

8 Male Sexual Dysfunctions: immersive Virtual Reality and multimedia therapy

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Abstract The study describes a therapeutic approach using psycho-dynamic psychotherapy integrating virtual environment (VE) for resolving impotence or better erectile dysfunction (ED) of presumably psychological or mixed origin and premature ejaculation (PE). The plan for therapy consists of 12 sessions (15 if a sexual partner was involved) over a 25-week period on the ontogenetic development of male sexual identity, and the methods involved the use of a laptop PC, joystick, Virtual Reality (VR) helmet with miniature television screen showing a new specially-designed CD-ROM programs using Virtools with Windows 2000 and an audio CD. This study was composed of 30 patients, 15 (10 suffering from ED and 5 PE) plus 15 control patients (10 ED and 5 PE), that underwent the same therapeutic protocol but used an old VR helmet to interact with the old VE using a PC Pentium 133 16Mb RAM. We also compared this study with another study we carried out on 160 men affected by sexual disorders, underwent the same therapeutic protocol, but treated using a VE created (in Superscape VRT 5.6) using always Windows 2000 with portable tools. Comparing the groups of patients affected by ED and PE, there emerged a significant positive results value without any important differences among the different VE used. However, we had a % increase of undesirable physical reactions during the more realistic 15-minute VR experience using Virtools development kit. Psychotherapy alone normally requires long periods of treatment in order to resolve sexual dysfunctions. Considering the particular way in which full-immersion VR involves the subject who experiences it (he is totally unobserved and in complete privacy), we hypothesise that this methodological approach might speed up the therapeutic psycho-dynamic process, which eludes cognitive defences and directly stimulates the subconscious, and that better results could be obtained in the treatment of these sexual disorders. This method can be used by any psychotherapist and it can be used alone or associated with pharmacotherapy prescribed by the urologist/andrologist as part of a therapeutic alliance.

1. Introduction

Regarding the reason for our investigations into male sexuality, some bare statistics should be borne in mind. Briefly summarised: in Italy [1] 12.8% of the male population suffers

erection dysfunction (ED) commonly referred to as “a persistent or recurrent inability to attain, or to maintain, until completion of sexual activity, an adequate erection” [2]; an estimate based on the examination of 1700 non-hospitalized males in the U.S. indicates that approximately 18 million Americans suffer from the same dysfunction [3], and approximately 5 to 20% of men in the world have moderate-to-severe ED [4] and this sexual problem increases with age and co-morbidity [5]. Available statistical data suggest that 70% of erectile dysfunctions can be attributed to organic causes, while the remaining 30% is due to psychogenic or mixed causes [6]. Even if we diagnose that the primary cause of sexual dysfunction is organic, we must also consider that a psychogenous component is always present thus contributing to maintain a vicious circle. In fact primary and secondary psychological elements may both be hidden in the innermost recesses of the impotent patient’s mind.

What are the conventional therapies in use? As a rule, often only after conventional therapies have been tried (pharmacotherapy, intracavernous injections, vacuum therapy) are patients advised to seek the help of a psychotherapist. Today, oral medication is regularly prescribed, often by family and general practitioners in the primary care setting [7], because the patient often prefers a simple and, above all, immediate successful treatment [8], although this may be at the expense of accurate patient assessment [9]. Recent news about the rush to get Sildenafil to take care of impotence indicates a sizeable mass phenomenon (there is however a dropout rate of about 45% after 18 months in previously untreated ED) [10]. International clinical reports on the subject tell us that between 30% and 50% of those undergoing intracavernous injection eventually abandon therapy before its completion [11,12,13].

Moreover, it’s estimated that about 75% of men at some time or other in their sexually active lives have suffered from Premature Ejaculation (PE) commonly referred to as: “a persistent or recurrent onset of orgasm and ejaculation with minimal sexual stimulation before, upon, or shortly after penetration and before the person wishes it” [14].

