Virtual Reality Exposure versus Cognitive Restructuring for Treatment of Public Speaking Anxiety: A Pilot Study

Helene S. Wallach, PhD, Marilyn P. Safir, PhD, and Margalit Bar-Zvi, MD

ABSTRACT

Objectives: To determine the utility of Virtual Reality Exposure Therapy (VRE) in comparison with Cognitive Therapy (CT) and with Cognitive-Behavior Therapy (CBT).

Method: Subjects suffering from public speaking anxiety (PSA) were randomly allocated to VRE and CT, and received 12 therapy sessions, employing standardized treatment manuals. Outcome (questionnaires, observer and self ratings of a behavioral task) was compared to results of subjects in a previous study CBT and Wait List Controls who were not significantly different on demographic data.

Results: CT was not superior to VRE on cognitive measures, but was superior to VRE on one behavioral measure (LSAS fear). VRE was superior to CT on one behavioral measure (fear reduction on a behavioral task). No differences were found between either CT, or VRE, and CBT and all were superior to WL.

Limitations: Subject group was small and homogeneous. It appeared advisable to increase number of therapy sessions.

Conclusions: VRE and CT proved to be equally effective to CBT in reducing PSA relative to a control group, with minimal differential effects between them. Therefore, employing either one may be satisfactory and sufficient.

The gold standard treatment for phobias is Cognitive Behavior Therapy (CBT) which combines both behavioral and cognitive elements (1-4). Although numerous studies have been conducted to examine the necessity of employing both cognitive and behavioral elements in therapy, it remains unclear whether it is sufficient to deliver cognitive therapy (CT) alone, behavior therapy (BT) alone or if both need to be employed (5-8). In recent years, Virtual Reality Exposure (VRE) has been utilized for the BT (exposure) component of CBT. Therefore, for this pilot study, we compared VRE to CT in an attempt to examine the relative efficacy of each component independently, and in comparison with the combined treatment.

SOCIAL PHOBIAS
Social phobia is defined as a fear of and desire to avoid a situation in which the individual may come under scrutiny by others and fears he/she may act in ways that may be humiliating or embarrassing (9). Social phobia affects school performance, ability to create social networks and intimate relationships as well as work performance, is the most common anxiety disorder, and the third most common psychiatric disorder (10, 11). In the present study we focused on a non-generalized social phobia - public speaking anxiety. Public speaking anxiety (PSA) is the most common social phobia, afflicting 40% of all those who suffer from social phobia (11).

VIRTUAL REALITY EXPOSURE (VRE) FOR SOCIAL PHOBIAS
Exposure is presumed to extinguish maladaptive conditioning (phobic object = fear) through anxiety reduction, and to shape new conditioned responses (neutral or adaptive responses to the formally phobic object).
This occurs as the client experiences both a reduction in anxiety during the exposure (habituation) and the absence of the catastrophic event he/she anticipated (extinction) (1, 12, 13). VR is defined as a situation in which sensory information is generated by a computer rather than by the natural environment (e.g., 14). During the exposure stage in VR, the client puts on a helmet which is connected to a computer. The helmet provides both visual and audio input. The therapist employs a special computer program enabling her/him to change various elements in the virtual environment, thus providing the client with gradual exposure to aversive stimuli. The therapist views exactly what the client views in the helmet, on the computer screen. The client’s head movements change the environment, just as they would in the real world, hence increasing the sense of immersion. The therapist monitors the client’s Subjective Units of Discomfort (SUD) and thus controls the fear level of the environment. Thus, VRE is superior to conventional exposure for people who have difficulty imagining situations vividly, for those who avoid remaining in the imagined fearful situation, and for those who are unable to control their imagination and flood themselves with higher levels of anxiety than are produced by the hierarchy. In addition, the drop-out rate from VRE has been found to be much lower than the drop-out rate from traditional BT (15, 16).

