensions of being psychologically enabled, and is conceived of as a positive additive function of the following three dimensions [112]:

- *perceived competence*: reflects role-mastery, which besides requiring the skilful accomplishment of one or more assigned tasks, also requires successful coping with non-routine role-related situations;
- *perceived control*: includes beliefs about authority, decision-making latitude, availability of resources, autonomy in the scheduling and performance of work, etc;
- *goal internalization*: this dimension captures the energizing property of a worthy cause or exciting vision provided by the organizational leadership.

Virtual reality can be considered the preferred environment for the empowerment process, since it is a special, sheltered setting where patients can start to explore and act without feeling threatened. In this sense the virtual experience is an "empowering environment" that therapy provides for patients. As noted by Botella [113], nothing the patient fear can "really" happen to them in VR. With such assurance, they can freely explore, experiment, feel, live, experience feelings and/or thoughts. VR thus becomes a very useful intermediate step between the therapist and the real world.

Besides, it is unnecessary to wait for situations to happen in the real world because any situation can be modelled in a virtual environment, thus greatly increasing self-training possibilities. In addition, VR allows the situation to be graded so the patient can start at the easiest level and progress to the most difficult. Gradually, because of the knowledge and control afforded by interaction in the virtual world, the patient will be able to face the real world.

Given to its flexibility, VR is an excellent source of information on self-efficacy. In fact, as underlined by Botella and colleagues [113], "different environments can be designed to practically ensure success in all of the patient's virtual adventures; and occasional difficulties, challenges, and failures can be posed for the patient to overcome.

This means that patients are able to discover that difficulties can be defeated. They also have the experience of a competent, effective, empowered self, and can attribute all this personal competence to internal factors: perseverance and effort." (p. 77).

According to Vitousek et al. [41], another well suited approach to face denial and to support the empowerment process is the *Socratic method*. In this method, the therapist uses different questions to help patients synthesize information and to reach conclusions on their own. Usually, the therapist poses hypothetical, inverse, and third-person questions [41]: for example, would the significance of body shape change if anorexic patient became stranded on a desert island? Would a patient swallow a magic potion that could remove her fear of

normal weight? Would a bulimic client exchange her bingeing and purging for a 5- or 10-pound gain?

VR is well suited to this approach, for its ability of immersing the patient in a real-like situation that she/he is forced to face. Infact, the key characteristic of VR is the high level of control of the interaction with the environment without the constraints usually found in real life. VR is highly flexible and programmable. It enables the therapist to present a wide variety of controlled stimuli and to measure and monitor a wide variety of responses made by the user [114]. Both the synthetic environment itself and the manner in which this environment is modified by the user's responses can be tailored to the needs of each client and/or therapeutic application. Moreover, VR is highly immersive and can cause the participant to feel "present" in the virtual rather than real environment. It is also possible for the psychologist to follow the user into the synthesised world.

The advantages of a VR-based Socratic method are clear. It minimizes distortion in self-report, since there is no script for conforming clients to parrot or oppositional clients to reject; a typical behaviour of anorexic individuals.

Moreover, it circumvents power struggles because the therapist can be invisible to the patient and presents no direct arguments to oppose. Finally, evidence is more convincing and conclusions better remembered because they are one's own. As noted by Miller & Rollnick [115] people are "more persuaded by what they hear themselves say than by what other people tell them" (p. 58).

As we have seen before, change often calls for the recognition of the distinction between an assumption and a perception [70]. By using VR, the therapist can actually prove that what looks as a perception doesn't really exist. This gets across the idea that a person can have a false perception. Once this has been understood, individual maladaptive assumptions can then be challenged more easily. In this sense, the use of VR can support the development of a psychologically empowered state [112]: a cognitive state characterized by a sense of perceived control, competence, and goal internalization.

4. The design of a VR and telemedicine system for clinical use

Even starting by the above considerations, understanding how to use immersive virtual reality (VR) to support clinical practice presents a substantial challenge for the designers and users of this emerging technology.

4.1 The design of a VR system for clinical use

As recently noted by Banos et al. [116] VR has two opposite faces. On one side it can be used by clinicians as a "setting lab where to study anomalous behaviors, emotions and beliefs" (p.284). On the other side, "VR can be also seen as a creator of psychopathology" (p. 288) for its potential of inducing reality judgement and identity problems. Moreover, it is well known that this tool can provoke important side effects such as cybersickness and after-effects [117], forcing the clinician to a precise planning of his approach to lessen the probability of inducing harmful consequences for the patients.

These opposite faces are owed to the peculiar characteristics of VR. This tool is not simply a particular collection of technological hardware, but can be considered as a new *medium* defined in terms of its effect on both basic and major psychological processes [118-120]. According to Bricken [121] the essence of VR is the inclusive relationship between the participant and the virtual environment, where direct experience of the immersive environment constitutes communication. In this sense, VR can be considered as the leading edge of a general evolution of present communication interfaces like television,

computer and telephone [122]. Main characteristic of this evolution is the full immersion of the human sensorimotor channels into a vivid and global communication experience [123].

Following this approach, it is also possible to define VR in terms of human experience [124]: "a real or simulated environment in which a perceiver experiences telepresence", where telepresence can be described as the "experience of presence in an environment by means of a communication medium" (pp.78-80).

As noted by Banos et al. [116], through the experience of telepresence VR can affect cognitive development for "its capability of reducing the distinction between the computer's reality and the conventional reality". Moreover "VR can be used for experiencing different identities and... even other forms of self, as well" (p. 289). As Mantovani [125] notes, "Virtual reality is a communication environment in which the interlocutor is increasingly convincing in terms of physical appearance, yet increasingly less tangible and plausible in terms of personal identity. This paradox results from juxtaposing a convincing simulation of the physical presence of the other, and the disappearance of the interlocutor's face behind a mask of false identities" (p.197). It is surely no accident that members of electronic communities very often adopt false 'nickname' identities, and openly accept them in others.

According to Vincelli [23, 126] this situation produces a change with respect to the traditional relationship between client and therapist. The new configuration of this relationship is based on the awareness of being more skilled in the difficult operations of recovery of past experiences, through the memory, and of foreseeing of future experiences, through the imagination. At the same time, the subject undergoing treatment perceives the advantage of being able to re-create and use a real experiential world within the walls of the clinical office of his own therapist. However, this is possible only if the virtual environment is able to support the relationship between the clinician and the patient.

Following the suggestions and feedbacks of the therapist, the patient is not simply an external observer of pictures or one who passively experiences the reality created by the computer, but on the contrary may actively change the three-dimensional world in which he is acting, in a condition of complete sensorial immersion.

This approach shifts the focus of our attention in creating successfully clinical virtual environments. Faithfulness in reproducing the physical characteristics of the "real" environment is not necessarily the only thing to be borne in mind in simulation: the possibility of interaction which virtual environments allow is also important. More than the richness of available images [127, 128], the sensation of presence depends on the level of interaction/interactivity which actors have in both "real" and simulated environments [129, 130]. Human action needs a certain amount of freedom of movement to adapt itself smoothly to the needs of a changing environment, which is why a good clinical VR system must grant a certain amount of freedom of movement to the patient who moves in it. As noted by Ellis [131] the key questions for a VR designer are: "Can the users accomplish the tasks they accept? Can they acquire the necessary information? Do they have the necessary control authority? Can they correctly sequence their subtasks?" (p.258). In fact, the successful implementation of virtual environment simulations will directly depend on the answers to these types of questions.

The main consequence of this approach for the design and the development of clinical oriented VR systems is that a patient's presence in an environment exists if and only if that patient can use the VR for cooperating with the therapist and/or other patients, and even for entering into conflict with them. In fact, than the richness of available images [127, 128], the sensation of presence depends on the level of interaction/interactivity which actors have in both "real" and simulated environments [129]. In this sense, emphasis shifts from quality of image to freedom of movement, from the graphic perfection of the system to the actions of actors in the environment.

4.2. The design of a telehealth system for clinical use

According to Wootton [132], there are basically two reasons why telehealth is used: "either because there is no alternative, or because it is in some sense better than traditional medicine" (p. 12). In this sense telehealth has been used very successfully for optimizing health services delivery to people who are isolated because of social and physical boundaries and limitations [133, 134]. Nevertheless, the benefits of telehealth, because of the variety of its applications and their uneven development, are not self-evident [135, 136]. In a recent study Currel *et al.* [137] assessed all the randomized trials available in scientific literature to verify the effects of telemedicine as an alternative to face-to-face patient care. Although none of the studies showed any detrimental effects from the interventions, neither did they show unequivocal benefits and the findings did not constitute evidence of the safety of telemedicine.

However, the emergence of e-health is supporting the cost-effectiveness of certain applications [138] such as radiology, prisoner health care, psychiatry, and home health care. Its key advantage is the possibility of share different media and different health care tools in a simple to use and easily accessible interface. A recent Australian study showed that the cost-effectiveness of both telehealth and telemedicine improves largely when they are part of an integrated use of telecommunications and information technology [139]. The conclusion of the author is that it is unwise to promote telehealth in isolation from other uses of technologies in health-care.