An American study of 1994 [15] estimates that 29% of men suffer from this disturbance. PE is undoubtedly a more wide-spread phenomenon than has been hitherto assumed. The statistical data mentioned above clearly indicate the alarming size of the problem, as well as the obstacles which medicine must overcome in dealing with it adequately. The natural sense of shame which afflicts individuals affected by these pathologies is probably the reason why only a fraction of cases is brought to medical attention. Impotence and premature ejaculation cause a loss of self-esteem, and may lead the patient to a clinically depressed condition, putting a strain on his relationship and having an impact on his quality of life. The use of pharmacotherapy alone to resolve these problems is sometimes akin to the use of a mere aphrodisiac which stimulates and enhances sexual performance thus giving the impression of having resolved any problems which may exist between the sufferer and his partner.

The idea of using virtual technology came to us several years ago in London, after trying out some first-generation video-games just for fun. The impression we got from that chance experience was one of total involvement: the passage of time and the surrounding reality became irrelevant while the immediacy of the virtual reality was more intensely experienced. In other words, one starts taking part in a dynamic reality, having the real sensation of living a new, concrete experience. We took our first steps by combining a Virtual Reality (VR) experience with the method we were already using for the treatment of male sexual disturbances: the pre-existing method had already included an audio element, and thus the innovation (the inclusion of an audio-*visual* element) was as simple and immediate as connecting already existing electric wires. The dark space was lit up; what was a hitherto partial view was now complete. Then we devised a specially-designed VR program integrating previous experiments into a cycle of therapy that was both more

wide-ranging, as well as more precisely targeted. Along with the new technological support, the psychotherapy sessions remained unaltered but were integrated with VR. The innovation was that using multimedia immersion therapy (i.e. VR), the treatment of male sexual dysfunctions following a therapeutic programme is (a) repeatable; (b) focuses on the ontogenetic development of the male sexual identity and (c) can be utilized by any psychotherapist, psychologist or medical doctor.

2. The therapeutic protocol and its clinical rationale

This treatment is an evolution of the first sex therapy proposed by Masters and Johnson [36,37] and also takes into account the new, advanced theories of Kaplan [38], Stoller [39], Money [40], Schaffer and Emerson [41], Bowlby and Ainsworth [42,43] and Baldaro Verde Verde [44,45].

The treatment follows the hypothesis that sexual identity, which is defined by a multi-factor concept, is acquired in the earliest years of life through a process of identification with the same-sexed parent and is completed by the parent of the opposite sex. It is only consolidated at the end of an often difficult, complex process which includes a fusion of biological, psychological and social elements in a dynamic continuum. The evolving aspect lies in the temporal order in which gender identity, social role and aim emerge. The dynamic aspect involves the risk of one of the pillars of sexual identity being damaged or even destroyed. Therapy is required in such cases: sexual identity must be rebuilt and symptoms decoded (in our opinion this is also true for cases of organic ED in that the sexual dysfunction can spark off and sustain a vicious circle). In this critical process, the VR method rapidly enables the patient to evoke memories and emotions that are worked through with the psychotherapist at the end of the session whilst the patient is still under the influence of the interactive experience, thus accelerating the process of working through events and sensations personally. This allows the patient to enter the sphere of associations of sexual dysfunction which takes much longer when only conventional psychotherapy sessions are used. Indeed, traditional psychotherapy primarily privileges the use of words, and if used alone, normally requires long periods of treatment in order to resolve sexual dysfunctions. We hypothesized that our methodological approach could speed up the cure for sexual disorders, accelerating the psychodynamic process, overcoming cognitive barriers in the patient and directly engaging his unconscious. This type of psychotherapy takes into consideration both the immediate and the more remote causes of sexual dysfunction both in the male and in his relationship with his partner. The cycle of treatment takes place over 15 sessions and is a form of sexual therapy which falls within the accepted confines of short-term psychodynamic psychotherapies. After a urological/andrological examination, we used a therapeutic protocol for the treatment of male sexual dysfunctions which consists of 12 sessions of psychotherapy each lasting 45 minutes (plus 3 additional sessions involving the patient's sexual partner, if any). The cycle of treatment takes place over a period of six months and uses the new Virtual Reality technology employing a VR headset, a computer and a joystick. After a sexological diagnosis (a decoding of sexual symptoms), the psychotherapy (with integral use of VR) facilitates the objective (i.e. non-interpreted) installation of a positive transference, attempting to remove pre-existing adaptive defences and looking to restructure the sexual identity of the patient - including his perception of himself and his view of his role and position in society - in order that the patient might come to understand the process by which his sexual dysfunction has been created and perpetuated. The objective being to consider, contrasting both the signs of anxiety and the mechanisms which induce us to

control instinctive behaviour, crises during the critical periods in the life of the male. Such crises come from the interaction of a series of factors (biological, cultural and personal).

