Psychiatry Research 236 (2016) 189–195

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Short communication

Virtual reality in the psychological treatment for mental health problems: An systematic review of recent evidence

Lucia R. Valmaggia [a,b,*], Leila Latif [a], Matthew J. Kempton [a], Maria Rus-Calafell [a,b]

[a] King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom
[b] South London and Maudsley NHH Trust, London, United Kingdom

ARTICLE INFO

Article history:
Received 26 September 2014
Received in revised form
16 December 2015
Accepted 7 January 2016
Available online 12 January 2016

Keywords:
Virtual reality
Mental health
Systematic review

ABSTRACT

The aim of this paper is to provide a review of controlled studies of the use of Virtual Reality in psychological treatment (VRT). Medline, PsychInfo, Embase and Web of Science were searched. Only studies comparing immersive virtual reality to a control condition were included. The search resulted in 1180 articles published between 2012 and 2015, of these, 24 were controlled studies. The reviewed studies confirm the effectiveness of VRT compared to treatment as usual, and show similar effectiveness when VRT is compared to conventional treatments. Current developments and future research are discussed.

1. Introduction

The decreasing costs and increasing convenience and power of digital media is creating a revolution in healthcare and new technologies are affecting the way we provide and access care. Virtual Reality (VR) can enable the assessment of cognitions, emotions and behaviour in an ecologically valid environment. The ecological validity of VR derives from the precise presentation and control of dynamic perceptual stimuli. Indeed, virtual environments may provide valid assessments through presenting situations that combine the control of laboratory measures with the verisimilitude of everyday experiences (Parsons et al., 2011). Another important added value of VR is the sense of presence (the psychological sensation of "being there") that individuals can experience in immersive VR environments (Slater, 2004). Furthermore, VR enables the manipulation of the environment and can be used to manipulate the environmental triggers that elicit distress in people with mental health problems, allowing them to learn to better manage their difficulties (Rizzo and Kim, 2005). VR has been used in clinical settings to treat a range of cognitive, emotional and motor problems in various psychological and psychiatric disorders and according to a recent poll of 70 psychotherapy experts, VR and other computerised intervention are ranked at the top of interventions which are predicted to increase in use in the next ten years (Norcross and Prochaska, 2013). Until recently, a disadvantage of VR has been its high cost and hardware limitations. However, technological advances in computation speed and graphics processing power, and the integration of VR into the computer games industry have contributed to the creation of a much simpler, immersive VR systems, meaning it can run on a typical desktop computer at a fraction of the costs. These new developments are generating a new impulse in VR research and a substantial number of studies have been published in recent years. The aim of this manuscript is to provide an up-to-date systematic review of the literature about the effectiveness of VR in the psychological treatment for mental health problems. A previous comprehensive review (Eichenberg and Wolters, 2012), described in detail the studies conducted before 2012, therefore in this short communication we will briefly summarise those findings but focus on papers published after 2012. To facilitate access to more disorder specific information, whenever possible we will also provide up-to-date references to recent disorder specific reviews.

2. Methods

2.1. Design

A systematic review was conducted including pilot randomised clinical trails and randomized controlled trials, which have utilised VR in psychological treatment (VRT). Only studies comparing immersive and or interactive VR to a control condition were included. By immersive VR we mean a VR environment displayed in colour

* Corresponding author at: King's College London, Institute of Psychiatry, Department of Psychology (PO 77), De Crespigny Park, SE5 8AF London, United Kingdom.
E-mail addresses: Lucia.Valmaggia@kcl.ac.uk (L.R. Valmaggia), leilatalia@hotmail.co.uk (L. Latif), matthew.kempton@kcl.ac.uk (M.J. Kempton), maria.rus-calafell@kcl.ac.uk (M. Rus-Calafell).

http://dx.doi.org/10.1016/j.psychres.2016.01.015
0165-1781/

and in 3D using a head monted display. The computer generated images and the movements of the user are syncronised, generating a virtual world in which the user can feel as immersed as in real life (Rizzo et al., 2013). Depending on the set-up, participants can interact with the environment either by head movements, full body turning or with a joystick. For a video example please see https://vimeo.com/145992521 (Password: cure)

We also included the job interview studies by Smith and colleagues, which were not immersive, but were delivered used a computer screen. However they were interactive and could be tailored to the participant.