Moreover, the research in the area clearly underlines that e-health is not simply a technology but a complex technological and relational process [140]. In this sense, clinicians and health care providers that want to exploit e-health need a significant attention to technology, ergonomics, human factors and organizational changes in the structure of the relevant health service [141].

At this stage, there are different shortcomings that the potential of this approach.

The main problem is non-technical and is connected to the personal and organizational changes needed to introduce e-health in healthcare organizations [142].

Although the introduction of shared media has been successful and become accepted practice in many areas of industry, traditional methods have tended to prevail in health-care. Telehealth and e-health have been adopted by enthusiasts who recognize the potential benefits of a these new media. However, the more widespread introduction of e-health needs considerable organizational change in the way health-care is delivered [143].

This requires an alteration of established factors such as consultations and referral patterns, ways of payment, specialist support for primary healthcare, cooperation between primary and secondary healthcare, defining geographical catchment areas and the "ownership" of the patients [144].

A further problem is the technology of e-health. Actual technology – hardware, software and transmission – is costly and far from perfect [145]. Insufficient image quality, low framing rate, flickering and delays makes working in front of a video terminal unattractive and specifically very tiring. An important effect of this is, among other, an increased tendency to produce errors.

Fortunately, the quality of technology in this area is increasing while costs are falling down. Prices are declining by about 25 per cent per year [146]. Simple telephone-based videoconferencing systems are now available for under \$500 while high quality board-based ISDN systems can cost less than \$1000. New transmission technologies, including Digital Subscriber Line (xDSL) and cable modem, promise to provide order-of-magnitude increases in dependable bandwidth for a small increment of price. For the success of e-health applications widespread access to the Internet is also required. Many

applications today demand only moderate bandwidth and latency, meaning that standard modem access to the Internet, at 28.8 to 56 kbit/s may suffice.

A recent research studied a low-bandwidth e-health system in eight community hospitals connected to a central hospital via the Internet. PCs were used with videoconferencing software and modem connections to the telephone network. Even if the average live video frame rate was 1 frame/sec. (at the best image quality), with an average latency of 3 seconds, the results suggested that Internet-based videoconferencing is acceptable for certain telemedicine applications [147]. Successful results with a limited bandwidth have also been obtained by an e-health teleconsultation application developed in Croatia: a 33 kbit/s link was established between a team of specialists in the General Hospital 'Sveti Duh' in Zagreb and a general practitioner's clinic in Selca, on the island of Brac using \$700 computer systems [148].

Another relevant issue is that of ensuring equitable access to health resources by different demographic groups. There are already considerable differences in access to health care in the world. Ensuring that differential access to the Internet along demographic lines does not exacerbate this imbalance could become an increasingly important issue, especially if the provision of health care moves online [149].

Security and legal protection are two more key issues for the diffusion of e-health [150, 151]. In fact, this approach involves three basic types of relationship [152] in which a duty is owed by one party to another:

- the relationship between the clinician and the patient;
- the relationship between clinicians; and
- the relationship between the provider of the telemedicine system and the user.

The situation may be complicated by the involvement of multiple clinicians and/or the providers of the telemedicine systems (call centers, telecommunications network, etc). As noted by Stanberry [152], if “a patient is harmed during a teleconsultation (the healthcare centre) could choose to name a number of these organizations or individuals as defendants to a legal action for negligence if it is unclear what went wrong or where responsibilities are” (p. 24).

Moreover, e-health can hide severe privacy and security risks, because patient data and hospital data stored on a secure Intranet can be manipulated by connecting it to the Web. This is even truer for e-mail consulting. Most e-mail exchanges between patient and provider involve discussions of personal health information, which must be suitably protected from breaches of confidentiality and, to a lesser extent, change [153].

However, the establishing of a firewall and the introduction of HPC (Health Professional Card) can drastically reduce the risk of unauthorized access to the hospital server. For secure e-mail, PGP (Pretty Good Privacy) can be easily used as a standard protocol [150]. Generally, planning all activities exactly and introducing advanced form of data protection are important requisites for reduction of security risks in Internet [154].

5. VREDIM: Virtual Reality for Eating Disorders Modification

Starting from the above rationale the VEPSY UPDATED – Telemedicine and Portable Virtual Environments for Clinical Psychology - European Community funded project (IST-2000-25323) has developed the Virtual Reality for Eating Disorders Modification - VREDIM – VR system to be used in the Experiential Cognitive Therapy. VREDIM is an enhanced version of the original Virtual Reality for Body Image Modification (VEBIM)

immersive virtual environment, previously used in different preliminary studies on non-clinical subjects [25, 27].

5.1 VREDIM: Hardware and software

VREDIM is implemented on a Thunder 1300/C virtual reality system by VRHealth, Milan, Italy (<http://www.vrhealth.com>). The Thunder 1300/C is a Pentium IV based immersive VR system (1300 mhz, 256 mega RAM, graphic engine: Matrox MGA 450 32Mb WRam) including a head mounted display (HMD) subsystem. The HMD used is the Glasstron from Sony Inc. The Glasstron uses LCD technology (two active matrix colour LCD's) displaying 180000 pixels each. Sony has designed its Glasstron so that no optical adjustment at all is needed, aside from tightening a two ratchet knobs to adjust for the size of the wearer's head. There's enough "eye relief" (distance from the eye to the nearest lens) that it's possible to wear glasses under the HMD. The motion tracking is provided by Intersense through its InterTrax 30 gyroscopic tracker (Azimuth: ± 180 degrees; Elevation: ± 80 degrees, Refresh rate: 256Hz, Latency time: $38\text{ms} \pm 2$).

We used a two-button joystick-type input device to provide an easy way of motion: pressing the upper button the operator moves forward, pressing the lower button the operator moves backwards. The direction of the movement is given by the rotation of operator's head.

VREDIM is composed by different 3D Healing Experiences™ (see Table 3) each one individually used by the therapist during ten 45-minute sessions with the patient (see Table 1 for the description of the different 3D Healing Experiences™ used in the sessions).

Each experience was created by using the software Virtools Dev. 2.0 (<http://www.virttools.com>). Based on a building-block, object-oriented paradigm, Virtools makes interactive environments and characters by importing geometry and animation from several animation packages, including Discreet 3D Studio MAX (www.discreet.com), Alias|Wavefront Maya (www.aliaswavefront.com), Softimage (www.softimage.com), and Nichimen Nendo and Mirai (www.nichimen.com), and combining them with an array of more than 200 basic behaviors. By dragging and dropping the behavior blocks together the user can combine them to create complex interactive behaviours.

The Virtools toolset consists of Virtools Creation, the production package that constructs interactive content using behavior blocks; Virtools Player, the freely distributable viewer that allows anyone to see the 3D content; Virtools Web Player, a plug-in version of the regular player for Netscape Navigator and Microsoft Internet Explorer; and the Virtools Dev for developers who create custom behaviors or combine Virtools with outside technology. Virtools Dev includes a full-blown software development kit (Virtools SDK) for the C++ developer that comes with code samples and an ActiveX player which can be used to play Virtools content in applications developed with tools such as Frontpage, Visual Basic or Visual C++.

Content created with Virtools can be targeted at the stand-alone Virtools Player, at web pages through the Virtools Web Player, at Macromedia Director, or at any product that supports ActiveX. Alternatively, the Virtools SDK allows the user to turn content into stand-alone executable files. Virtools's rendering engine supports DirectX, OpenGL, Glide and software rendering, although hardware acceleration is recommended.

5.2 VREDIM: the ten sessions

Each session is divided in three phases:

- 15 minutes of psychological individual interview;

- 15 minutes of immersion into Virtual Reality;
- 15 minutes of psychological interview.

During the first interview the therapist investigates the feelings of the subject, the iter of the therapy and will introduce the virtual reality session (table 2). In the second interview, the therapist discusses what emerged from the immersion in 3D Healing Experiences™ and analyses emotions, behaviors and cognitions of the patient.

The main goal of the first session is to introduce the patient to the procedure and to the instruments needed for exploring the virtual environments (HMD and joystick). The first session is also used to assess any body-related stimuli that could elicit abnormal eating behaviour. In particular the attention is focused on the patient's concerns about body image, eating, shape and weight. This assessment is normally part of the Temptation Exposure with Response Prevention protocol [46]. At the end of the first 3D Healing Experience™ the therapist uses the *miracle question*, a typical approach used by the solution-focused brief therapy [110, 111]. According to this approach the therapist asks the patient to imagine what life would be like without her/his complaint. Answering to this question in writing the patient constructs her/his own solution, which then guides the therapeutical process [111]. According to deShazer [111] this approach is useful for helping patients establish goals that can be used to verify the results of the therapy.