Our therapeutic protocol tries to find pre-existing connections through those “windows on the past” of the male sexual development corresponding to the critical periods of major change – infancy, puberty, adolescence. In the course of the therapy, the patient from the start re-elaborates and subsequently reconstructs an ideal image of infancy, via the virtual experiences and discussions with the psychotherapist, which becomes a safe virtual base from which he can confront “the other”. In practice, session after session, the patient relives symbolical “key moments” on his journey - from infancy through adolescence to adulthood – to create a secure sexual identity. We consider that the creation of secure sexual identity retains a positive emotional value over time, probably due to the fact that it forms a mental reference model.

From the assumption that, as Joseph LeDoux puts it [16], the unconscious mind is able to operate more fluidly in non-verbal modes, and for each emotional module there is a corresponding neuronal line which allows its functioning, such as in the case of laughter or fear. Coherently with these assumptions, the application of VR treatment, which uses images and involves the subject emotionally, can stimulate new mental associations in a sort of reality-monitoring meant as “a way of referring to the activity of discriminating between memories primarily derived from external events and those primarily derived from internal events” [17]. On the basis of Erik Kandel’s studies on the Californian sea snail, *aplysia californica* [18,19], of the studies regarding the functioning of the big brain gene of *drosophila* [20], and considering also research on the cortical reorganisation of monkeys [21,22], and in socially dominant or subordinate crayfish [23], in which both adaptations as well as certain types of stimulation can cause changes in neuronal functioning, we may, therefore, dare to affirm that, using this therapeutic protocol, it is possible to make changes in functional metabolic activity in specific areas of the brain probably connected with the erection mechanism, (a finding confirmed by tests performed using brain PET done before and after therapy) [24,34]. VR enables the patient rapidly to develop memories and emotions that are worked through with the psychotherapist at the end of the session while the patient is still under the influence of the interactive experience. This accelerates the process of working through events and sensations, allowing the patient to enter the sphere of associations of sexual dysfunction, which requires much more time when only psychotherapy is used. Moreover, during the virtual experience, the patient follows pathways that accelerate a psychodynamic process: VR experience eludes cognitive defences and directly stimulates the subconscious, hence also everything related to the patient’s experience in the sexual sphere. The obstacles that lead to sexual dysfunction are thus brought to light. As the patient becomes aware that the causes of his sexual dysfunction can be modified, he acquires, under the therapist’s guidance, a further means of taking part in the healing process. We suggest, on the basis of the neuro-psychological work of Damasio [35,47], that by interacting with his own senses through VR, the patient generates inputs that act on phylogenetically lower brain centres through the neocortex to modify certain associations. Disinhibition of the sex drive, in the Freudian sense [26], is the probable result. Preliminary studies made by our group showed that the positive results of this approach were lasting: this suggests that this method accelerates the healing process by re-opening old brain pathways or consolidating and implies that new and rarely-used inter-synaptic connections, characterized by a particular magnitude of activation [27], may be established so that new mnemonic associations favouring satisfaction of natural drives can flow.

All patients in the groups received psychotherapeutic treatment using the *Virtual Reality-Optale Method* [30, 25]. The 12 treatment sessions are structured as follows: the first baseline session employs multimedia acoustic session, the second consist of

psychotherapy alone; then, in subsequent weeks, four multimedia acoustic sessions are alternated with six VR experiences; a final discussion is held. During the multimedia acoustic experience using words and music studied specifically for the different phases of evolution, the psychotherapist and patient (comfortably seated in a swivel chair) listen together to a recording of two voices (with background music) that describe pathways through a forest, which requires the listener to make choices regarding the situation in which he finds himself. The patient's reactions, comments and body language are noted [28] and afterwards the patient speaks to the psychotherapist about his experience. During the 15-minute VR experiences, the patient sits comfortably in a swivel chair and uses a joystick and a stereophonic head-mounted display (HMD) to interact in a Virtual environment (VE) developed using the virtual reality development kit. The subject, who wears a HMD, feels free to move as he would in the real world in complete privacy. This allows the therapist, who experiences the same virtual world on the computer monitor, to offer assistance to overcome technical difficulties when needed, through a microphone connection with the headphones inside the HMD. During the Virtual experience, the subject listens to pre-arranged background music in MP3 format through the headphones inside the helmet. The music played in the soundtracks have been created in such a way so as to try to avoid any possible personal memory of them in order to allow greater involvement both in the stories told, as well as in the pictures seen during these experiences in the virtual world. Following each listening or virtual experience, the subject was always encouraged to summarise aloud what he had been thinking.

