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Virtual Reality Treatment in Acrophobia: A Comparison with Exposure in Vivo

PAUL M.G. EMMELKAMP, Ph.D.,[1] MARY BRUYNZEEL, M.S.,[1] LEONIE DROST, M.S.[1] and CHARLES A.P.G. VAN DER MAST, Ph.D.[2]

ABSTRACT

The aim of the present study was to evaluate the effectiveness of low-budget virtual reality exposure versus exposure in vivo in a within-group design in 10 individuals suffering from acrophobia. Virtual reality exposure was found to be at least as effective as exposure in vivo on anxiety and avoidance as measured with the Acrophobia Questionnaire (AQ), and even more effective on the Attitude Towards Heights Questionnaire (AHQ). The present study shows that virtual reality exposure can be effective with relatively cheap hardware and software on stand-alone computers currently on the market. Further studies are recommended, in which virtual reality exposure is compared with in vivo exposure in a between-group design, thus enabling investigation of the long-term effects of virtual reality treatment.

INTRODUCTION

Virtual reality environments have potential clinical application, especially in the treatment of phobias. Virtual reality integrates real-time computer graphics, body-tracking devices, visual displays, and other sensory input to immerse the phobic patient in a computer-generated virtual environment. Virtual reality exposure has several advantages over exposure in vivo. The treatment can be conducted in the therapist's office, rather than that therapist and patient have to go outside to do the exposure exercises in real phobic situations, and hence treatment may be more cost-effective than therapist-assisted exposure in vivo. Further, virtual reality treatment can also be applied with patients who are too phobic to experience real-life exposure in vivo.

A few case studies have been reported demonstrating the effectiveness of exposure provided by virtual reality. Such case studies have been reported on fear of flying,[1] acrophobia,[2] claustrophobia,[3] spider phobia,[4] and agoraphobia.[5] To date, only one controlled study has been reported. In this study on college students with fear of heights seven weekly sessions of virtual reality exposure was found to be more effective than no-treatment control.[6] Subjects in the no-treatment control group were unchanged.

No study has evaluated the effects of virtual reality exposure versus the effects of other treatments. The effects of exposure in vivo in acrophobia have been well established.[7] There is a clear need to compare the effectiveness of virtual reality treatment with the effectiveness of exposure in vivo.

[1]Department of Clinical Psychology, University of Amsterdam, Amsterdam, The Netherlands.
[2]Delft University of Technology, Delft, The Netherlands.

In the Rothbaum et al. study,[6] a rather expensive laboratory computer created the virtual environment. However, to be of practical usefulness virtual reality exposure should be shown to be effective on not-too-expensive personal computers, which are currently on the market.

The aim of the present study was to evaluate the effectiveness of low-budget virtual reality exposure versus exposure in vivo in a within-group design in individuals suffering from acrophobia.

METHOD

Design

All patients received two sessions of virtual reality exposure followed by two sessions of exposure in vivo. After an intake session patients received a pretest followed by two sessions of virtual reality exposure. After an intermediate test all patients received two sessions of exposure in vivo. After the last treatment session the post-test was held. Sessions in both treatment blocks lasted approximately 1 hour and were held twice weekly.

Subjects

Patients were individuals suffering from acrophobia as their main complaint. Patients were recruited by advertisements in local media, offering treatment for acrophobia. Fifteen individuals referred themselves for treatment. Of these 15 individuals, 4 were not included in the study, since their fear of heights was not severe enough to justify intensive treatment, and 1 patient declined the treatment offered. The remaining 10 subjects (7 females, 3 males) signed the informed consent and completed the project.

Treatment

Virtual reality exposure was provided in a dark laboratory room. The virtual worlds were generated using an ordinary Pentium Pro 200 MHz computer with 64 Mb RAM and a Matrox Mystique 220 graphic card running Windows 95. The software used was Superscape VRT 5.0, a commonly used VR modeling and visualization toolkit. In all, the system was able to generate the display at a rate of about 10 frames per second. The worlds were displayed using I-glasses from Virtual-IO. This head mounted display has an integrated 3-degrees-of-freedom tracker and does support stereographic projection. (For further technical details see Ref. 8). To give the individual an enhanced feeling of height, the patient was standing on a metal grid a few inches above the ground, surrounded by a railing the user could hold on to. A piece of cloth was placed over the patients' head, blinding the subject to all but the virtual world.