The next eight sessions are used to assess and modify:

- *the symptoms of anxiety related to food exposure*. This is done by integrating different cognitive-behavioral methods (see Table 1): Countering, Alternative Interpretation, Label Shifting, Deactivating the Illness Belief and Temptation Exposure with Response Prevention [39, 46].
- *the body experience of the subject*. To do this the virtual environment integrated the therapeutic methods (see Table 1) used by Butter & Cash [155] and Wooley & Wooley [94]. Particularly in VREDIM we used the virtual environment in the same way as guided imagery [97] is used in the cognitive and visual/motorial approach.
- *the approach to critical interpersonal settings*: using the virtual environments the patient can experience or re-experience critical interpersonal situations and *reframe* them, using different cognitive-behavioral methods (see Table 1): Countering, Alternative Interpretation and Label Shifting. Moreover, the therapist presents the patients applicable ways of honestly *communicating their feelings* during the interaction (assertiveness training).

The conclusive session is used for a final analysis of the inpatient/outpatient phase with particular attention to the reached goals, prevention of relapses and maintenance of the therapeutic compliance in the forthcoming outpatient phase.

In all the sessions, the therapists followed the Socratic style: they used a series of questions, related to the contents of the virtual environment, to help clients synthesize information and reach conclusions on their own.

5.3 VREDIM: The 3D Healing Experiences™

Each session of Virtual Reality (15 minutes) is divided into three phases reached through successive virtual doors (see Table 2):

The *psychologist's office* is the first 3D Healing Experience™. It represents the start and the end of each session, and it has the important function to outline boundaries of the session in virtual reality. It is a neutral and reassuring place which allows continuity in the phases of the individual session: face to face, virtual reality and face to face.

Table 2. Phases included in each VR session

PHASE 1	Psychologist Office
PHASE 2	Specific 3D Healing Experience
PHASE 3	Psychologist Office

In the psychologist's office there are the following objects: a writing-desk with two comfortable chairs, a bookshelf and complements of furnishings that make the environment more comfortable and hospitable (pictures, carpets, lamps, green plants, etc.)

The full list of the environments used is reported in Table 3. Below is reported a more detailed description of all the 3D Healing Experiences™ used in the ten sessions.

5.3.1 Virtual Balance (First session)

The room of the virtual balance is a not very wide environment with windows. The patient can come up to weight herself on the balance in the middle of the room. When the patient comes up on the virtual balance her weight, which has previously been typed in, appears on the display.

This experience is used by the therapist to explore any symptoms of anxiety related to the experience of weighting in the patients and their concerns about eating, shape and weight. The data collected are used to plan the next sessions.

Key questions used for the assessment phase

Reaction to the virtual balance

- What can you see there?
- What are your feelings/sensations?
- Do you have a balance at home?
- Where do you keep it?

Concern about weight

- Do you often weight yourself? How often in a week?
- Now come up to the scales... Touch it (*The therapist "takes" the patient, and the patient's weight, which has earlier been typed in, appears*). Now tell me how you feel when you see your weight on the display...

Wish to modify one's weight

- Have you tried to do something about your weight in the last few months? How?
- How do you feel when you can't manage to change your weight despite the effort? What do you do to feel better?
- What happens instead when you can manage to change your weight?
- Now imagine that you can change the figures on the display... what figures would you like to appear?
- In your opinion, is it a reasonable weight considering your age, height and actual weight?
- How would you feel if this was your weight?

Influence of one's own weight on the opinions of others

- When you weight yourself, are you alone? Always? (*If so*) Why? Would you feel uneasy if others (relatives, friends) saw your weight?
- If you couldn't be alone, who would you like to be with when weight yourself? What does this other person think about your weight?
- In your opinion, what do you think the significant others think about your weight? Do you think they give importance to your weight when they judge you?

- *(The therapist expresses his question specifying four groups of people: relatives, friends, acquaintances and strangers)*
- *Would you be able to tell me what the significant others think about you beside your weight? (Also here the therapist expresses his question specifying four groups of people: relatives, friends, acquaintances and strangers).*

Influence of weight on one's opinion of oneself

- *Do you think your life would be different if you had a different weight?*
- *When you see your weight on the balance and notice a difference (The therapist supposes both an increase and a decrease of weight), what do you think of yourself?*
- *If in this very moment you had to list the things that are most important to you (work or study, family, friends, etc.) what the rating of weight is?*

Influence of other people's weight on one's opinion.

- *What do you tell to a friend who has the same weight as your?*
- *When you see somebody who is overweight/underweight (The therapist chooses the choices that corresponds to the patient's characteristics), what do you think about that person?*
- *Do you think that an overweight/underweight person is happy? (If So) Always? (Through this question the therapist gets the patient to understand the mistake of generalization)*

5.3.2 *Sitting room (First session)*

This 3D Healing Experience™ is used in the first session to allow the patients to familiarize with the virtual reality tools (HMD, joystick) and to learn to move into the virtual environments.

Into the sitting room there are wide windows, a sofa, two comfortable armchairs, a bookshelf, a cocktail cabinet, a table with four chairs and food on it. Complements of furnishings were inserted to make the environment more comfortable (pictures, carpets, lamps, green plants, vases, etc.). Moreover in the room there are some specific objects (TV, HI-FI, phone, newspapers, etc.) that are used to suggest to the patients substitutive behaviors to dysfunctional food intake during the “critical” moments.

The patients can perform some different actions and interact with several objects: to open the cocktail cabinet, to listen music, to watch the television, etc.

This environment is used to identify any symptoms of anxiety related to interpersonal relationships in the patients. These data, too, are collected and used to plan the next sessions.

Table 3. 3D Healing Experiences™ used in VREDIM

<i>1st 3D Healing Experience</i>	Virtual balance
<i>2nd 3D Healing Experience</i>	Sitting room
<i>3rd 3D Healing Experience</i>	Kitchen
<i>4th 3D Healing Experience</i>	Bedroom
<i>5th 3D Healing Experience</i>	Bathroom
<i>6th 3D Healing Experience</i>	BIVRS
<i>7th 3D Healing Experience</i>	9 doors room
<i>8th 3D Healing Experience</i>	Shopping centre
<i>9th 3D Healing Experience</i>	Supermarket
<i>10th 3D Healing Experience</i>	Gymnasium
<i>11th 3D Healing Experience</i>	Pub
<i>12th 3D Healing Experience</i>	Clothes shop
<i>13th 3D Healing Experience</i>	Restaurant
<i>14th 3D Healing Experience</i>	Swimming pool + beach

Key questions used for the assessment phase

Interpersonal relationships

- Do you like staying at home? (*If the patient expresses a preference*) What do you think the reason is?
- (*If the patient dislikes it*) Is there anything that bothers you at home? What are your relations with your relatives (*The therapist expresses his question specifying the different relatives: mother, father, brother/s, sister/s*).
- (*If the patient likes it*) Is there something that bothers you outside? Other people make you feel uneasy? Why? Is it because of your body?
- Do you think other people look at you because of your body? (*The therapist expresses his question specifying four groups of people: relatives, friends, acquaintances and strangers*)
- What do they think of you?
- Do you think they are right?
- If they noticed your weight has changed (*The therapist supposes both an increase and a decrease of weight*), what would they think of you? (*The therapist expresses his question specifying four groups of people: relatives, friends, acquaintances and strangers*)

5.3.3 Kitchen (*Second and Tenth sessions*)

The kitchen is the first environment of the second virtual reality session. The virtual room is a quite wide environment with windows, an equipped kitchen (refrigerator, oven, gas-ring, sink, mixer, toaster, etc.), a wide shelf of job, spacious cupboards, a table with four chairs.

Into the kitchen the subject can interact with the presented objects: she can open the cupboards, the refrigerator, the freezer and the oven. Moreover, she can choose and “eat” any of the available food.

As in the previous session, the therapist analyzes the reactions elicited by food.

Moreover, any dysfunctional belief and/or feeling are discussed with the patient according to the Label Shifting and Objective Counters methods. The kitchen setting is also used to explore the relationships with other family members (father, mother, brother/s and sister/s).

5.3.4 Bathroom (*Second session*)

In the virtual flat there is also a bathroom that is useful to investigate feelings, sensations and thoughts, of the patients with inappropriate compensatory methods as self-induced vomiting and misuse of laxatives.

In add to the sanitary fittings (shower, bath, wash-basin, WC) in the bathroom there are some towels, a bath-robe, a big mirror, a bath closet, a scales, etc.

The patients can do the following actions: to open the shutters, to enter in the shower, to open the taps of the bath, of the shower and of the wash-basin, etc.

In presence of compensatory behaviors the Temptation Exposure with Response Prevention method is used. Any dysfunctional belief and/or feeling are discussed with the patient according to the Label Shifting and Objective Counters methods.

5.35 Bedroom (*Second session*)

The bedroom is used instead with patients having binge episodes in this room or that have difficulties in eating control (night eaters) during the night.