COGNITIVE THERAPY FOR SOCIAL PHOBIA

Cognitive factors are especially obvious in social phobia (6, 17, 18). Socially anxious individuals over-estimate the threat of public criticism, scrutiny or embarrassment (17). They also have negative and distorted images of how others view them (19, 20). In addition, clients exaggerate the “social cost” of their performance (21). This leads to the perception of social situations as dangerous, to an increase in anxiety relevant physical sensations when encountering feared situations, to hyper vigilance to the environment and to bodily sensations and to avoidance of feared social situations or the use of “safety” behaviors. Therefore, faulty cognitions develop, maintain and increase social phobia (18, 20). However, therapy that challenges these cognitions was found to be beneficial and crucial in the treatment of PSA (2, 22, 23).

COGNITIVE-BEHAVIOR THERAPY FOR PHOBIAS

The combination of Cognitive and Behavior Therapies (CBT) has been reported to be the treatment of choice for phobias (e.g., 23-25). Thus this pilot attempted to compare VRE to both CT and to the gold standard treatment for PSA, namely CBT.

METHODS AND EXPERIMENTAL DESIGN

PARTICIPANTS

Twenty subjects who suffered from PSA were recruited for this study. Candidates suffering from a psychotic disorder, drug or alcohol abuse, or epilepsy, or who were in psychotherapy for this problem, or were taking psychotropic medication were excluded. Epilepsy may be aggravated by the use of VR, and therefore this served as an exclusion criteria. Subjects were young (average age 28), were mostly Jewish (85%) and single (75%) (Table 1). In addition, their results were compared with data from a recent study that employed CBT (28 participants) for PSA using similar protocols and a wait list control (WL) (30 participants) condition (16). Subjects in the previous study were also primarily Jewish (89%, 90%), young (average age 28, 25) and single (75%, 93%) and not significantly different on these variables from the subjects in the present study (Table 1).

<table>
<thead>
<tr>
<th>Measure</th>
<th>VRE</th>
<th>CT</th>
<th>CBT</th>
<th>WL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>28</td>
<td>30</td>
</tr>
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<td>4 6</td>
<td>5 23</td>
<td>9 21</td>
</tr>
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<td>6 6</td>
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<td>9 1</td>
<td>25 3</td>
<td>27 3</td>
</tr>
</tbody>
</table>

Note. aMaj=Majority; bMin=Minority

Table 1. Demographic Variables

MEASURES

1. Liebowitz Social Anxiety Scale (LSAS) (26) includes 24 questions. For each question, the participant rates the amount of fear experienced (answered on a 4-point Likert scale from 0 – “not at all” to 3 – “very much”) and the amount of avoidance experienced (rated on a 4-point Likert scale from 0 – “never, 0%” to 3 – “usually, 68%-100%”). This scale has high reliability (Cronbach α .90-.95). It also has good validity (high correlations with other anxiety measures, e.g., Social Interaction Anxiety Scale – fear scale .72, avoidance scale .68; Social Phobia Scale – fear scale .64, avoidance scale .59).

2. Self Statements During Public Speaking (SSPS) (27). This 10-item measure assesses fearful thoughts during public speaking. It consists of two subscales: posi-
tive and negative self-statements. This scale has high reliability (.78-.80 & .80-.86, respectively). It also has good validity (discriminates between social phobics and the general population; correlates with other anxiety scales: e.g., Personal Report of Confidence as a Speaker .67; Fear of Negative Evaluation .49; Social Phobia and Anxiety Inventory .48. For the positive scale, higher scores indicate less anxiety.

3. Fear of Negative Evaluation (FNE) (28) includes 30 yes/no questions. The questions relate to cognitive aspects of the phobic experience – fear of criticism or negative evaluation. FNE has high reliability (.78-.94), and good validity (e.g., correlations with Taylor's Manifest Anxiety -.60, social and evaluative parts of the Endler-Hunt S-R -.47).

4. Behavioral Task: Upon completion of treatment, participants presented a 10-minute talk on a topic they choose (standing, and without notes) in front of a live audience composed of four or five staff members who served as observers, and were unaware of treatment group placement. Participants were rated on 10 anxiety indicators. Nine indicators were rated on a 5-point Likert type scale from “very much” to “not at all” (e.g., eye contact, stuttering), and one was a global fear assessment rated on a 0-10 scale from 0 – “not at all anxious” to 10 – “very anxious.” Prior to rating the subjects, all observers underwent a brief training session in order to insure high inter-rater reliability. In addition, subjects rated their anxiety at various points (waiting outside the room, giving the lecture, etc.) on 5-point Likert type scales.