During the first session of virtual reality exposure patients were acquainted with the headmounted device and the virtual reality by watching a neutral virtual reality environment (inside an office) for a few minutes. Then patients were exposed to two different virtual environments, which had been especially created for this project: (1) a diving tower and a swimming pool; and (2) a tower building with a glazed elevator (For technical details see Schluemie et al.[8]). Virtual reality exposure was gradual and the therapist gave verbal guidance. Patients has to rate their anxiety level (Subjective Units of Disturbance: SUDS) at regular times during the virtual reality exposure exercises on a 0–8 scale. When the anxiety was diminished the therapist introduced the patient to a more difficult exercise in the virtual world. The therapist, who handled the program by means of the keyboard of a personal computer and a joystick, controlled the virtual reality exposure. The actual world seen by the patient was displayed for the therapist on a video display.

To aid the therapist in deciding whether anxiety had diminished, heart rate was monitored throughout the virtual reality exposure sessions using an ambulatory heart rate device (PPG Hellige compact monitor type SM-152-M). The actual heart rate was displayed continuously on a monitor. Based on reduction in SUDS and heart rate, therapists decided to switch to a more difficult exposure scene.

Treatment activities during the exposure in vivo condition were held at different locations depending on the needs of the patient, and involved climbing a fire escape on a five-story

Table 1. Means and Standard Deviations in Parentheses of the Dependent Variables

	Pretest	*Intermediate test*	*Post-test*
AQ-Anxiety	45.7 (22.1)	24.8 (20.1)	18.4 (15.9)
AQ-Avoidance	15.0 (12.6)	7.00 (8.6)	5.4 (7.4)
ATHQ-Attitude	39.0 (15.0)	28.3 (14.7)	24.2 (15.7)

building to reach the landings, going near the edge of a landing, and looking down at the ground level. Other exposure exercises involved walking on the balconies of an 18-story building and looking down at ground level, and walking on the roof of a 5-story building and looking down at ground level. All patients started in the first exposure in vivo session on the balconies of the 18-story building. Exposure was gradual and the therapist gave verbal guidance. Patients had to rate their anxiety level at regular times during the exposure exercises on a 0–8 scale (SUDS). When the anxiety was diminished the therapist encouraged the patient to do a more difficult exercise. All exposure tasks were performed during the sessions. Neither during the virtual reality exposure, nor during the exposure in vivo phase, were patients encouraged to do exposure exercises outside the therapy sessions.

Two advanced clinical psychology students who were supervised by the senior author conducted treatments. The therapists had taken advanced courses in behavior therapy before they were admitted to the therapist team.

ASSESSMENT

The following questionnaires were completed at pretest, intermediate test, and post-test:

1. *Acrophobia Questionnaire* (AQ).[9] This questionnaire has two subscales: anxiety (range 0–120) and avoidance (range 0–60).
2. *Attitude Toward Heights Questionnaire* (AHQ).[10] The questionnaire contains six questions assessing attitude toward heights (range 0–60).
3. After each session of virtual reality exposure subjects completed *The Fear and Presence Questionnaire*,[11] assessing realism, immersion, interaction and presence, respectively. Results on the technological aspects of this study are discussed elsewhere.[8]
4. Finally, at pretest only the subjects completed the *Symptom Checklist* (SCL-90).[12]

RESULTS

The data were analyzed with MANOVA for repeated measures. Results are presented in Tables 1 and 2. As shown in Table 1, there was a significant time effect on the AQ-anxiety, the AQ-avoidance, and on the ATHQ. Posthoc analyses revealed that both virtual reality as well as exposure in vivo led to significant improvement on AQ-anxiety. However, virtual reality exposure led to significant improvement on the AQ-avoidance and ATHQ, but exposure in vivo did not result in significant improve-