The room is quite large, and the wide windows make it very bright. In the bedroom there is a king bed, two bedside tables with abajour, a big wardrobe, a clothes-hanger, a bookshelf, some shelves, a writing-desk with a computer and a chair. The patients can perform some different actions: to open the wardrobe, to interact with the present food, to eat virtually the food, etc. As in the previous session, the Temptation Exposure with Response Prevention is used in presence of compensatory behaviors. Moreover, the different dysfunctional beliefs and/or feelings are discussed with the patient according to the Label Shifting and Objective Counters methods.

5.3.6 BIVRS (Third and Tenth sessions)

This 3D Healing Experience™ - the Body Image Virtual Reality Scale - BIVRS - is a three part virtual world in which the user has to choose between 9 figures of different size which vary from underweight to overweight [114, 156].

Subjects are asked to choose the figures that they think to reflect their current and their ideal body sizes. The discrepancy between these two measures is an indication of their level of dissatisfaction. In the first two zones (one for real body and one for ideal body) the subject chooses between nine 2D images that are shown simultaneously. Opening the central door the patient enters in a third zone where there are two panels showing the ideal body and the real body chosen by the subject in the two preceding zones. The two silhouettes are now presented in 3D and between them is presented the real picture of the patient previously digitised using an EPSON Photo PC camera. The 3D images can be modified using two arrow buttons located around the images.

We decided to use both 2D and 3D images to improve the effectiveness of the scale.

Even if existing body image scales use mainly 2D images, using 3D it is easier for the subject to perceive the differences between the silhouettes, especially for specific body areas (breasts, stomach, hips and thighs). Also, here the patients can perform some different actions and interact with several objects: to open the doors, to choose the panels, to turn on the silhouette, etc.

The vision of her own body usually elicits in the user strong feelings that can be matched using the Counterattacking and the Countering cognitive methods. The mirror is also used, as indicated by Wooley and Wooley [94], to develop an awareness of the body image distortion. Finally, the therapist instructs the patient to imagine herself as different on several dimensions including size, race, and being larger or smaller particularly areas.

The subject is also asked to imagine herself as younger, older, what they look and feel like before and after eating and social successes/failures.

5.3.7 Nine doors room 9 (Tenth session)

In this room the patient is in front of 9 doors of different sizes varying gradually from the narrowest to the largest. The subject can proceed to the next room only by choosing the door corresponding to her body dimension (earlier inserted in the computer by the therapist).

In this room the patients can open only the door corresponding to the size of your hips. When the patient makes a mistake, she is not being able to open the chosen door.

The experience is used as stimuli to support a cognitive approach: the elicited feelings are analysed by the therapist according to the Label Shifting and Objective Counters methods. The feelings and their associated beliefs are identified, broken down into their logical components, replaced with two or more descriptive words, and then critically analysed.

5.3.8 Shopping Mall (Fourth, Fifth, Sixth, Seventh and Eight sessions)

This is the more complex environment of our virtual reality system. Into the shopping centre there are several shops and commercial activities - a supermarket, a clothes shop, a gymnasium, a pub, a restaurant - that the patient will explore during different sessions.

The shopping centre is very large and bright. The patient navigating in this environment can observe many people, the shopwindows and the different signs.

5.3.8.1 Supermarket (Fourth session)

The supermarket is divided in different departments: fruit and vegetables, cakes and biscuits, cheese and dairy products, pork products, meat and fish, sweets, drinks and alcoholic drinks, deep-frozen food, etc.

Into the supermarket there are many people. Near the exit of the supermarket there are two cash-desks, but only one of these is free.

Also in this session the patients can perform some different actions and interact with several objects: to put the food acquired in the shopping bag, to put back the wrong purchases in the shelves, to eat immediately something, to do a list of food, to pay at the cash-desk, etc.

If the patient activates maladaptive behaviors the Temptation Exposure with Response Prevention is used. Moreover, the different dysfunctional beliefs and/or feelings are discussed with the patient according to the Label Shifting and Objective Counters methods.

5.3.8.2 Gymnasium (Fifth session)

This virtual environment is divided in four parts:

- Entrance,
- Female dressing room,
- Cyclette and tapie roulant room,
- Fitness room.

Entering in the gymnasium the patient crosses the entrance that has a writing-desk with a computer, chairs, a comfortable sofa, a table with newspapers, scales, a carpet, some posters, etc.

In the female dressing room there are some cabinets, clothes-hangers, platform seats, a big mirror, sports bag, shoes and wears.

In the first room of the gymnasium there are some cyclette, a tapie roulant, a side for exercises, mirrors, TV, HI-FI, etc. In the second room there are different fitness machines. In each room of the gymnasium there are many people with sports wear (females and males).

Also in this session the patients can perform some different actions and interact with several objects.

This session is used to reframe the effect of negative appearance related comments from others. Specifically, using the Countering, Alternative Interpretation and Label Shifting methods the patient is instructed to recognize the irrational beliefs (i.e. "I must look good to be liked") that usually underlie the interpretation of the comments. The environment is also used to explore the interpersonal relationships outside the family.

5.3.8.3 Pub (Sixth session)

The pub is a very large room arranged in four different areas:

- Counter bar;
- Tables;
- Live music zone;
- Game zone.

The counter bar is well furnished: alcoholic drinks and soft drinks, beer, sweet dispenser, snack dispenser (cheeps, salts, pop corn, etc.), sandwiches, pizza, toast, etc.; near to the counter there is the freezer with ice-creams listed on a sign-board

In the zone of the tables the patient can find a big screen, some posters, green plants. On the engaged tables there are some drinks (beer, coke, fruit juice, etc.) and some food (salts, sandwiches, toast, ice-cream, slices of cake etc.).

The patients can sit down because there is a free table. They can choose food and/or drinks, listen music, watch the video on the big screen, eat and drink virtually, see the people into the pub, etc.

If the patient activates maladaptive behaviors or binge eating the Temptation Exposure with Response Prevention is used. Moreover, the different dysfunctional beliefs and/or feelings are discussed with the patient according to the Label Shifting and Objective Counters methods. Finally, the environment is used to further explore the interpersonal relationships outside the family.

5.3.8.4 Clothes shop (Seventh session)

After to have seen the shop-windows of the clothes shop the patient enters in the little environment subdivided in two parts:

- The inner shop;
- Two dressing rooms.

Inside the shop the wears are arranged on different shelves and clothes-hangers. Moreover in the shop there are some mirrors, manikins, a counter and two dressing rooms.

In the two dressing rooms develops the second part of the seven sessions. In each dressing room can be found a mirror, a chair, a clothes-hanger and with T-shirts (in the first room) and trousers (in the second) of different sizes.

Also in this room the patients can perform some different actions and interact with several objects: to open the doors of the dressing room, to wear T-shirts and trousers, to look herself in the mirror, etc.

Also, this session is used to reframe the effect of negative appearance related comments from others. Specifically, using the Countering, Alternative Interpretation and Label Shifting methods the patient is instructed to recognize the irrational beliefs (i.e. "I must look good to be liked") that usually underlie the interpretation of the comments. The mirror is also used, as shown by Wooley and Wooley [94], to instruct the user to imagine herself as different on several dimensions including size, race, and being larger or smaller in specific areas. The subject is also asked to imagine herself as younger, older, what they look and feel like before and after eating and social successes/failures.

5.3.8.5 Restaurant (Eighth session)

The restaurant is a little and hospitable environment. The little hall allows to enter the room with the tables where the patient can sit-down. In the room there are differently engaged tables, comfortable chairs, trolley with cakes and a cocktail cabinet. The patients can perform some different actions and interact with several objects into the restaurant: to sit down at the table, to open and read the menu and to eat and drink virtually.

If the patient activates maladaptive behaviors or binge eating the Temptation Exposure with Response Prevention is used. Moreover, the different dysfunctional beliefs and/or feelings are discussed with the patient according to the Label Shifting and Objective Counters methods.

5.3.9 Swimming pool and beach (Nineth session)

The swimming pool and the beach are two different places but inserted in the same virtual environment.

When the patients enter this environment they find themselves in front of a swimming pool surrounded by deck-chairs, towels on the floor, and people sunbathing on the lawn and on the edge of the swimming pool. Some people have a swim.

A path connects the swimming pool with the beach. On the beach there are some people that sunbathe, walk, swim, chat and there are children that play, etc. On the beach there are deck-chairs, beach-umbrellas, dressing room, paddleboat; while in the sea there are some windsurf that move. In this session the patients cannot interact with the objects.

The reframing of the impact of negative appearance related comments from others is the main goal of this session. As before, using the Countering, Alternative Interpretation and Label Shifting methods the patient is instructed to recognize the irrational beliefs that underlie the interpretation of the comments.

6 Clinical Trials

6.1 Subjects

Subjects are 120 women, aged 18-50 years (Mean age: 33,07 \pm 8,08 yrs; Mean weight: 105,44 \pm 17,73 Kg.; Mean height: 1,62 \pm 0,06 cm; Mean B.M.I.: 39,80 \pm 6,10) After diagnostic assessment, subjects were categorized as Obese (68 subjects) and Eating Disorders (36 Binge Eaters; 12 Bulimics and 3 Eaters Disorder not otherwise specified).