2.2. Selection procedure

Studies were included in the review if they were published on or after 2012, written in English; contained original empirical findings, published in a peer-reviewed journal; and focused on the efficacy or effectiveness or process of VRT. Studies were excluded from the review if they were; not treatment studies; case studies; reviews; not available in English; or book chapters.

The databases used were Web of Science, PsychInfo, Embase, and Medline. Reference lists of collected papers were also visually inspected to locate any cited journal articles addressing mental disorders before and after VRT.

2.3. Search criteria

Studies for review were identified following a keyword search for the terms 'virtual reality' in conjunction with 'treatment' OR 'therapy' OR 'mental health', OR 'mood disorders', 'depression', OR 'bipolar', OR 'mania', OR 'paranoia', OR 'psychosis', OR 'schizophrenia', OR 'phobias',OR 'obsessive compulsive disorder', OR 'anxiety', OR 'post traumatic stress disorder', OR 'trauma'. Only studies comparing immersive virtual reality to a control condition were included.

The search resulted in 1180 articles published between 2012 and 2015 (final search conducted August 2015). From these, 24 of these were controlled studies, which compared the effectiveness of VRT with an alternative treatment approach or a no treatment control (see Fig. 1).

3. Review

3.1. Brief review of the evidence before 2012

Most research carried out before 2012 focused on anxiety disorders (Opris et al., 2012), eating disorders (Ferrer-Garcia et al., 2013), phobias (Botella et al., 2014) and post traumatic stress disorder (DiMauro, 2014). Findings showed the effectiveness of VR compared to treatment as usual, but only small effect sizes when VR was compared to conventional cognitive behaviour therapy (Eichenberg and Wolters, 2012). A Cochrane Review of the available literature up to 2013 of the use of VR for serious mental disorders and found only three RCT, all with schizophrenia. Their conclusion was that VR had small effects regarding compliance, cognitive functioning, social skills and acceptability of intervention (Valimaki et al., 2014). More recently two reviews have reviewed