Table 2. Results of MANOVA

Measures		*F*	*df*	*p<*
AQ-Anxiety	Time-effect	16.8	2	.0000
	Virtual reality	13.78	1	.005
	Exposure in vivo	6.02	1	.037
AQ-Avoidance	Time-effect	10.35	2	.001
	Virtual reality	8.18	1	.019
	Exposure in vivo	1.42	1	.264
ATHQ	Time-effect	7.87	2	.013
	Virtual reality	15.22	1	.004
	Exposure in vivo	1.71	1	.223

ment. To investigate whether severity of psychopathology was associated with improvement, bivariate correlations were calculated between SCL-90 scores and improvement on the AQ-anxiety, AQ-avoidance, and ATHQ after virtual reality exposure (intermediate test–pretest) and exposure in vivo (post-test–intermediate test), respectively. None of these correlations were significant ($p < 0.05$).

DISCUSSION

This is the first study in acrophobia in which the effects of virtual reality exposure were compared with the golden standard of treatment for specific phobias: exposure in vivo. Virtual reality exposure was found to be at least as effective as exposure in vivo on anxiety and avoidance as measured with the AQ, and even more effective on attitudes toward heights (AHQ). It should be noted, however, that all patients received virtual reality exposure as first treatment. We did not counterbalance both treatments because we expected a ceiling effect after two sessions of exposure in vivo,[7] leaving insufficient room for further improvement with virtual reality exposure. Unexpectedly, this is exactly what may have happened with virtual reality exposure in the present study in a number of patients: virtual reality exposure as first treatment was already so effective that a ceiling effect occurred, thus diminishing the potential effects of exposure in vivo. The positive results of only two sessions of virtual reality with acrophobics from the community in the present study support the earlier findings of Rothbaum et al.,[6] who found seven sessions of virtual reality exposure more effective than no-treatment control in college students with fear of heights.

As to the process of virtual reality exposure, both SUDs and heart rate data revealed that the results of virtual reality exposure are best explained in terms of habituation. Given the idiosyncratic nature of VR exposure (i.e., the choice and the duration of specific exposure exercises were individually determined), statistical analyses of the SUDs and heart rate data were precluded. Inspection of the SUDS data during virtual reality exposure and exposure in vivo revealed that patients were basically experiencing the same reactions. Typically, both in exposure in vivo and in virtual reality exposure anxiety would first increase and steadily decrease when confronted with a new phobic situation. The same pattern emerged on heart rate data, but heart rate was only monitored during the virtual reality sessions, given the fact that movement would confound the interpretation of heart rate data during exposure in vivo. The overall anxiety level experienced during exposure in vivo, however, was somewhat lower than the anxiety experienced during exposure in vivo.

For ethical reasons, in the present study we used a within-group design, since we felt that all patients deserved exposure in vivo, given its demonstrated effectiveness. Given the rather positive results of virtual reality exposure, the time seems ripe to test the comparative effectiveness of virtual reality exposure versus exposure in vivo in a between-group design, thus enabling us to establish the effects of virtual reality exposure in the long term.

In contrast to previous studies using virtual reality exposure, in which rather expensive VR hardware and software was used, the present study shows that virtual reality exposure can be effective with relatively cheap hardware and software on stand-alone computers currently on the market. This suggests that virtual reality exposure will come within reach of the ordinary practitioner within the next few years.