Subjects were then randomly assigned to the experimental group and to the three control groups as following:

- **Experimental group** (Experiential-Cognitive Therapy)
30 subjects; Mean age: 33,43 \pm 8,29 yrs; Mean weight: 104,25 \pm 19,98 Kg; Mean height: 1,62 \pm 0,07 cm; Mean B.M.I.: 39,56 \pm 6,20;
- **Control Group I** (Cognitive-Behavioral Therapy)
30 subjects; Mean age: 32,2 \pm 7,95 yrs; Mean weight: 107,63 \pm 11,62 Kg; Mean height: 1,62 \pm 0,05 cm; Mean B.M.I.: 41,14 \pm 5,70;
- **Control Group II** (Nutritional Group)
30 subjects; Mean age: 33,5 \pm 8,17 yrs; Mean weight: 105,59 \pm 19,76 Kg; Mean height: 1,62 \pm 0,07 cm; Mean B.M.I.: 39,95 \pm 6,40;
- **Control Group III** (Waiting List)

30 subjects; Mean age: 33,16 ±8,25 yrs; Mean weight: 104,3 ±18,91 Kg; Mean height: 1,64 ±0,06 cm; Mean B.M.I.: 38,56 ±6,09.

Individuals were excluded if they were acutely suicidal, medically ill or pregnant, had abused alcohol or drugs within the last year or had evidence of cardiac conduction disease.

The study received ethical approval by Ethical Committee of the Istituto Auxologico Italiano. Before starting the trial, the nature of the treatment was explained to the patients and her written informed consent was obtained.

6.2 Assessment

Subjects were assessed by one of three independent assessment clinicians who were not involved in the direct clinical care of any subject. They were two MA-level chartered psychologists and a PhD-level chartered psychotherapist. All subjects were assessed at pre-treatment and upon completion of the clinical trial.

The following psychometric tests were obtained at entry to the study:

- Eysenck Personality Inventory EPI (H.J. Eysenck & S. Eysenck, 1964) – Italian Version (O.S., 1976)
- Italian version of the Eating Disorders Inventory 2 - EDI 2 [I].

Moreover, the following psychometric tests were administered at each assessment point:

- Italian version [IV] of the State-Trait Anxiety Inventory -STAI [V];
- Beck Depression Inventory (A.T. Beck, C.H. Ward, M. Mendelson, J. Mock & J. Erbaugh, 1961);
- Rosenberg Self-Esteem Questionnaire (M. Rosenberg, 1965);
- Rathus Assertion Schedule (S.A. Rathus, 1973) – Italian Version (M. Campanelli & A. Tamburello; 1979)
- Italian version [II] of the Dieter's Inventory of Eating Temptations [III]. The inventory has 30 items, each presenting a situational description along with a competent response. The subject rates the percentage of time he or she would behave as described in similar situations. A total score and six subscales are computed. The subscales are Resisting Temptation, Positive Social, Food Choice, Exercise, Overeating and Negative Emotions. The inventory was originally designed for use with obese individuals who are trying to lose weight in behavioral weight loss programs, but, according to the authors, it may be useful for identifying situations most likely to trigger loss of control by bulimic patients.
- Italian version (Riva, Bacchetta, & Baruffi, 1999b) of the Weight Efficacy Life-Style Questionnaire - WELSQ (Clark, Abrams, Niaura, Eaton, & Rossi, 1991a). The WELSQ is composed by 20 items that measure the confidence of the subjects about being able to successfully resist the desire to eat using a 10-point scale ranging from 0 (not confident) to 9 (very confident). The questionnaire was used to predict both acute change and long-term maintenance of weight loss across a range of ages in man and women (Clark et al., 1991a).
- Italian version [VI] of the University of Rhode Island Change Assessment Scale - URICA [VII]. The URICA consists of 32 items designed to measure four stages of change in psychotherapy: *pre-contemplation*, *contemplation*, *action* and *maintenance*. Each item is scored using a 5-point Likert-type format: higher scores indicate greater agreement with statements. The URICA was originally developed for use with clients

in psychotherapy reporting on their problems. However the instrument is also used for measuring readiness to change across a wide variety of problem behaviors, especially the addictions including smoking cessation, alcohol use, and cocaine use.

- Italian version [VIII] of the Body Satisfaction Scale - BSS [IX]. The scale consists of a list of 16 body parts, half involving the head (above the neck) and the other half involving the body (below the head). The subjects rate their satisfaction with each of these body-parts on a seven-point scale: the higher the rating, the more dissatisfied the individual. A total score and three subscale scores are computed for head, torso and limbs items. The scale was designed for work in health-related fields. In particular the scale was used by the authors to assess body dissatisfaction in eating disorders, to monitor changes in body satisfaction in subjects undergoing surgical treatment for breast cancer and to determine the psychological effects of either maxillary or mandibular joint surgery.
- Italian version [X] of the Body Image Avoidance Questionnaire - BIAQ [XI]. The BIAQ is 19-item self-report questionnaire on avoidance of situations that provoke concern about physical appearance, such avoidance of tight-fitting clothes, social outings, and physical intimacy. In particular the questionnaire measures the avoidance behaviors and grooming habits associated with negative body image (Rosen et al., 1991). The questionnaire uses a 6-point scale to rate frequency of behavior: never, rarely, sometimes, often, usually, and always. A total score and four subscales are computed for: clothing, social activities, eating restraint and grooming/weighting.
- The Contour Drawing Rating Scale - CDRS [XIII], a set of 9 male and female figures with precisely graduated increments between adjacent sizes. In this test subjects rate the figures based on the following instructional protocol, (a) current size and (b) ideal size. The difference between the ratings is called the *self-ideal discrepancy score* and is considered to represent the individual's dissatisfaction.

6.3 Treatment

The design of the investigation is outlined in the following schema:

Experimental Group

A. Psychological Iter:

- Psychodiagnostic assessment (Administration of psychometric tests and Individual Psychological Assessment);
- 5 sessions of psychological groups;
- 10 individual sessions of Virtual Reality with psychological interview;

B. Nutritional Iter:

- 1 interview for nutritional assessment;
- personalized balanced dieting;
- 4/6 sessions of nutritional groups.

C. Physical Iter:

- Physical activity (physical activities, cyclette, walking, etc.)
- Physiotherapy if necessary.

Control Group I (Cognitive-Behavioral Therapy)

A. Psychological Iter:

- Psychodiagnostic assessment (Administration of psychometric tests and Individual Psychological Assessment);

- 5 sessions of psychological groups;
- 10 Individual Psychological sessions.

B. Nutritional Iter:

- 1 interview for nutritional assessment;
- personalized balanced dieting;
- 4/6 sessions of nutritional groups.

C. Physical Iter:

- Physical activity (physical activities, cyclette, walking, etc.)
- Physiotherapy if necessary.

Control Group II (Nutritional Group)

A. Psychological Iter:

- Psychodiagnostic assessment (Administration of psychometric tests and Individual Psychological Assessment);
- Psychological support (once a week);

B. Nutritional Iter:

- 1 interview for nutritional assessment;
- personalized balanced dieting;
- 4/6 sessions of nutritional groups.

C. Physical Iter:

- Physical activity (physical activities, cyclette, walking, etc.)
- Physiotherapy if necessary.

Control Group III (Waiting List)

- No inpatient phase.
- Psychodiagnostic assessment (Administration of psychometric tests and Individual assessment);
- Administration of psychometric tests (after one month).

6.4 Statistical analysis

A power calculation was made to verify the opportunity to obtain statistically significant differences between the pre- and post-treatment scores. The Wilcoxon non-parametric test was then carried out to test the effect of the treatments.

Data obtained from patients with diagnosis of Bulimia Nervosa and of Eating Disorders (Not Otherwise Specified) were excluded from statistic analysis because the size of the respective sample was too small.

6.5 Outcome

In this section the outcome of statistical analysis is provided. In order to present results more clearly, tables 4-6 show respectively psychological, physiological and behavioral changes between the start and the end of the treatment in the BED Group; tables 7-9 show psychological, physiological and behavioral changes between the start and the end of the treatment in the OBESE Group. In each table, significant contrasts are marked in bold font.