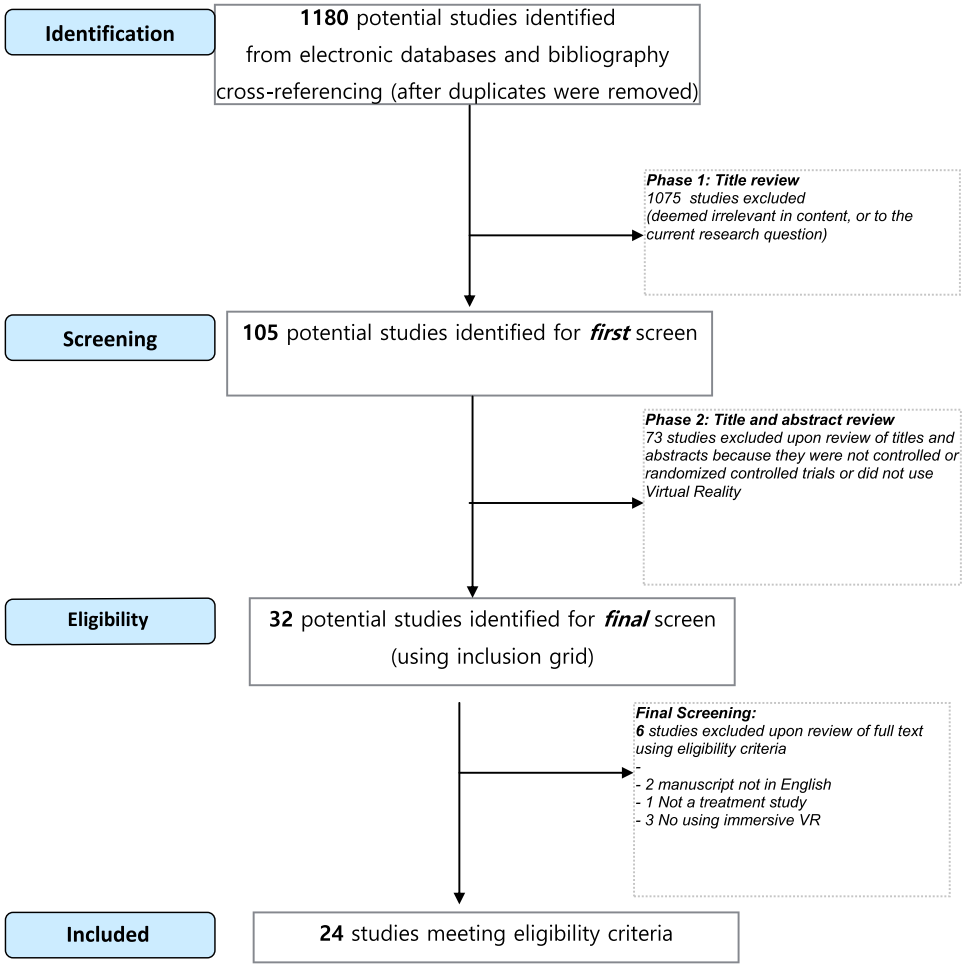

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Diagram of selected studies.

Table 1

Study	Year	Country	Clinical sample	Age	*N*	Treatment conditions	No. of sessions	Main findings	Strengths	Limitations
Agoraphobia with or without panic disorder										
Pelissolo et al.	2012	France	Panic disorder with agoraphobia	Mean age 44.1 Age range 24 to 72	92 (62 females, 30 males)	VRET CBT Waiting List	12 weekly sessions of 60' 6 and 12 month Follow-up	Reduction in fear in both treatment groups. No difference between the groups but more effective than waiting list Maintained at Follow-up	Large sample size	Relatively large drop-out rate (27%) in both groups
Malbos et al.	2013	Australia	Panic disorder with agoraphobia	Mean age 37 Age range not stated	19 (12 females, 9 males)	VRET only VRET+CBT	10 weekly sessions of 90' 3 month Follow-up	Mood, anxiety, fear and avoidance improved in both groups. No difference between the groups Maintained at Follow-up	Duration of treatment Follow-up	Small sample size No control group
Meyerbroeker et al.	2013	The Netherlands	Panic disorder with agoraphobia	Mean age not stated Age range for recruitment 18-65	55 (not stated)	VRET+CBT Exposure +CBT Waiting list	10 weekly sessions of 60'	Reduction in panic disorder severity in both treatment groups. No difference between the groups but more effective than waiting list	Severely impaired patients	Relatively small sample size Relatively large drop-out rate (32%) in both groups
Penate-Castro et al.	2013	Spain	Agoraphobia with or without panic disorder	Mean age not stated Age range 24 to 60	50 (36 females 24 males)	CBT+medication VRET+CBT+med. Medication only	11 weekly session of 30'-45' 6 months Follow-up	Reduction in agoraphobia severity in both CBT groups. No difference between the groups but more effective than medication alone. Maintained at Follow-up	Severely impaired patients	Relatively large drop-out rate (37%), larger in CBT group (50%).
Pitti et al.	2015	Spain	Agoraphobia with or without panic disorder	Mean age 39 Age range not stated	99 (70 females, 29 males	CBT+medicationVRET+CBT+med. Medication only	11 weekly session of 30'-45' 6 months Follow-up	Reduction in agoraphobia severity in all three groups. VRET+CBT+med. had slightly better results at Follow-up	Severely impaired patients	Relatively large drop-out rate
Social Anxiety Disorder and Public Speaking Anxiety										
Safir et al.	2012	Israel	Public Speaking Anxiety	Mean age 27 Age range not stated	88 (70 females, 18 males)	VRET+CBT CBT Waiting list	12 weekly sessions of 60' 12 months Follow-up	The reduction in public speaking anxiety in both groups reported in Wallach et al 2009 was maintained at Follow-up.	Large sample size Long Follow-up	Most participants were young female students.
Anderson et al.	2013	USA	Social Anxiety Disorder	Mean age 39 Age range 19 to 69	97 (60 females, 37 males)	VRET Exposure group therapy Waiting list	8 weekly sessions 12 months Follow-up	Reduction in social anxiety in both groups. Maintained at Follow-up	Large sample size Long Follow-up	Exposure involved public speaking in a group which may not be the same as social anxiety disorder
Fear of flying										
Mayerbroeker et al.	2012	The Netherlands	Fear of flying	Mean age not stated Age range for recruitment 18 to 65	67 (not stated)	VRET+Yohimbine Hydrocholoride (YHO) VRET+Placebo	4 weekly sessions of 60'	Fear of flying reduction in both groups. No evidence that YHO enhanced outcome	Large sample size	Relatively large drop-out rate (27%) in both groups
Rus-Calafell et al.	2013	Spain	Fear of flying	Mean age 37 Age range for recruitment 18 to 65	15 (13 females, 2 males)	VRET Imaginal exposure	8 sessions twice a week of 60' to 75' 6 month Follow-up	Fear of flying reduction in both groups, but VRET showed better results. Maintained at Follow-up	Follow-up	Small sample size
Spider phobia										
Shiban et al.	2013	Germany	Spider phobia	Mean age 28 Age range 18	30 (not stated)	VRET+ in four different scenarios VRET+ in a single scenario	2 sessions	Fear of spiders was reduced in both groups.		Small sample size. Only one