3. Materials and methods

The investigation was conducted on 30 heterosexual males affected by sexual disorders (STUDY ONE), who had undergone no prior sexual therapy. (Another study "STUDY TWO" of 160 men affected by sexual disorders who underwent the same therapeutic protocol, but treated using a VE created (in Superscape VRT 5.6) using always Windows 2000 with portable tools. Study two is discussed below).

STUDY ONE

After collecting the subjects' medical history, a physical examination [29] and other diagnostic procedures carried out by medical staff in the Andrologic Centre, patients were assigned either to the experimental or to the control groups. **Group I** included 10 patients who had been suffering from ED for more than six months.

Group I was further divided into two subgroups:

Subgroup A = 5 patients (average age 43,4) suffering from ED presumable due to purely psychological causes.

Subgroup B = 5 patients (average age 50) suffering from ED presumable due to mixed causes (psychological and general medical condition or substance use deemed contributory but not sufficient on its own to account for the sexual dysfunction).

Group II contained 5 patients (average age 39,8) affected by primary PE.

Control Group I included 10 patients who had been suffering from ED for more than six months. This control Group I was further divided into two subgroups also:

Subgroup AI= 5 patients (average age 44,2) suffering from ED presumable due to purely psychological causes.

Subgroup BI= 5 patients suffering from ED (average age 48,6) presumable due to mixed causes (psychological and general medical condition or substance use deemed contributory but not sufficient on its own to account for the sexual dysfunction).

Control Group II contained 5 patients (average age 32,8) affected by primary PE.

Experimental groups and control groups underwent the same therapeutic protocol, but control groups were presented with the old virtual reality-based sexual treatment [30,25], while experimental groups used a completely new virtual environment, which was developed in the VEPSY project. Due to ethical reasons, no control group using traditional psychotherapy alone was included in this study, since previous investigations have already proven the greater effectiveness of the Optale Method over traditional psychotherapy alone [30,25].

All patients were given:

- a. the “The International Index of Erectile Function (IIEF)” [31]. The IIEF instrument (a self-administered sexual activity questionnaire) consists of 15 items, six of which are included in the erectile function domain;
- b. a generic self-evaluation questionnaire for the presence of depressive and anxiety symptoms and eventually to the “Hamilton Psychiatric Rating Scale Depression, 1993” [32].

These instruments together with the clinician’s evaluation were used to assess the weight of psychological factors in the aetiology of the disturbance and to allow the exclusion of those cases whose organic pathologies were severe enough to constitute the sole cause of the sexual dysfunction. Patients suffering from major psychiatric disorder or having history of alcohol or substance abuse were also excluded from the present study.

The patients’ informed consent was obtained and the method of choosing the two groups (experimental and control) at random was explained to the patients. It was also made clear that at the end of the cycle of treatment, patients assigned to the control group could undergo the new treatment if the results of the experimental group were found to be more effective than those of the control group.

Structure of the Psychological Interview:

During the interview (face to face) the therapist underlines the fact that the subject will be supported by specific psychotherapy attempting to highlight and understand the problem.

Key issues investigated are:

- Past uro-genital pathologies?
- Nocturnal bedwetting after 5 years of age?
- Does he uncover the glans to urinate or to masturbate?
- The frequency and the situational context of the sexual disorder.
- Whether it is associated with loss of desire [47] or with other sexual dysfunctions (DSM-IV, 1994).

Finally the patient is asked about prior attempts at solutions and what results he expects from the therapy.

Presentation of the therapy:

After the interview, the clinician explains the therapy schedule and shows to the patient the material that will be used.