Table 4. Psychological changes between the start and the end of the treatment in the BED Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

	Experiential Cognitive Group		Cognitive Behavioral Group		Nutritional Group		Waiting List	
	Z	p	Z	p	Z	p	Z	p
Psychological scales								
<i>STAI Total Score</i>	-2.371	0.018	-1.481	0.139	-2.490	0.013	-2.016	0.044
<i>BDI Total Score</i>	-2.670	0.008	-1.963	0.050	-1.604	0.109	-1.122	0.262
<i>Rosenberg Self Esteem Total Score</i>	-2.375	0.018	-2.527	0.012	-2.546	0.011	-0.175	0.861
<i>Rathus Assertion Schedule – F. 1-2 Rathus Assertion Schedule – F. 1-1</i>	-1.366	0.172	-1.785	0.074	-2.136	0.033	-0.595	0.552
<i>Rathus Assertion Schedule – F. 2-2 Rathus Assertion Schedule – F. 2-1</i>	-2.428	0.015	-1.866	0.062	-1.786	0.074	-1.121	0.262
<i>Rathus Assertion Schedule – F. 3.2 Rathus Assertion Schedule – F. 3-1</i>	-0.423	0.672	-1.876	0.061	-1.734	0.083	-1.382	0.167
<i>Rathus Assertion Schedule – F. 4-2 Rathus Assertion Schedule – F. 4-1</i>	-1.691	0.091	-1.057	0.291	-1.965	0.049	-1.275	0.202
<i>Rathus Assertion Schedule – F. 5-2 Rathus Assertion Schedule – F. 5-1</i>	-2.388	0.017	-1.310	0.190	-0.427	0.669	-1.890	0.059
<i>Rathus Assertion Schedule – F. 6-2 Rathus Assertion Schedule – F. 6-1</i>	-0.850	0.395	-1.186	0.236	-1.518	0.129	0.0	1.0
<i>Diet Overeating 2 – Diet Overeating 1</i>	-2.429	0.015	-1.960	0.050	-2.240	0.025	-0.535	0.592
<i>Diet Negative Emotions 2 – Diet Negative Emotions 1</i>	-1.199	0.230	-1.619	0.105	-0.949	0.342	-0.339	0.735
<i>Diet Positive Social 2 – Diet Positive Social 1</i>	-1.718	0.086	-1.424	0.154	-2.192	0.028	-1.248	0.212
<i>Diet Food Choice 2 – Diet Food Choice 1</i>	-0.535	0.592	-1.053	0.292	-0.631	0.528	-0.341	0.733
<i>Diet Resisting Temptations 2- Diet Resisting Temptations 1</i>	-1.599	0.110	-1.843	0.065	-2.552	0.011	-1.689	0.091
<i>Diet Exercise 2 – Diet Exercise 1</i>	0.000	1.000	-0.508	0.611	-0.237	0.812	-0.239	0.811
<i>Diet Total Score 2- Diet Total Score 1</i>	-0.711	0.477	-1.011	0.312	-2.243	0.025	-0.889	0.374
<i>Body Image Avoidance Quest. – Clothing 2- Body Image Avoidance Questionnaire – Clothing 1</i>	-2.536	0.011	-1.620	0.105	-2.692	0.007	-0.513	0.608
<i>Body Image Avoidance Quest. – Grooming/weighing 2- Body Image Avoidance Questionnaire – Grooming/weighing 1</i>	-1.382	0.167	-1.706	0.088	-1.279	0.201	-0.171	0.865
<i>Body Image Avoidance Quest. –Eating Restraint 2- Body Image Avoidance Questionnaire – Eating Restraint 1</i>	-0.779	0.436	-1.735	0.083	-1.411	0.158	-2.111	0.035

<i>Body Image Avoidance Quest. – Social Activities 2- Body Image Avoidance Questionnaire – Social Activities 1</i>	-2.521	0.012	-1.612	0.107	-1.620	0.105	-1.380	0.168
<i>Body Image Avoidance Quest. – Total 2- Body Image Avoidance Questionnaire – Total 1</i>	-2.547	0.011	-1.334	0.182	-1.474	0.141	-1.965	0.049
<i>Weight Efficacy Life Style – Total 2 - Weight Efficacy Life Style – Total 1</i>	-2.666	0.008	-2.666	0.008	-2.310	0.021	-0.652	0.515
<i>Body Satisfaction Scale – Head 2 – Body Satisfaction Scale – Head 1</i>	-1.863	0.063	-0.211	0.833	-2.379	0.017	-0.983	0.326
<i>Body Satisfaction Scale – Torso 2 – Body Satisfaction Scale – Torso 1</i>	-2.043	0.041	-1.612	0.107	-0.172	0.863	-1.913	0.056
<i>Body Satisfaction Scale – Limbs 2 – Body Satisfaction Scale – Limbs 1 –</i>	-1.866	0.062	-1.895	0.058	-1.474	0.141	-0.935	0.350
<i>Body Satisfaction Scale – Total 2 – Body Satisfaction Scale – Total 1 –</i>	-2.371	0.018	-1.187	0.235	-2.383	0.017	-1.609	0.108
<i>CDRS – real body 2 – CDRS – real body 1</i>	-2.070	0.038	-2.000	0.046	-1.890	0.059	0.000	1.000
<i>CDRS – ideal body 2 – CDRS – ideal body 1</i>	-1.414	0.157	-1.414	0.157	-0.378	0.705	-0.816	0.414
<i>CDRS – body dissatisfaction 2 – CDRS – body dissatisfaction 1</i>	-2.388	0.017	-2.201	0.028	-1.363	0.173	-0.535	0.593
<i>URICA - pre-contemplation 2 URICA - pre-contemplation 1</i>	-0.171	0.864	-0.178	0.859	-0.849	0.396	-0.679	-0.497
<i>URICA - contemplation 2 – URICA -contemplation 1</i>	-1.015	0.310	-0.423	0.672	-1.078	0.281	-0.085	0.932
<i>URICA - action 2 – URICA - action 1 -</i>	-1.136	0.256	-2.388	0.017	-1.205	0.228	-0.071	0.943
<i>URICA – maintenance 2 – URICA maintenance 1</i>	-0.837	0.402	-0.656	0.512	-2.138	0.033	-0.705	0.481
<i>URICA Total 2 – URICA Total 1</i>	-0.949	0.342	-0.775	0.438	-2.670	0.008	-0.771	0.441

Table 5. Physiological changes between the start and the end of the treatment in the BED Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

<i>Physiological data</i>	<i>Experiential Cognitive Group</i>		<i>Cognitive Behavioral Group</i>		<i>Nutritional Group</i>		<i>Waiting List</i>	
	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>
Weight	102.7+/- 17.2	97.2+/- 15.6	109.3+/- 10.5	102.1+/- 9.14	103.8+/- 21.3	97.0+/- 19.3	105.5+/- 17.2	107.3+/-17.3
	Z	p	Z	p	Z	p	Z	p
	-2.666	0.008	-2.666	0.008	-2.666	0.008	-2.375	0.018
Body Mass Index	41.2+/-4.5	39.0+/-4.2	42.3+/-2.9	39.6+/-2.7	41.6+/-7.1	38.9+/-6.7	39.1+/-4.5	39.7+/-4.5
	Z	p	Z	p	Z	p	Z	p
	-2.666	0.008	-2.666	0.008	-2.666	0.008	-2.366	0.018
Hips width	42.3+/-3.1	40.7+/-2.6	44.5+/-5.7	42.55+/- 5.84	41.3+/-4.0	39.4+/-4.0	no data	no data
	Z	p	Z	p	Z	p	Z	p
	-2.375	0.018	-2.536	0.011	-2.694	0.007	no data	no data

Table 6. Behavioral changes between the start and the end of the treatment in the BED Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

<i>Physiological data</i>	<i>Experiential Cognitive Group</i>		<i>Cognitive Behavioral Group</i>		<i>Nutritional Group</i>		<i>Waiting List</i>	
	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>
Binge	13.3+/-6.6	0.0	12.8+/-6.9	0.0	23.3+/-10.5	0.0	20.0+/-17.4	17.3+/-17.0
	Z	p	Z	p	Z	p	Z	p
	-2.699	0.007	-2.684	0.007	-2.670	0.008	-1.289	0.197
Vomiting	0.0	0.0	1.5+/-4	0.0	0.0	0.0	0.0	0.0
	Z	p	Z	p	Z	p	Z	p
	0	1	-1.342	0.180	0	1	0	1
Laxative	0.0	0.0	2.2+/-6.7	0.0	0.0	0.0	0.0	0.0
	Z	p	Z	p	Z	p	Z	p
	0	1	-1.000	0.317	0	1	0	1

Table 7. Psychological changes between the start and the end of the treatment in the OBESE Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