PROCEDURE
Subjects were recruited through advertisements on the university website, in campus newspapers and strategically placed flyers on campus. Those interested in participating were interviewed by a research assistant, signed an informed consent form, completed pre-treatment questionnaires, and were randomly assigned by the research assistant by order of arrival to one of two groups: VRE or CT. Random assignment was performed before scoring of the questionnaires was undertaken. Data compiled from subjects that participated in a previous study was employed for the CBT treatment and the WL groups (16). Recruitment and exclusion criteria were similar for that study.

Due to technical, logistic and budgetary constraints no formal diagnosis of PSA or of psychiatric co-morbidity was undertaken. Therefore, we cannot be certain our subjects met the formal criterion for PSA. However, they volunteered for this study, reporting that they suffered from PSA, and would like treatment. Additionally their pre-therapy scores were similar to those of individuals suffering from social phobia in previous studies. For example, mean LSAS Fear scores ranged from 28.18-34.80 in this study which is higher than mean scores found in a previous studies (18.92 and 24.9), mean LSAS Avoidance scores ranged from 24.46-27.97 in this study which is also higher than 18.20 and 16.7 found in a previous studies (29, 30). Mean FNE scores ranged from 20.07-21.80 in this study which is similar to mean FNE scores (.23.14-25.04) found in previous studies (29, 31). Mean SSPS positive scores ranged from 10.18-13.90 in this study similar to the score of 9.4 found in a previous study, while mean SSPS negative scores ranged from 11.64-13.10 in this study compared to mean of 15.80 in a previous study (32).

Subjects in both treatment groups (VRE and CT) in this study and in the CBT treatment group in the previous study received 12 individual one-hour treatment sessions administered according to protocols designed for both studies. Therapists (graduate psychology students in the final stages of their clinical training) were given extensive training in application of the treatment protocols, and supervised throughout the study by senior Clinical Psychologists to ensure that they were actually following treatment protocols. The WLC group filled out questionnaires at the beginning and end of a 12-week wait period, after which they were randomly assigned to CBT (first study).

All subjects performed the behavioral task at the end of treatment or wait period.

TREATMENT PROTOCOLS:
Cognitive treatment protocol: The cognitive aspects of the treatment outlined by Heimberg and Becker (22) were utilized in this research. They included: presentation and discussion of the cognitive model of social phobia and the rational for cognitive treatment, training in cognitive restructuring (identification of automatic thoughts, identification of thinking errors, learning to correct thinking errors and to replace automatic thoughts with rational responses). Cognitive restructuring was practiced during sessions through role play and in homework assignments as well. No behavioral homework was given and role-play in the sessions was limited to cognitive disputing without behavioral exposure.

Virtual reality exposure treatment components:
The behavioral aspects of the treatment outlined by Heimberg and Becker (22) were also utilized in this research. They included: presentation and discussion of the behavioral model of social phobia and the rationale for behavioral treatment, graded in-session behavioral exposure in virtual environments using SUDS ratings, and graded homework assignment. No cognitive homework assignments were given, and no discussion of cognitions occurred during in session exposures.

VR was employed for the exposure. VR components consisted of software and hardware (computer, head-mounted display – HMD). The software package was purchased from Virtually Better, Inc. It provides scenes in which the subject is required to read from text, which appears on a podium in the virtual world, in front of a large audience in various situations (audience clapping, asking questions, appearing hostile, etc.). The subjects provided the text, but the scenes were controlled by the therapist, according to the hierarchy which was developed for each subject prior to exposure.

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RESULTS

DEMOGRAPHIC VARIABLES
The two treatment groups composed of subjects solicited for this pilot study (CT, VRE) were compared on demographic variables (Table 1) using Wilcoxon Two Sample Test for age, and χ² for group status, family status and gender. No significant differences were found on majority/minority group status, family status, or percentages of males and females. A significant difference was found on age (p≤0.05). The CT group participants were slightly older (28.11) than VRE group participants (27.5). The three treatment groups were then compared (CT, VRE, and CBT) on demographic variables (Table 1). No significant differences were found on age, majority/minority group, family status, or percentages of males and females. In addition, the two treatment groups were compared on demographic variables to the WL group from the former study (Table 1). Here again, no significant differences were found on majority/minority group, family status, or percentages of males and females. A significant difference was found on age using the Wilcoxon two sample test, Z=2.04, p≤0.05. The WL group participants were younger (25.29) than the treatment group participants (27.79).