Key points discussed are:

- How Virtual Reality and Multimedia system is used in the treatment.
- Length of the Therapy: 15 psychotherapy sessions (12 plus 3) over a period of 6 months. Each consultation lasts 45 minutes.

- Length of multimedia acoustic and Virtual Reality experience: about 15 minutes each.

4. Results

Results of STUDY ONE

Group I divided into two subgroups:

Subgroup A I – 5 patients suffering from ED presumable due to purely of psychological origin:

drop-outs: 0 cases;
 improvement: 1 case (partial positive response);
 resolution: 3 cases (complete positive response).
 no result: 1 case;

The overall partial and complete positive responses thus amounted to 80%. A partial positive response is defined as an increase in positive results, but still less than 66% (two out of three times). We considered as drop-out cases only before the 7th session of the treatment cycle, the drop-outs after session 7 are counted as negative results. This evaluation is applied to the whole study.

Subgroup B I - 5 patients suffering from ED presumable due to mixed origin (organic and psychological):

drop-outs: 0 cases;
 improvement: 1 case (partial positive response);
 resolution: 1 case (complete positive response).
 no result: 3 cases;

The overall partial and complete positive responses thus amounted to 40%.

Group II – 5 patients affected by primary PE:

drop-outs: 1 case;
 improvement: 0 cases (partial positive response);
 resolution: 4 cases (complete positive response).
 no result: 0 cases;

The overall partial and complete positive responses thus amounted to 80%.

After a 25-week treatment period, the overall partial and complete positive response rate was, therefore, 67%.

Two patients reported temporary vertigo and one nausea during the first 15-minute VR experience, during subsequent VR experiences we suggested that they move in the VE more slowly.

The two groups used the new stereophonic head-mounted display to interact in the new VE, developed using the Virtools toolkit software with laptop PC with Microsoft Windows 2000.

Control Group I divided into two subgroups:

Control **subgroup A I** – 5 patients suffering from ED presumable due to purely of psychological origin:

drop-outs: 0 cases;
improvement: 2 cases (partial positive response);
resolution: 2 cases (complete positive response).
no result: 1 case;

The overall partial and complete positive responses thus amounted to 80%.

Control **subgroup B I** - 5 patients suffering from ED presumable due to mixed origin (organic and psychological):

drop-outs: 0 cases;
improvement: 0 cases (partial positive response);
resolution: 2 cases (complete positive response).
no result: 3 cases;

The overall partial and complete positive responses thus amounted to 40%.

Control Group II – 5 patients affected by primary PE:

drop-outs: 1 case;
improvement: 0 cases (partial positive response);
resolution: 4 cases (complete positive response).
no result: 0 cases;

The overall partial and complete positive responses thus amounted to 80%.

After a 25-week treatment period, the overall partial and complete positive response rate was, therefore, 67%.

Nobody reported an undesirable physical reaction during the 15-minute VR experience.

The two control groups followed the same therapeutic protocol but used the old stereophonic head-mounted display to interact in the old VE, developed using the VREAM toolkit software with a PC Pentium 133 (16 Mb RAM).

STUDY TWO

The aim of this study was to evaluate the efficiency of combined use of psychodynamic psychotherapy integrating VR for the treatment of ED and PE in 160 heterosexual males who had neither any prior sexual therapy nor had made use (either before, during or after therapy) of any specific pharmaceuticals for the treatment of primary sexual dysfunction. All subjects had given their informed consent. After a clinical diagnosis in an andrologic center, 50 presumably purely psychological ED (average age 43.7 years), 60 mixed ED (53.9 years) and 50 primary PE (39 years) who suffered of these problems over six months were undergoing to a cycle of 12 sessions, over a 25-week period, of psychotherapy integrating an audio CD and helmet with a miniature television screens that projected specially-designed CD-ROM program, using a VE created (in Superscape VRT 5.6) using Windows 2000 with portable tools, on the ontogenetic development of male sexual identity (Optale Method).

Results of STUDY TWO

After 25 weeks of cycle of treatment, we obtained the following results:

Group IA – 50 ED presumably of purely psychological origin:

drop-outs: 5 cases (10%);
 improvement: 13 cases (26%) (partial positive response);
 resolution: 25 cases (50%) (complete positive response).
 no result : 7 cases (14%).