<i>Psychological scales</i>	<i>Experiential Cognitive Group</i>		<i>Cognitive Behavioral Group</i>		<i>Nutritional Group</i>		<i>Waiting List</i>	
	<i>Z</i>	<i>p</i>	<i>Z</i>	<i>p</i>	<i>Z</i>	<i>p</i>	<i>Z</i>	<i>p</i>
<i>STAI Total Score</i>	-2.071	0.038	-2.500	0.012	-2.325	0.020	-0.207	0.836
<i>BDI Total Score</i>	-3.187	0.001	-2.589	0.010	-1.813	0.70	-0.491	0.626
<i>Rosenberg Self Esteem Total Score</i>	-2.968	0.003	-2.439	0.015	-1.903	0.057	-0.365	0.715
<i>Rathus Assertion Schedule – F. 1-2; Rathus Assertion Schedule – F. 1-1</i>	-2.582	0.004	-2.464	0.014	-1.494	0.135	-0.910	0.363
<i>Rathus Assertion Schedule – F. 2-2; Rathus Assertion Schedule – F. 2-1</i>	-2.025	0.043	-1.850	0.064	-1.350	0.177	-0.673	0.524
<i>Rathus Assertion Schedule – F. 3-2; Rathus Assertion Schedule – F. 3-1</i>	-2.369	0.018	-2.145	0.032	-1.208	0.227	-0.857	0.391
<i>Rathus Assertion Schedule – F. 4-2; Rathus Assertion Schedule – F. 4-1</i>	-3.292	0.001	-0.600	0.549	-1.928	0.054	-0.143	0.887
<i>Rathus Assertion Schedule – F. 5-2; Rathus Assertion Schedule – F. 5-1</i>	-1.314	0.189	-0.984	0.325	-0.964	0.335	-0.660	0.509
<i>Rathus Assertion Schedule – F. 6-2; Rathus Assertion Schedule – F. 6-1</i>	-0.432	0.666	-2.140	0.032	-0.406	0.685	-0.513	0.608
<i>Diet Overeating 2 – Diet Overeating 1</i>	-3.154	0.002	-2.924	0.003	-2.316	0.021	-0.398	0.690
<i>Diet Negative Emotions 2- Diet Negative Emotions 1</i>	-1.588	0.112	0.000	1.000	-0.492	0.623	-0.370	0.711
<i>Diet Positive Social 2 – Diet Positive Social 1</i>	-2.767	0.006	-2.110	0.035	-2.392	0.017	-0.966	0.334
<i>Diet Food Choice 2 – Diet Food Choice 1</i>	-1.552	0.121	-1.062	0.288	-0.410	0.682	-0.596	0.551
<i>Diet Resisting Temptations 2 – Diet Resisting Temptations 1</i>	-2.393	0.017	-3.184	0.001	-1.132	0.258	-0.422	0.673
<i>Diet Exercise 2 – Diet Exercise 1</i>	-0.208	0.836	-1.529	0.126	-1.855	0.064	-1.056	0.291
<i>Diet Total Score 2 - Diet Total Score 1</i>	-2.638	0.008	-1.397	0.162	-2.059	0.039	-0.284	0.776
<i>Body Image Avoidance Quest. – Clothing 2- Body Image Avoidance Questionnaire - Clothing 1</i>	-3.317	0.001	-2.350	0.019	-1.325	0.185	-0.811	0.417
<i>Body Image Avoidance Quest. – Grooming/weighing 2- Body Image Avoidance Questionnaire – Grooming/weighing 1</i>	-1.554	0.120	-0.791	0.429	-2.166	0.030	-0.603	0.546
<i>Body Image Avoidance Quest. –Eating Restraint 2- Body Image Avoidance Questionnaire – Eating Restraint 1</i>	-2.180	0.029	-0.434	0.665	-0.095	0.924	-1.355	0.176

<i>Body Image Avoidance Quest. – Social Activities 2- Body Image Avoidance Questionnaire – Social Activities 1</i>	-3.265	0.001	-3.162	0.002	-2.994	0.003	-2.000	0.46
<i>Body Image Avoidance Quest. – Total 2- Body Image Avoidance Questionnaire – Total 1</i>	-3.199	0.001	-2.586	0.010	-2.140	0.032	-1.127	0.260
<i>Weight Efficacy Life Style – Total 2 - Weight Efficacy Life Style – Total 1</i>	-3.575	0.000	-3.575	0.000	-2.557	0.011	-0.597	0.551
<i>Body Satisfaction Scale – Head 2 – Body Satisfaction Scale – Head 1</i>	-0.315	0.753	-2.359	0.018	-1.698	0.089	-0.409	0.682
<i>Body Satisfaction Scale – Torso 2 – Body Satisfaction Scale – Torso 1</i>	-3.201	0.001	-2.134	0.033	-3.346	0.001	-0.319	0.750
<i>Body Satisfaction Scale – Limbs 2 – Body Satisfaction Scale – Limbs 1 –</i>	-2.366	0.018	-1.998	0.046	-2.803	0.005	-0.60	0.953
<i>Body Satisfaction Scale – Total 2 – Body Satisfaction Scale – Total 1 –</i>	-2.691	0.007	-2.640	0.008	-3.056	0.002	-0.171	0.864
<i>CDRS – real body 2 – CDRS – real body 1</i>	-1.931	0.053	-2.511	0.012	-2.653	0.008	-1.732	0.083
<i>CDRS – ideal body 2 – CDRS – ideal body 1</i>	-0.513	0.608	-1.732	0.083	-2.111	0.035	-1.414	0.157
<i>CDRS – body dissatisfaction 2 – CDRS – body dissatisfaction 1</i>	-0.966	0.334	-2.587	0.010	-2.798	0.005	-0.730	0.465
<i>URICA - pre-contemplation 2 – URICA - pre-contemplation 1</i>	-2.019	0.043	-1.405	0.160	-0.052	0.959	-0.285	0.775
<i>URICA - contemplation 2 – URICA -contemplation 1</i>	-1.239	0.215	-0.657	0.511	-0.770	0.441	-0.915	0.360
<i>URICA - action 2 – URICA - action 1 -</i>	-1.846	0.065	-2.102	0.036	-0.441	0.659	-0.428	0.669
<i>URICA – maintenance 2 – URICA maintenance 1</i>	-2.181	0.029	-2.115	0.034	-0.727	0.467	-0.289	0.772
<i>URICA Total 2 – URICA Total 1</i>	-2.383	0.017	-0.803	0.422	-0.640	0.522	-0.598	0.550

7. Discussion

Results obtained to date are only preliminary and subject to much further analysis and refinement. However, some general considerations can be made on the basis of these outcomes. In the following paragraph, data will be discussed separately for the BED and Obese samples.

7.1 Binge Eating Disorder sample

Pre-post treatment comparison revealed several interesting changes both at psychological and physiological level. State Anxiety (STAI X2) significantly decreases in both Experiential Cognitive Therapy (ECT) (Main before: 49,44; Main after: 36,77; p : 0,018) and Nutritional (NT) conditions, (Main before: 49,77; Main after: 38,77; p : 0,013), while no significant changes are evidenced in Cognitive-Behavior Therapy (CBT) condition. On the other hand, Anxiety of patients assigned to the Waiting List (WL)

condition significantly increases from initial levels (Main before: 52,33; Main after: 61,88; p : 0,044).

Depression levels (BDI) significantly decrease in both ECT (Main before: 22,23; Main after: 8,11; p : 0,008) and CBT (Main before: 20,55; Main after: 12,11; p : 0,050); however, complete remission of depressive symptoms is observed only in the ECT group.

Improvement of Self-Esteem levels (RSE) is significant in all groups, with the exception of WL. This suggests that being involved in rehabilitation program increases self-esteem independently of the kind of treatment that patients undergo.

Positive changes of Assertive Behaviors (RAS) are observed in ECT only. This confirms the assumption that virtual simulation of real situations allows to improve patient's social skills.

DIET and WELSQ pre- and post-treatment comparisons revealed that eating control and eating self-efficacy significantly increase in all conditions (with the exception of WL).

This emphasizes the importance of nutritional course underwent by all subjects during the in-patient phase. Significant reduction of binge eating episodes (see Tab. 7) further confirms this assumption. However, it should be noted that the entity of change, as far as DIET levels are concerned, is greater in ECT than in control groups. This suggests that Virtual Reality can play an important role in treating eating control diseases.

Moreover, the observation that WELSQ values are generally greater in ECT than in CBT indicates that ECT is more effective than CBT in increasing self-efficacy levels.

Also, ECT is more effective than CBT in improving body image (BIAQ – BSS – CDRS): in particular, ECT increases body awareness, body satisfaction and physical acceptance and makes patients confident about the possibility of further progresses.

The analysis performed on CDRS revealed significant shifts in the Real Body scale in both ECT and CBT conditions at the conclusion of the in-patient phase. Most likely, awareness of weight loss increased patients' body satisfaction and body perception. In addition, patients undergoing ECT and CBT might have benefited by the participation to psychological groups. In these groups, in fact, the topic of self-esteem related to body awareness has been extensively discussed. As a confirmation of this, weight loss (see Tab. 5) is significant in ECT, CBT and NT conditions, while mean weight significantly increases in WL (no treatment condition).

7.2 Obese sample

Also for the obese group, pre-post treatment comparison revealed relevant changes both at psychological and physiological level. State Anxiety (STAI X2) significantly decreases in ECT (Main before: 38,82; Main after: 32,41; p : 0,038), in CBT (Main before: 43,29; Main after: 37,17; p : 0,012), and in NT (Main before: 38,29; Main after: 32,76; p : 0,020), while no significant changes are evidenced in WL condition.

Depression levels (BDI) significantly decrease in both ECT (Main before: 13,05; Main after: 6,23; p : 0,001) and CBT (Main before: 17,64; Main after: 10,29; p : 0,010); however, complete remission of depressive symptoms is observed only in the ECT condition.