Table 1 (*continued*)

Study	Year	Country	Clinical sample	Age	*N*	Treatment conditions	No. of sessions	Main findings	Strengths	Limitations
				to 58				Multiple context reduced renewal effect.		session. No control condition
Shiban et al.	2015a	Germany	Spider phobia	Mean age 31 Age range 18 to 60	32 (not stated)	VRET+ Reactivation stimulus+ in vivo exposure VRET+ Control stimulus+ in vivo exposure	4 sessions twice a week 6 month Follow-up	Fear of spiders was reduced in both groups. Reactivation stimulus did not attenuate fear. Fear reduction maintained at Follow-up	Follow-up	Small sample size. Both groups had VRET and in vivo
Shiban et al.	2015b	Germany	Spider phobia	Mean age 23 Age range 18 to 38	58 (49 females, 8 males, 1 not stated)	VR single stimulus and single context VR multiple stimuli and single context VR single stimulus and multiple contexts VR multiple stimuli and multiple scenarios	2 sessions 2 weeks Follow-up	Fear of spiders was reduced in all groups, but was more pronounced in the multiple context condition. Only the multiple stimuli, single context condition had long term effect on fear attenuation at follow-up	Follow-up	Relatively small sample size for four conditions.
More than one phobia										
Moldovan and David	2014	USA	Social Phobia N=15 Flying phobia N= 9 Acrophobia N=8	Mean age rot stated Age range for recruitment over 18	32 (15 females, 17 males)	VRET+CBT Waiting list	1 session of 60'	No differences found between the two groups		No active control condition. Small sample size. Only one session.
Management of Psychological Stress										
Gaggioli et al.	2014	Italy	Teacher and Nurses exposed to high levels of psychological stress	Mean age 39 to 46 Age range not stated	121 (73 females, 48 males)	VRET+VR relaxation+biofeedback+cognitive restructuring Imaginal Exposure+imaginal relaxation+diary+cognitive restructuring Waiting list	10 sessions twice a week of 60'	Perceived stress, and coping skills improved in both treatments. VR group showed a decrease in anxiety and larger improvements in perceived stress and coping skills.	Large sample size.	No follow-up
Eating disorders										
Marco et al.	2013	Spain	Eating disorders	Mean age 22 Age range 1 to 40	34 all females	CBT CBT+VR	15 CBT group sessions 8 individual CBT +VR 12 months Follow-up	Body image improved in both groups, but VR was more efficient and accelerated changes regarding body image and eating disorder psychopathology. Maintained at Follow-up	Follow-up	Relatively small sample size
Post Traumatic Stress Disorder (PTSD)										
Rothbaum et al.	2014	USA	War veterans with PTSD	Mean age 35 Age range 22 to 55	156 (8 females, 148 males)	VRET+D-cycloserine VRET+alprazolam VRET+Placebo	5 weekly sessions of 90' 6 months Follow-up	All three groups showed a reduction of PTSD after treatment Effects of D-cycloserine are inconclusive. Maintained at Follow-up	Large sample size. Use of biomarkers. Follow-up	Relatively large drop-out rate.
Difede et al.	2014	USA	PTSD following the World Trade Centre attack	Mean age 43 to 47 Age range for recruitment 18 to 70	25 (6 females, 19 males)	VRET+D-cycloserine VRET+Placebo	12 weekly sessions of 90' 6 months Follow-up	Both groups showed a reduction of PTSD after treatment. D-cycloserine was associated with greater reduction of PTSD as well as improvement in sleep, depression and anger expression.	Follow-up	Small sample size.
Smith et al.[a]	2015	USA	War veterans with PTSD	Mean age 51 Age range for recruitment 18	33 all males	VR job interview training Treatment as usual	10 sessions of 60' over 5 to 10 days	Role-play job interview was better in VR job interview training group.	High attendance. Found to be easy to	No active control condition Small sample size