(A partial positive response was defined as an increase in positive results, but still less than 66% (two out of three times). We considered as drop-out cases only before the 7th session of the treatment cycle, the drop-outs after session 7 are counted as negative results. This evaluation was applied to the whole study).

The overall partial and complete positive responses thus amounted to 76 %.

Group IB – 60 ED of mixed origin (organic and psychological):

drop-outs: 10 cases (17%);
 improvement: 8 cases (13%) (partial positive response);
 resolution: 19 cases (32%) (complete positive response);
 no result: 23 cases (38%).

The overall partial and complete positive responses thus amounted to 45%.

Group II – 50 primary PE:

drop-outs: 13 cases (26%);
 improvement: 4 cases (8%) (partial positive response);
 resolution: 24 cases (48%) (complete positive response).
 no result: 9 cases (18%).

Two patients reported nausea and one, vertigo during the first 15-minute VR experience during the first viewing.

The overall partial and complete positive responses thus amounted to 56 %.

After a 25-week treatment period, the overall partial and complete positive response rate was, therefore, 58%.

5. Statistical Analysis

STUDY ONE

Loglinear Model 1

30 subjects were involved in the study and were subdivided into two groups (control and experimental). Following therapy, the results set out in the Table 1 were observed.

To analyse this table, we consider three variables (Result (R), Pathologies (P) and Group (G)) and used the following loglinear model:

$$\log m_{ijk} = \mu + \lambda^R + \lambda^{RG} + \lambda^{RP}$$

- $\log m_{ijk}$ represents the logarithm of the expected frequency in cell ijk ;
- μ represents the main effect;
- λ^R represents the effect of Result;
- λ^{RG} represents the interaction between Result and Group;
- λ^{RP} represents the interaction between Result and Pathology;

Table 1. Results of the Study One

| GROUP | RESULT | | pathologies | | | Total |
|--------------|--------|----------------|-------------|-----------|----------|-------|
| | | | Subgr A I | Subgr B I | Group II | |
| control | | positive | 2 | 2 | 4 | 8 |
| | | Partially pos. | 2 | | | 2 |
| | | drop out | | | 1 | 1 |
| | | negative | 1 | 3 | | 4 |
| | | Total | | 5 | 5 | 5 |
| experimental | | positive | 3 | 1 | 4 | 8 |
| | | Partially pos. | 1 | 1 | | 2 |
| | | drop out | | | 1 | 1 |
| | | negative | 1 | 3 | | 4 |
| | | Total | | 5 | 5 | 5 |

The Likelihood Ratio [33] was equal to $G^2 = 2.27$ (df 8, $p = 0.97$) which shows a good fit to the model used. None of the parameters, however, was significant.

The lack of effects could be attributed to the small number of subjects involved. As can be seen in the table, the frequency distribution is almost equal in the two groups (control and experimental).

Loglinear model 2

STUDY ONE plus 15 patients selected at random from STUDY TWO

From a sample of 160 patients (STUDY TWO), 15 patients who were of similar age to the previous sample (STUDY ONE) were randomly pooled and subdivided into three groups.

The results set out in the Table 2 were observed.

Table 2. Results of the Study Two

| GROUP | RESULT | | pathologies | | | Total |
|-----------------------|--------|----------------|-------------|-----------|----------|-------|
| | | | Subgr A I | Subgr B I | Group II | |
| control | | positive | 2 | 2 | 4 | 8 |
| | | Partially pos. | 2 | | | 2 |
| | | drop out | | | 1 | 1 |
| | | negative | 1 | 3 | | 4 |
| | | Total | | 5 | 5 | 5 |
| experimental | | positive | 3 | 1 | 4 | 8 |
| | | Partially pos. | 1 | 1 | | 2 |
| | | drop out | | | 1 | 1 |
| | | negative | 1 | 3 | | 4 |
| | | Total | | 5 | 5 | 5 |
| 15 from sample of 160 | RESULT | positive | 2 | 2 | 1 | 5 |
| | | Partially pos. | 1 | 1 | | 2 |
| | | drop out | 2 | | 3 | 5 |
| | | negative | | 2 | 1 | 3 |
| | | Total | | 5 | 5 | 5 |

Table 3. Estimated parameters in the loglinear model

| | | lambda | s.e. |
|---------------|----------------|--------|--------|
| RESULT | positive | 2,061 | 1,227 |
| | Partially pos. | -7,393 | 27,059 |
| | drop out | 2,572* | 1,225 |
| | negative | 0,000 | , |

In the table 2, the results from the previous analysis are repeated. Again, we can see that the result fits well with the model used: $G^2 = 9,84$ (df 16, $p = 0,87$).