Improvement of Self-Esteem (RSE) is significant, but only in the ECT (Main before: 6,70; Main after: 8,47; p : 0,003) and BCT conditions (Main before: 5,35; Main after: 7,70; p : 0,015). This supports the assumption that being involved in an intensive psychological rehabilitation program has a positive effect on self-esteem.

Positive changes of Assertive Behaviors (RAS) are pronounced in ECT, confirming the assumption that virtual simulation of real situations allows to improve patient's social skills. Assertive Behaviors improves in BCT as well, underlying the therapeutical added value of psychological group discussions.

Table 8. Physiological changes between the start and the end of the treatment in the OBESE Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

	<i>Experiential Cognitive Group</i>		<i>Cognitive Behavioral Group</i>		<i>Nutritional Group</i>		<i>Waiting List</i>	
<i>Physiological data</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>
Weight	111.4+/-16.4	104.14+/-15.25	109.6+/-10.3	101.5+/-9.9	109.8+/-16.7	102.27+/-15.38	110.3 +/-13.9	111.1 +/-13.8
	Z	p	Z	p	Z	p	Z	p
	-3.62	0.000	-3.621	0.000	-3.62	0.000	-1.633	0.102
Body Mass Index	40.83+/-4.54	38.17+/-4.07	42.1+/-5.9	39.0+/-5.3	40.6+/-4.8	37.8+/-4.4	40.6 +/- 4.3	40.9 +/- 4.1
	Z	p	Z	p	Z	p	Z	p
	-3.621	0.000	-3.621	0.000	-3.621	0.000	-1.664	0.096
Hips width	43.3+/-3.4	41.97+/-3.41	44.8+/-2.6	43.0+/-2.7	43.1+/-3.9	41.1+/-3.5	no data	no data
	Z	p	Z	p	Z	p	Z	p
	-3.429	0.001	-3.448	0.001	3.550	0.000	no data	no data

Table 9. Behavioral changes between the start and the end of the treatment in the OBESE Group
(Z: Wilcoxon non parametric test; significant values are marked in bold font)

	<i>Experiential Cognitive Group</i>		<i>Cognitive Behavioral Group</i>		<i>Nutritional Group</i>		<i>Waiting List</i>	
<i>Physiological data</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>Before</i>	<i>After</i>
Binge	1.8+/-4.9	0.0	0.5+/-1.5	0.0	0.5+/-1.1	0.0	1.7+/-4.0	0.4+/-1.1
	Z	p	Z	p	Z	p	Z	p
	-1.890	0.059	-1.633	0.102	-1.841	0.066	-1.826	0.068
Vomiting	0.0	0.0	0.00	0.00	0.1+/-0.5	0.0	0.2+/-0.7	0.2+/-0.7
	Z	p	Z	p	Z	p	Z	p
	0	1	0	1	-1.000	0.317	0.447	0.6555
Laxative	0.0	0.0	0.9+/-3.9	0.0	0.0	0.0	0.0	0.0
	Z	p	Z	p	Z	p	Z	p
	0.0	1	-1.000	0.317	0	1	0	1
Physical activity	2.88+/-2.02	3.17+/-1.70	2.3+/-1.8	3.5+/-1.6	2.8+/-2.0	3.3+/-1.4	2.8+/-1.9	2.6+/-1.8
	Z	p	Z	p	Z	p	Z	p
	-0.794	0.427	-2.218	0.027	-1.341	0.180	-0.7	0.4

The group, in fact, reproduces a similar circumstance but it is protected: patient can practise and then go out "in the open". During the group meeting, assertive, passive and aggressive interactions can develop among patients who can provide real situations to work on and experiment the assertiveness on various kind of people to apply these behaviours outside the group.

Results of analysis conducted on DIET and WELSQ data reveal that in all conditions (with the exception of WL) patients' eating control and self-efficacy are significantly strengthened. This emphasizes the positive effect of the nutritional course carried out during the in-patient phase. However, it should be noted that the entity of change, as far as DIET levels are concerned, is greater in ECT than in control groups. This finding is the same of BED group and is consistent with the assumption that Virtual Reality can play an important role in treating eating control diseases. Also, the observation that WELSQ values are generally higher in ECT than in CBT indicates that ECT is more effective than CBT in increasing self-efficacy levels.

ECT is more effective than CBT in improving body image (BIAQ – BSS – CDRS): in particular, ECT increases body awareness, body satisfaction and physical acceptance and is in agreement with findings of BED group. The analysis performed on CDRS revealed significant shifts in the Real Body scale in ECT, CBT and NT conditions at the conclusion of the in-patient phase. The most reasonable explanation of this change is the awareness of weight loss, which increases patients' body satisfaction and body perception. Motivation to change is greater in ECT and CBT than in NT and WL. This further supports the assumption that being involved in an intensive psychological rehabilitation program increases therapeutical compliance independently of the kind of treatment that patients undergo.

7.3 General discussion

By clinical reputation, eating disorders are some of the most frustrating and recalcitrant forms of psychopathology. As noted by Vitousek et al. [41]: "Few symptom patterns evoke stronger reactions from professionals and none may require more forbearance and self-questioning to manage... [These] disorders are unpopular with clinicians because of the perception that clients habitually deny, deceive and rationalize to protect their symptomatology" (pp. 391-392). This is mostly owed to the strong resistance to change that characterises eating disorders patients, mainly anorectic and bulimic ones.

The first obtained result is the significant change induced by the treatment on the body image of the patients. ECT produced a significant change in the body image, usually associated to a reduction in problematic eating and social behaviors. Actual body-image treatment involves a cognitive/behavioural or a visuomotor therapy that needs many sessions. The possibility of inducing a significant change in body image and its associated behaviors using a short-term therapy can be useful to improve the efficacy of the existing approaches. As such, the procedure can be considered as a comprehensive treatment package to break through the "resistance" to treatment in clinical subjects [157].

Second, using ECT, therapists were able to improve the motivation for change in clinical sample. According to Prochaska and DiClemente [109] it is possible to identify five stages of change that people face in replacing problematic behavior. These stages can be considered predictable and stable subprocesses within the therapeutic process.

The five stages are: Precontemplation, Contemplation, Determination, Action and Maintenance/Relapse.

Particularly, a stage of change is critical for therapy of eating disorders: Contemplation. Contemplation is a paradoxical stage of change, since the patient is open to the possibility of change but is stopped by ambivalence. The characteristic style of the

contemplator is, "yes, but . . .". Two key techniques are usually in facilitating a shift from the contemplation stage to the determination stage of change [110]. The first technique is the use of the *miracle question*, a typical approach used by the solution-focused brief therapy [110, 111]. The miracle question is used to help the client identify how her life would be different if her eating disorder were miraculously gone. The second technique is the search for exceptions: situations in which the patient has been able to manage the problematic eating behaviours more successfully. Using the VR sessions to experience the effects of the miracle and the successful situations, the patients gained an awareness of her need to do something to create change but also to experience a greater sense of personal efficacy.

VR also appeared to be well suited to the Socratic approach. In fact, VR immerses the patient in a real-like situation that she/he is forced to face. The advantages of a VR-based Socratic method are clear. It can minimize distortion in self-report, since there is no script for conforming clients to parrot or oppositional clients to reject. Moreover, it circumvents power struggles because the therapist can be invisible to the patient and presents no direct arguments to oppose. Finally, evidence is more convincing and conclusions better remembered because they are one's own.

Change often requires the recognition of the distinction between an assumption and a perception [70]. Until revealed to be fallacious, assumptions constitute the world; they seem like perceptions, and as long as they do, they are resistant to change. By using VR, the therapist can actually prove that what looks like a perception doesn't really exist. Once this has been understood, individual maladaptive assumptions can then be challenged more easily. As underlined by social cognitive theory, performance-based methods are the most effective in producing therapeutic change across behavioral, cognitive, and affective modalities [158]. In fact, the proposed experiential approach could help patients to discover that difficulties can be defeated, so improving their cognitive and behavioral skills for coping with stressful situations.

The final interesting result is the lack of side effects and simulation sickness after the experience in the virtual environment, confirming the possibility of using virtual environments in ECT. As such, the use of VR sessions might help as a part of a comprehensive treatment package to break through the "resistance" to treatment in clinical subjects [157, 159]. We assume that the virtual experience might be useful to achieve these goals, not as a magic trick but as a catalyser in a therapeutic process.

In summary, results of the small clinical trial show that the virtual simulation of demanding "real-life" situations is useful to improve patient's awareness, body satisfaction, eating control, social skills, self-esteem and motivation to change. In particular, pre-treatment/post-treatment comparison seems to indicate that Experiential Cognitive Therapy was more effective than traditional approaches in the treatment of Obesity and Eating Disorders (Cognitive-Behavior Therapy and Nutritional Course). However, since a limited number of subjects was tested in a relatively high number of conditions, statistical power of the contrasts was reduced. For this reason, clearer indications regarding the relative effectiveness of the treatments are expected from large-scale clinical trials.

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