REFERENCES

1. Rothbaum, B.O., Hodges, L., Watson, B.A., Kessler, G.D., & Opdyke, D. (1996). Virtual reality exposure therapy in the treatment of fear of flying: A case report. *Behaviour Research & Therapy*, 34:477–481.
2. Rothbaum, B.O., Hodges, L., Kooper, R., Opdyke, D., Williford, J., & North, M.M. (1995). Virtual reality graded exposure in the treatment of acrophobia: A case report. *Behavior Therapy*, 26:547–554.
3. Botella, C., Banos, R.M., Perpina, C., Villa, H., Alcaniz, M., & Rey, A. (1998). Virtual reality treatment of claustrophobia. *Behaviour Research & Therapy*, 36:239–246.
4. Carlin, A.S., Hoffman, H.G., & Weghorst, S. (1997). Virtual reality and tactile augmentation in the treatment of spider phobia: A case report. *Behaviour Research & Therapy*, 35:153–158.
5. Coble, J.R., North, M.M., & North, S.M. (1995). Effectiveness of virtual reality environment desensitization

in the treatment of agoraphobia. *International Journal of Virtual Reality*, 1:25–34.
6. Rothbaum, B.O., Hodges, L., Kooper, R., Opdyke, D., Williford, J., & North, M.M. (1995). Effectiveness of virtual graded exposure in the treatment of acrophobia. *American Journal of Psychiatry*, 152:626–628.
7. Emmelkamp, P.M.G., & Felten, M. (1985). The process of exposure in vivo: Cognitive and physiological changes during treatment of acrophobia. *Behaviour Research & Therapy*, 23:219–223.
8. Schuemie, M.J., Bruynzeel, M., Drost, L., Brinckman, M., de Haan, G., Emmelkamp, P.M.G., & van der Mast, C.A.P.G. (2000). Treatment of acrophobia in virtual reality: A pilot study. In: Brockx, F., & Pauwels, L. (eds). *Euromedia 2000.* San Diego; Society for Computer Simulation International, pp. 271–275.
9. Cohen, D.C. (1997). Comparison of self-report and behavioral procedures for assessing acrophobia. *Behavior Therapy*, 8:17–23.
10. Abelson, J.L., & Curtis, G.C. (1989). Cardiac and neuroendocrine responses to exposure therapy in height phobics: Desynchrony with the physiological response system. *Behaviour Research & Therapy*, 27: 556–561.
11. Slater, M., Usah, M., & Steed, A. (1994). Depth of presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, 3:130–144.
12. Derogatis, L.R. (1977). *Scl-90-R: Administration. Scoring and procedures manual-I for the revised version of other instruments of the Psychopathology Rating Scale Series.* Baltimore: John Hopkins University of Medicine, Clinical Psychometrics Research Unit.

Address reprint requests to:
Paul M.G. Emmelkamp, Ph.D.
Department of Clinical Psychology
Roetersstraat 15
1018 WB Amsterdam, The Netherlands