PRE-THERAPY MEASURES
We compared the two treatment groups from this study, CT and VRE to the WL control group from the previous study on pre-treatment clinical measures. None of the comparisons were significant: LSAS fear F(2,50)=.48, n.s.; LSAS avoidance F(2,50)=.16, n.s.; SSPS positive F(2,50)=1.17, n.s.; SSPS negative F(2,50)=.02, n.s.; FNE F(2,50)=.23, n.s. Therefore, the groups did not differ significantly prior to treatment.

DIFFERENTIAL UTILITY OF VRE IN COMPARISON WITH CT
We compared CT to VRE on both cognitive (FNE, SSPS positive, SSPS negative), and behavioral (self and observer ratings of global fear, LSAS ratings of fear and avoidance) measures (Tables 2 & 3). As our primary goal was to differentiate between CT and VRE, and not in their interaction, comparisons were made using difference scores employing alpha correction for multiple analyses. In addition, we calculated effect sizes for the difference between these two groups using the Mann-Whitney statistic. No significant differences were found between CT and VRE on cognitive measures. Effect sizes for these comparisons were 0.665 for FNE, 0.615 for SSPS positive, 0.575 for SSPS negative, therefore, CT was not superior to VRE on cognitive measures. Effect sizes for these comparisons were 0.665 for FNE, 0.615 for SSPS positive, 0.575 for SSPS negative. For comparison, effect size for FNE in a previous study was 0.68 (29). Nor was a significant difference found between CT and VRE on LSAS avoidance. Effect size for this comparison was 0.620. However, a significant difference was found between them on the LSAS fear, t(18)=−2.88, p≤0.01, after performing alpha correction: p≤0.049). Effect size for this comparison was 0.845. For comparison, effect size in a previous study was 0.12-0.34 for LSAS fear and 0.32-0.51 for LSAS avoidance (29). Contrary to predictions, the CT group showed larger reductions in fear than the VRE group. Comparing the treatment groups on self ratings of global fear (Table 3), only one measure (level of fear while standing in front of the audience) was significant, S=80, p≤0.05. As predicted the VRE
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Group reported feeling less anxious than the CT group. However, no significant differences were found when they were compared on observer ratings.

Are CT and VRE effective?

Examining Changes from Pre to Post Therapy in Each Treatment Group

For each therapy group, post-therapy scores were compared to pre-therapy scores using t-tests. The VRE group improved significantly on LSAS avoidance t(9)=5.40, p≤0.005, after alpha correction, p≤0.005, and on SSPS positive t(9)=2.16, p≤0.05, but not after alpha correction, p≤0.264. The changes on LSAS fear t(9)=1.25, SSPS negative t(9)=1.70; and FNE t(9)=0.84 and on FNE t(9)=0.51 were not significant.

Comparing CT and VRE to WL

As the two treatment groups did not differ significantly on most of the measures and the groups were so small, we combined the two treatment groups from this pilot study (VRE, CT) and compared them to the WL participants. We found significant differences on three of the five questionnaires (Table 2). LSAS fear, t (48)=2.31, p≤0.05, however, this difference disappeared after alpha correction p≤0.12. The combined treatment group improved more (reducing their fear by 6.80) than the WL group (who reduced their fear by 1.10). The effect size of this comparison was 0.67. LSAS avoidance, t(48)=4.08, p≤0.0005, after alpha correction p≤0.001. The treatment group also significantly reduced their avoidance (8.55) more than the WL group (-1.16). Effect size for this comparison was 1.21. SSPS positive, t(48)=-1.96, p≤0.05, however, this difference disappeared following alpha correction p≤0.25. The treatment group improved more (increased by 3.75) than the WL group (increased by -1.00). Effect size for this comparison was 0.58. No significant results were found on the FNE, t(48)=0.92, n.s. (effect size 0.26) or on the SSPS negative, t(48)=-1.52, n.s. (effect size 0.43).