From subsequent analysis of the parameters emerged a significant value in relation to effect R. Moreover, as we can see from a reading of the table of estimated parameters relative to effect R, and using the category “negative” as the reference category, the parameter relative to “drop out” is statistically significant.

We must point out that the parameter relative to “partially positive” gives rise to a standard error which is very high.

6. Discussion

The aim of this study, which follows on from our earlier research on VR use integrating the psychotherapy for the treatment of ED [30] and PE [25], was to evaluate the therapeutic efficiency of this method - which uses a repeatable therapeutic protocol – using a more realistic VE and to discern if the more realistic VE could increase the positive results. The percentage of positive results obtained from all samples supports the combination of this psychotherapeutic method integrating VR for curing the process of male sexual dysfunctions (ED and PE). Furthermore, this method could accelerate the healing process favoring a rapid solution of the sexual problem leading to a satisfactory sexual performance. Regarding the necessity of integrating the pharmacotherapy with psychotherapy for the treatment of ED, we agree completely with Levine who says: “We increasingly recognise that ED usually arises from a mix of organic and psychogenic causes, yet management of this condition too often neglects the complexity of most cases of ED. While therapy with sildenafil and similar investigational drugs can play an important role in many cases of ED, physicians should recognise and try to address the psychological and interpersonal context in which ED exists in their patients”[9].

Through the VR experience which uses audio and visual schemes preceded by verbal narratives, we can generate new imaginary scenes, stimulating the long-term memory and activating the consequent logical deductions. The patient, while undergoing the VR experience, feels not only free to interact with the virtual world with the sensation of not being observed, but the patient also feels free to remember facts and events (also unpleasant). In the immediately following sessions with the psychotherapist – carried out while the patient is still “fresh” from his VR experience - the virtual reliving of such remembered events form the basis for deeper investigation. It is not necessary that the VR image and that coming from our long term memory be exact matches. The brain, as well as being able to fix for prolonged intervals an image in the absence of the object it represents, has the ability to extend and enrich this information with greater background detail, thus developing a representation of reality much more complex and articulate than the relatively primitive input would suggest.

Comparing the groups of patients affected by ED and PE did not illuminate any significant differences between them. However, the group of patients affected by PE who

underwent the therapeutic cycle using the Virtool's VE (more realistic and more fluid VE) showed a increase in positive results with respect to the 15 from sample of 160 patients who used the Superscape VE. This percentage of positive results could be due to the fact that we may have fortuitously found a group of men who were highly motivated to solve their sexual problems and who also had very understanding partners. However, with the Virtools VE, we noticed an increase in the percentage of negative physical side-effects (nausea and vertigo) perhaps as a result of the greater realism of the virtual environment and the opportunities it affords for greater fluidity of movement. Negative side-effects observed during the VR experience were very rare and took the form of feelings of nausea or vertigo during the first session under the HMD. Gradually, as treatment continued, these feelings disappeared. Indeed, patients frequently expressed a strong wish to prolong the VR sessions beyond their 15-minute span.

Modifying and enriching in some way the mental map, we can think of determining also functional changes in mental associations regarding the sexual dysfunction. Revisiting our experiences according to this protocol, we can hypothesise that some synaptic connections are facilitated, probably modifying the magnitude of such connections and that certain intersynaptic connections are favoured. In that our memory of events is inexact, fluid and is susceptible to change and adaptation (above all when our emotions are involved), we could hypothesise that VR therapy can modify long-term memory due to its apparent effect on the emotions.

The identification of those patients who could derive greater benefit from the use of this method (using Virtools development kit integrated with pharmacotherapy at a precise moment in the therapeutic cycle) is to be the subject of future investigations as part of a therapeutic alliance.

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