E-mail: emmelkamp@psy.uva.nl

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1. Hong Yeon-Ju, Kim Hesun Erin, Jung Young Hoon, Kyeong Sunghyon, Kim Jae-Jin. 2017. Usefulness of the Mobile Virtual Reality Self-Training for Overcoming a Fear of Heights. *Cyberpsychology, Behavior, and Social Networking* **20**:12, 753-761. [Abstract] [Full Text HTML] [Full Text PDF] [Full Text PDF with Links]
2. Raquel Ellem Marcelino de Oliveira, Jauvane Cavalcante de Oliveira. Virtual Reality System for the Treatment of Acrophobia 74-77. [Crossref]
3. J. Cecil, Mary Sweet-Darter, Aaron Cecil-Xavier. Exploring the use of virtual learning environments to support science learning in autistic students 1-8. [Crossref]
4. Jessica L. Maples-Keller, Carly Yasinski, Nicole Manjin, Barbara Olasov Rothbaum. 2017. Virtual Reality-Enhanced Extinction of Phobias and Post-Traumatic Stress. *Neurotherapeutics* **14**:3, 554-563. [Crossref]
5. Thien-An P. Le, Deborah C. Beidel. 2017. Psychometric Properties of a Social Skills Assessment using a Virtual Environment. *Journal of Psychopathology and Behavioral Assessment* **39**:2, 230-240. [Crossref]
6. Yeon Kyoung Joo, Kyungbo Kim. 2017. When You Exercise Your Avatar in a Virtual Game: The Role of Avatars' Body Shape and Behavior in Users' Health Behavior. *Interacting with Computers* 1-12. [Crossref]
7. Pawel Bun, Filip Gorski, Damian Grajewski, Radoslaw Wichniarek, Przemyslaw Zawadzki. 2017. Low – Cost Devices Used in Virtual Reality Exposure Therapy. *Procedia Computer Science* **104**, 445-451. [Crossref]
8. Jessica L. Maples-Keller, Brian E. Bunnell, Sae-Jin Kim, Barbara O. Rothbaum. 2017. The Use of Virtual Reality Technology in the Treatment of Anxiety and Other Psychiatric Disorders. *Harvard Review of Psychiatry* **25**:3, 103-113. [Crossref]
9. Benson G. Munyan, Sandra M. Neer, Deborah C. Beidel, Florian Jentsch. 2016. Olfactory Stimuli Increase Presence in Virtual Environments. *PLOS ONE* **11**:6, e0157568. [Crossref]
10. Fanny Levy, Pierre Leboucher, Gilles Rautureau, Roland Jouvent. 2016. E-virtual reality exposure therapy in acrophobia: A pilot study. *Journal of Telemedicine and Telecare* **22**:4, 215-220. [Crossref]
11. Michael Madary, Thomas K. Metzinger. 2016. Recommendations for Good Scientific Practice and the Consumers of VR-Technology. *Frontiers in Robotics and AI* **3**. . [Crossref]
12. Dana Horvathova, Vladimir Siladi, Eva Lackova. Phobia treatment with the help of virtual reality 114-119. [Crossref]
13. Philip Schafer, Marius Koller, Julia Diemer, Gerrit Meixner. Development and evaluation of a virtual reality-system with integrated tracking of extremities under the aspect of Acrophobia 408-417. [Crossref]
14. Manning Li, Jiye Mao. 2015. Hedonic or utilitarian? Exploring the impact of communication style alignment on user's perception of virtual health advisory services. *International Journal of Information Management* **35**:2, 229-243. [Crossref]
15. Charles Pontonnier, Afshin Samani, Marwan Badawi, Pascal Madeleine, Georges Dumont. 2014. Assessing the Ability of a VR-Based Assembly Task Simulation to Evaluate PhysicalRisk Factors. *IEEE Transactions on Visualization and Computer Graphics* **20**:5, 664-674. [Crossref]
16. Katharina Meyerbröker. Virtual Reality Exposure Therapy 1310-1324. [Crossref]
17. Silvia Serino, Stefano Triberti, Daniela Villani, Pietro Cipresso, Andrea Gaggioli, Giuseppe Riva. 2014. Toward a validation of cyber-interventions for stress disorders based on stress inoculation training: a systematic review. *Virtual Reality* **18**:1, 73-87. [Crossref]
18. Eric Malbos, Laurent Boyer, Christophe Lançon. 2013. L'utilisation de la réalité virtuelle dans le traitement des troubles mentaux. *La Presse Médicale* **42**:11, 1442-1452. [Crossref]
19. Kevin M. Holloway, Greg M. Reger. 2013. T2 Virtual PTSD Experience: A Virtual Worlds Environment to Educate Service Members and Veterans About Combat-Related Posttraumatic Stress Disorder. *International Journal of Human-Computer Interaction* **29**:9, 594-603. [Crossref]
20. B. Kleim, F. H. Wilhelm, L. Temp, J. Margraf, B. K. Wiederhold, B. Rasch. 2013. Sleep enhances exposure therapy. *Psychological Medicine* 1-9. [Crossref]