				to 65					use Increased confidence	
Schizophrenia										
Rus-Calafell et al.	2013	Spain	Schizophrenia	Mean age 38 to 42 Age range 18-55	32 (6 females, 16 males)	VR social skills training Treatment as usual	16 weekly sessions of 60' 6 month Follow-up	Social cognition and functioning improved with the VR social skills training. Reduction of negative symptoms. Maintained at follow-up	High treatment acceptance. Follow-up	No active control condition Small sample size
Tsang and Man	2013	Hong Kong	Schizophrenia	Mean age 40 Age range for recruitment 18 to 55	75 (42 females, 33 males)	Prevocational training+VR vocational training Prevocational training+Vocational group training Prevocational training	Prevocational training of 180 minutes each day. 10 sessions twice a week of 30'	Both training were associated with an improvement of cognitive functioning. The VR group showed better results.	Improved self-efficacy	Relatively large drop-out rate. No long term follow-up
Smith et al. [a]	2015	USA	Schizophrenia	Mean age 40 Age range for recruitment 18 to 55	32 (12 females, 20 males)	VR job interview training Treatment as usual	10 sessions of 60' over 5 to 10 days 6 month Follow-up	Role-play job interview was better in VR job interview training group. At 6 months Follow-up participants in the VR groups had higher odds of receiving a job offer.	High attendance. Found to be easy to use Increased confidence	No active control condition Small sample size
Smith et al. [a]	2014	USA	Schizophrenia Bipolar Depression	Mean age not stated Age range for recruitment 18 to 65	37 (not stated)	VR job interview training Treatment as usual	10 sessions of 60' over 5 to 10 days	Role-play job interview was better in VR job interview training group.	High attendance. Found to be easy to use Increased confidence	No active control condition Small sample size
Autism										
Smith et al. [a]	2014	USA	Autism	Mean age 23 Age range for recruitment 18 to 31	26 (6 females, 20 males)	VR job interview training Treatment as usual	10 sessions of 60' over 5 to 10 days	Role-play job interview was better in VR job interview training group.	High attendance. Found to be easy to use Increased confidence	No active control condition Small sample size
Smith and Bell[a] Follow-up of the above study	2015	USA	Autism	As above	23 (3 females, 20 males)	VR job interview training Treatment as usual	6 month Follow-up of the above study	At 6 months Follow-up participants in the VR groups had higher odds of receiving a job offer.	Follow-up	As above

VR: Virtual reality; VRET: Virtual reality Exposure Therapy; CBT: Cognitive Behaviour Therapy.