Is CBT Superior to CT and to VRE?

Comparing CBT to CT and to VRE

No significant differences were found between the three treatment groups (VRE and CT from this pilot study, CBT from the previous study) (Table 2). Using the Kruskal-Wallis test, LSAS fear, χ²(2)=5.21, n.s.; LSAS avoidance, χ²(2)=0.64, n.s.; SSPS positive, χ²(2)=1.24,

Table 2. Pre- and Post-Anxiety Measures

<table>
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<tr>
<th></th>
<th>FNE M Sd</th>
<th>LSAS Fear M Sd</th>
<th>LSAS Avoidance M Sd</th>
<th>SSPS Positive M Sd</th>
<th>SSPS Negative M Sd</th>
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<td>2.40**</td>
<td>6.60***</td>
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<td>-1.16***</td>
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Note. *p ≤ 0.05; **p<0.01; ***p<0.0005

Table 3. Ratings of Behavioral Task (lecture)

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<th>SG1a Mean Sd</th>
<th>SG2 Mean Sd</th>
<th>SG3 Mean Sd</th>
<th>SG4 Mean Sd</th>
<th>SG5 Mean Sd</th>
<th>SGt Mean Sd</th>
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<td>VRE</td>
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<td>7.40* ± 1.07</td>
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<tr>
<td>CT</td>
<td>7.00 ± 2.98</td>
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<td>7.10 ± 0.35</td>
<td>8.40* ± 1.84</td>
<td>7.30 ± 1.77</td>
<td>6.84 ± 1.79</td>
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</table>

Note. SG= self grading (1-preparing for the lecture, 2-listening to instructions, 3-waiting for turn, 4-standing in front of the audience, 5-giving the talk, t-total)
* p<0.05
DISCUSSION
VR has only been employed in therapy for public speaking anxiety in a few studies (14, 32, 33). Although VR was found to reduce anxiety in these studies, random assignment with a control group and comparative statistical analyses were not used. One randomized study using VR with public speaking anxiety (16) found that VR was equally effective as CBT without VR, and that both were superior to WL control group. The present pilot study was designed to compare the effectiveness of Virtual Reality Exposure (i.e., exposure without the cognitive component) in comparison with Cognitive Therapy (i.e., the cognitive component without exposure) and with Cognitive-Behavior Therapy (i.e., both the cognitive and the exposure components) for individuals who suffer from public speaking anxiety.

Both CT and VRE significantly reduced anxiety from pre to post treatment. CT was not superior to VRE on cognitive measures, and VRE was superior to CT on only one aspect of self observation (fear while standing in front of the audience), but CT was superior to VRE on LSAS fear reduction, which is a behavioral measure. No other differences were found between CT and VRE. In addition, no differences were found between either CT or VRE and CBT. All three active treatments (CT, VRE and CBT) were superior to the WL.

Previous studies (treating various phobias other than public speaking anxiety) failed to find significant lasting differences between CT and BT. Similarly, using a new technology, namely Virtual Reality, for the exposure rendered similar findings whereby using either CT or VRE alone is satisfactory, and probably sufficient. In accordance with the literature, both CT and VRE changed maladaptive cognitions and reduced fear levels, even though operating through different modalities. Although our conclusions parallel those of previous studies (e.g., 1, 3), it is premature to conclude that VRE and CT do not differ in their impact on specific aspects of the phobia. We found large, but insignificant differences between them. Because of our small sample size, statistical analyses were not powerful. Therefore, we plan to replicate this study utilizing larger sample sizes in order to further investigate this important question.

In addition, it should be noted that our participants cannot be considered representative – they were young, female and unmarried, as well as extremely compliant. It is necessary to repeat this study with a larger, more heterogeneous sample. We accepted self identified PSA participants and did not formally diagnose public speaking anxiety, nor did we examine for psychiatric co-morbidity. This may also have affected our results. Therefore, we recommended employing clinical interviews to derive formal diagnoses for future research participants. Lastly, although we closely supervised our graduate student therapists, we did not have the means to tape therapist performance in order to ensure treatment fidelity. It is important in future research to do this.

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References