21. Keisuke Suzuki, Sohei Wakisaka, Naotaka Fujii. 2012. Substitutional Reality System: A Novel Experimental Platform for Experiencing Alternative Reality. *Scientific Reports* **2**:1. . [Crossref]
22. F. Spyridonis, T-M Gronli, J. Hansen, G. Ghinea. Evaluating the usability of a Virtual Reality-based Android application in managing the pain experience of wheelchair users 2460-2463. [Crossref]
23. Yun Ling, Willem-Paul Brinkman, Harold T. Nefs, Chao Qu, Ingrid Heynderickx. 2012. Effects of Stereoscopic Viewing on Presence, Anxiety, and Cybersickness in a Virtual Reality Environment for Public Speaking. *Presence: Teleoperators and Virtual Environments* **21**:3, 254-267. [Crossref]
24. Taylor W. Cleworth, Brian C. Horslen, Mark G. Carpenter. 2012. Influence of real and virtual heights on standing balance. *Gait & Posture* **36**:2, 172-176. [Crossref]
25. Corey J. Bohil, Bradly Alicea, Frank A. Biocca. 2011. Virtual reality in neuroscience research and therapy. *Nature Reviews Neuroscience* . [Crossref]
26. Dario Deponti, Dario Maggiorini, Claudio E. Palazzi. Smartphone's physiatric serious game 1-8. [Crossref]
27. Michelle G. Newman, Lauren E. Szkodny, Sandra J. Llera, Amy Przeworski. 2011. A review of technology-assisted self-help and minimal contact therapies for anxiety and depression: Is human contact necessary for therapeutic efficacy?. *Clinical Psychology Review* **31**:1, 89-103. [Crossref]
28. Ivan Alsina-Jurnet, José Gutiérrez-Maldonado, María-Virgina Rangel-Gómez. 2011. The role of presence in the level of anxiety experienced in clinical virtual environments. *Computers in Human Behavior* **27**:1, 504-512. [Crossref]
29. Katharina Meyerbröker, Paul M.G. Emmelkamp. 2010. Virtual reality exposure therapy in anxiety disorders: a systematic review of process-and-outcome studies. *Depression and Anxiety* **27**:10, 933-944. [Crossref]
30. Maryrose Gerardi, Judith Cukor, JoAnn Difede, Albert Rizzo, Barbara Olasov Rothbaum. 2010. Virtual Reality Exposure Therapy for Post-Traumatic Stress Disorder and Other Anxiety Disorders. *Current Psychiatry Reports* **12**:4, 298-305. [Crossref]
31. Marcele Regine De Carvalho, Rafael C. Freire, Antonio Egidio Nardi. 2010. Virtual reality as a mechanism for exposure therapy. *The World Journal of Biological Psychiatry* **11**:2-2, 220-230. [Crossref]
32. Ernest N. Jouriles, Renee McDonald, Antje Kullowatz, David Rosenfield, Gabriella S. Gomez, Anthony Cuevas. 2009. Can Virtual Reality Increase the Realism of Role Plays Used to Teach College Women Sexual Coercion and Rape-Resistance Skills?. *Behavior Therapy* **40**:4, 337-345. [Crossref]
33. 2009. Abstracts from CyberTherapy 14Designing the Future of Healthcare, June 21–23, 2009, Lago Maggiore, Verbania, Italy. *CyberPsychology & Behavior* **12**:5, 581-673. [Citation] [Full Text PDF] [Full Text PDF with Links]
34. Dario Deponti, Dario Maggiorini, Claudio E. Palazzi. DroidGlove: An android-based application for wrist rehabilitation 1-7. [Crossref]
35. Carlos M. Coelho, Allison M. Waters, Trevor J. Hine, Guy Wallis. 2009. The use of virtual reality in acrophobia research and treatment. *Journal of Anxiety Disorders* **23**:5, 563-574. [Crossref]
36. M. Carmen Juan, David Pérez. 2009. Comparison of the Levels of Presence and Anxiety in an Acrophobic Environment Viewed via HMD or CAVE. *Presence: Teleoperators and Virtual Environments* **18**:3, 232-248. [Crossref]
37. Kwanguk Kim, Chan-Hyung Kim, So-Yeon Kim, Daeyoung Roh, Sun I. Kim. 2009. Virtual Reality for Obsessive-Compulsive Disorder: Past and the Future. *Psychiatry Investigation* **6**:3, 115. [Crossref]
38. Cristina Botella, Soledad Quero, Rosa Maria Banos, Azucena Garcia-Palacios, Juani Breton-Lopez, Mariano Alcaniz, Sonia Fabregat. 2008. Telepsychology and Self-Help: The Treatment of Phobias Using the Internet. *CyberPsychology & Behavior* **11**:6, 659-664. [Abstract] [Full Text PDF] [Full Text PDF with Links]
39. Thomas D. Parsons, Albert A. Rizzo. 2008. Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A meta-analysis. *Journal of Behavior Therapy and Experimental Psychiatry* **39**:3, 250-261. [Crossref]
40. Chih-Pei Chang, Timonthy C. Hain. 2008. A Theory for Treating Dizziness Due to Optical Flow (Visual Vertigo). *CyberPsychology & Behavior* **11**:4, 495-498. [Abstract] [Full Text PDF] [Full Text PDF with Links]