[a] The studies by Smith and colleagues did not use immersive VR delivered via a head mounted display, but were delivered used a computer screen. However they were interactive and could be tailored to the participant.

the evidence for the assessment and treatment of schizophrenia in a more comprehensive manner (Macedo et al., 2015; Veling et al., 2014) and a recent review also investigated the use of VR in autism (Grynszpan et al., 2014).

3.2. Evidence published after 2012

The current review found 24 controlled studies published since 2012. Table 1 briefly summarises each study, their main findings, strengths and limitations.

Overall, the present review indicates that VRT has potential within mental health research. VRT has been shown to be more effective than treatment as usual or waiting list control, and has similar results as conventional CBT and or in vivo exposure. The available evidence varied depending on the mental health disorder reviewed, and our results confirm that multiple sessions treatment protocols of VRT can be a valuable treatment for agoraphobia with or without panic disorder (Malbos et al., 2013; Meyerbroeker et al., 2013; Pelissolo et al., 2012; Penate-Castro et al., 2014; Pitti et al., 2015); fear of flying (Malbos et al., 2013; Meyerbroeker et al., 2013; Pelissolo et al., 2012; Penate-Castro et al., 2014; Pitti et al., 2015); social anxiety and fear of public speaking (Anderson et al., 2013; Safir et al., 2012); and spider phobia (Shiban et al., 2015a, 2013, 2015b). Also promising are the findings regarding the use of VRT for PTSD (Difede et al., 2014; Rothbaum et al., 2014; Smith et al., 2015a); and for the management of psychological stress (Gaggioli et al., 2014). Single session VR exposure did not seem effective for specific phobias (Moldovan and David, 2014). Limited research has been published recently for eating disorders (Marco et al., 2014) and autism (Smith et al., 2015c, 2014a). In schizophrenia VR was used to deliver vocational or social skills training, but no studies were reported using VR to target the distress associated with hallucinations or delusion (Rus-Calafell et al., 2013; Smith et al., 2015b, 2014b; Tsang and Man, 2013).

The findings should be considered in light of a number of limitations. A substantial number of studies reported relatively high drop-out rates, these were partly due to participants finding the treatment too confronting, and partly due to cyber-sickness a side effect of the use of VR headsets which induces nausea and dizziness. It is also important to note that studies often had small sample sizes and lacked statistical power.

Furthermore the studies reviewed were conducted with young or middle aged adults and no evidence was found with younger children or older adults.

Finally we only included studies using immersive virtual reality, and therefore excluded studies, which were conducted using internet platforms such as Second Life and studies which did not use 3D immersive equipment.

4. Conclusion

Digital technology has become an integral part of our daily life, therapies will benefit from becoming integrated in these exciting technical innovations. VR is becoming accessible and in the next few years immersive 3D head mounted displays such as the Oculus Rift (https://www.oculus.com/en-us/) or headsets which can be used with a mobile phone such as Unofficial Cardboard VR (http://www.unofficialcardboard.com) as well as platforms for walking in place navigation such as the Virtux OMNI (http://www.virtuix.com/) will become as common as the Xbox and the Play Station are nowadays. Increasingly the goals of modern medicine are that it should be personalised, predictive, preventative and participatory (P4,(Hood and Friend, 2011)). Adapting therapy to these media forms will ensure more people can access with the therapeutic process and it will help establish which individual factors play a role in the onset of mental health problems (Predict); it will Personalise treatment (right treatment, for the right person at the right time); it will be Preventative (improve functioning and wellness) and highly Participatory (interactive and responsive environments). Increasing the use of VR in clinical practice will help address some of the methodological limitations of current studies which often have small sample size, high drop out rates and lack long term follow-up.

Author disclosure statement

The authors have no conflict of interest to disclose.

Acknowledgements

We acknowledge the NIHR Biomedical Research Centre for Mental Health at the South London and Maudsley NHS Foundation Trust and Institute of Psychiatry Psychology and Neuroscience, King's College London, United Kingdom for their support.