41. Stéphane Bouchard, Julie St-Jacques, Geneviève Robillard, Patrice Renaud. 2008. Anxiety Increases the Feeling of Presence in Virtual Reality. *Presence: Teleoperators and Virtual Environments* **17**:4, 376-391. [Crossref]
42. Mark B. Powers, Paul M.G. Emmelkamp. 2008. Virtual reality exposure therapy for anxiety disorders: A meta-analysis. *Journal of Anxiety Disorders* **22**:3, 561-569. [Crossref]
43. Alessandra Gorini, Giuseppe Riva. 2008. Virtual reality in anxiety disorders: the past and the future. *Expert Review of Neurotherapeutics* **8**:2, 215-233. [Crossref]
44. Christiane Eichenberg. 2007. Einsatz von „virtuellen Realitäten" in der Psychotherapie. *Psychotherapeut* **52**:5, 362-367. [Crossref]
45. M. Krijn, P.M.G. Emmelkamp, R.P. Ólafsson, Martijn J. Schuemie, Charles A.P.G. Van Der Mast. 2007. Do Self-Statements Enhance the Effectiveness of Virtual Reality Exposure Therapy? A Comparative Evaluation in Acrophobia. *CyberPsychology & Behavior* **10**:3, 362-370. [Abstract] [Full Text PDF] [Full Text PDF with Links]
46. Lynsey Gregg, Nicholas Tarrier. 2007. Virtual reality in mental health. *Social Psychiatry and Psychiatric Epidemiology* **42**:5, 343-354. [Crossref]
47. Stéphane Bouchard, Sophie Côté, David C.S. Richard. Virtual reality applications for exposure 347-388. [Crossref]
48. James T. Todd, Janet L. Pietrowski. Animal models of exposure therapy 29-59. [Crossref]
49. Lisa K. Simone, Dr. Maria T. Schultheis, Jose Rebimbas, Scott R. Millis. 2006. Head-Mounted Displays for Clinical Virtual Reality Applications: Pitfalls in Understanding User Behavior while Using Technology. *CyberPsychology & Behavior* **9**:5, 591-602. [Abstract] [Full Text PDF] [Full Text PDF with Links]
50. Charles van der Mast,. 2006. Technological challenges in the Delft virtual reality exposure therapy system. *International Journal on Disability and Human Development* **5**:3, 205-210. [Crossref]
51. Amy Przeworski, Michelle G. Newman. 2006. Efficacy and utility of computer-assisted cognitive behavioural therapy for anxiety disorders. *Clinical Psychologist* **10**:2, 43-53. [Crossref]
52. Giuseppe Riva. Virtual Reality . [Crossref]
53. Dr. Michael J. Roy, Deborah L. Sticha, Patricia L. Kraus, Dale E. Olsen. 2006. Simulation and Virtual Reality in Medical Education and Therapy: A Protocol. *CyberPsychology & Behavior* **9**:2, 245-247. [Abstract] [Full Text PDF] [Full Text PDF with Links]
54. Barbara Olasov Rothbaum, Page Anderson, Elana Zimand, Larry Hodges, Delia Lang, Jeff Wilson. 2006. Virtual Reality Exposure Therapy and Standard (in Vivo) Exposure Therapy in the Treatment of Fear of Flying. *Behavior Therapy* **37**:1, 80-90. [Crossref]
55. Johan Rosqvist, Alecia Sundsmo, Chelsea Maclane, Kirsten Cullen, Darcy Clothier Norling, Mandy Davies, Danielle Maack. Analogue and Virtual Reality Assessment 43-61. [Crossref]
56. Daniela M Romano. 2005. Virtual Reality Therapy. *Developmental Medicine & Child Neurology* **47**:9, 580-580. [Crossref]
57. 2005. Commentary on Riva, G., Virtual Reality in Psychotherapy: Review. *CyberPsychology & Behavior* **8**:3, 231-240. [Citation] [Full Text PDF] [Full Text PDF with Links]
58. Dr. Giuseppe Riva. 2005. Virtual Reality in Psychotherapy: Review. *CyberPsychology & Behavior* **8**:3, 220-230. [Abstract] [Full Text PDF] [Full Text PDF with Links]
59. M Krijn, P.M.G Emmelkamp, R.P Olafsson, R Biemond. 2004. Virtual reality exposure therapy of anxiety disorders: A review. *Clinical Psychology Review* **24**:3, 259-281. [Crossref]
60. Merel Krijn, Paul M.G Emmelkamp, Roeline Biemond, Claudius de Wilde de Ligny, Martijn J Schuemie, Charles A.P.G van der Mast. 2004. Treatment of acrophobia in virtual reality: The role of immersion and presence. *Behaviour Research and Therapy* **42**:2, 229-239. [Crossref]
61. Jaye Wald. 2004. Efficacy of virtual reality exposure therapy for driving phobia: A multiple baseline across-subjects design. *Behavior Therapy* **35**:3, 621-635. [Crossref]
62. Geneviève Robillard, Stéphane Bouchard, Thomas Fournier, Patrice Renaud. 2003. Anxiety and Presence during VR Immersion: A Comparative Study of the Reactions of Phobic and Non-phobic Participants in

Therapeutic Virtual Environments Derived from Computer Games. *CyberPsychology & Behavior* **6**:5, 467-476. [Abstract] [Full Text PDF] [Full Text PDF with Links]

63. G. Riva, M. Alcãniz, L. Anolli, M. Bacchetta, R. Baños, C. Buselli, F. Beltrame, C. Botella, G. Castelnuovo, G. Cesa, S. Conti, C. Galimberti, L. Gamberini, A. Gaggioli, E. Klinger, P. Legeron, F. Mantovani, G. Mantovani, E. Molinari, G. Optale, L. Ricciardiello, C. Perpiñá, S. Roy, A. Spagnolli, R. Troiani, C. Weddle. 2003. The VEPSY UPDATED Project: Clinical Rationale and Technical Approach. *CyberPsychology & Behavior* **6**:4, 433-439. [Abstract] [Full Text PDF] [Full Text PDF with Links]
64. Stephen Baumann, Chris Neff, Scott Fetzick, Gregg Stangl, Lee Basler, Ray Vereneck, Walter Schneider. 2003. A Virtual Reality System for Neurobehavioral and Functional MRI Studies. *CyberPsychology & Behavior* **6**:3, 259-266. [Abstract] [Full Text PDF] [Full Text PDF with Links]
65. Giuseppe Riva. 2003. Virtual environments in clinical psychology. *Psychotherapy: Theory, Research, Practice, Training* **40**:1-2, 68-76. [Crossref]
66. Ivan L. Beale. 2002. An Evaluation Model for Psychoeducational Interventions Using Interactive Multimedia. *CyberPsychology & Behavior* **5**:6, 565-580. [Abstract] [Full Text PDF] [Full Text PDF with Links]
67. Maria T. Schultheis, Jessica Himelstein, Albert A. Rizzo. 2002. Virtual Reality and Neuropsychology. *Journal of Head Trauma Rehabilitation* **17**:5, 378-394. [Crossref]
68. Paul M.G. Emmelkamp, Agnes Scholing. 2001. The current status of clinical psychology in The Netherlands. *Epidemiologia e Psichiatria Sociale* **10**:03, 146-149. [Crossref]