References

Anderson, P.L., Price, M., Edwards, S.M., Obasaju, M.A., Schmertz, S.K., Zimand, E., Calamaras, M.R., 2013. Virtual reality exposure therapy for social anxiety disorder: a randomized controlled trial. J. Consult. Clin. Psychol. 81 (5), 751–760.
Botella, C., Garia-Palacios, A., Banos, R., Quero, S., 2014. Panic disorder, agoraphobia, and driving phobia: Lessons learned from efficacy studies. Adv. Virtual Real. Anxiety Disord., 163–185.
Difede, J., Cukor, J., Wyka, K., Olden, M., Hoffman, H., Lee, F.S., Altemus, M., 2014. D-cycloserine augmentation of exposure therapy for post-traumatic stress disorder: a pilot randomized clinical trial. Neuropsychopharmacology 39 (5), 1052–1058.
DiMauro, J., 2014. Exposure therapy for posttraumatic stress disorder: a meta-analysis. Mil. Psychol. 26 (2), 120–130.
Eichenberg, C., Wolters, C., 2012. Virtual Realities in the Treatment of Mental Disorders: A Review of the Current State of Research. InTech.
Ferrer-Garcia, M., Gutierrez-Maldonado, J., Riva, G., 2013. Virtual reality based treatments in eating disorders and obesity: a review. J. Contemp. Psychother. 43 (4), 207–221.
Gaggioli, A., Pallavicini, F., Morganti, L., Serino, S., Scaratti, C., Briguglio, M., Crifaci, G., Vetrano, N., Giulintano, A., Bernava, G., Tartarisco, G., Pioggia, G., Raspelli, S., Cipresso, P., Vigna, C., Grassi, A., Baruffi, M., Wiederhold, B., Riva, G., 2014. Experiential virtual scenarios with real-time monitoring (interreality) for the management of psychological stress: a block randomized controlled trial. J. Med. Internet Res. 16 (7), e167.
Grynszpan, O., Weiss, P.L.T., Perez-Diaz, F., Gal, E., 2014. Innovative technology-based interventions for autism spectrum disorders: a meta-analysis. Autism: Int. J. Res. Pract. 18 (4), 346–361.
Hood, L., Friend, S.H., 2011. Predictive, personalized, preventive, participatory (P4) cancer medicine. Nat. Rev. Clin. Oncol. 8 (3), 184–187.
Macedo, M., Marques, A., Queiros, C., 2015. Virtual reality in assessment and treatment of schizophrenia: a systematic review. J. Bras. Psiquiatr. 64 (1), 70–81.
Malbos, E., Rapee, R.M., Kavakli, M., 2013. A controlled study of agoraphobia and the independent effect of virtual reality exposure therapy. Aust. N. Z. J. Psychiatry 47 (2), 160–168.
Marco, J.H., Perpina, C., Botella, C., 2014. The treatment of the body image disturbances in eating disorders and clinically significant change. Tratamiento de la imagen corporal en los trastornos alimentarios y cambio clinicamente significativo. Anal. Psicol. 30 (2), 422–430.
Meyerbroeker, K., Morina, N., Kerkhof, G.A., Emmelkamp, P.M.G., 2013. Virtual reality exposure therapy does not provide any additional value in agoraphobic patients: a randomized controlled trial. Psychother. Psychosom. 82 (3), 170–176.
Moldovan, R., David, D., 2014. One session treatment of cognitive and behavioral therapy and virtual reality for social and specific phobias. Preliminary results from a randomized clinical trial. J. Evid.-Based Psychother. 14 (1), 67–83.
Norcross, J.C., Prochaska, J.O., 2013. Psychotherapy in 2022: a Delphi poll on its future. Prof. Psychol.: Res. Pract. 44, 363–370.
Opris, D., Pintea, S., Garcia-Palacios, A., Botella, C., Szamoskozi, Ş., David, D., 2012. Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis. Depress. Anxiety 29 (2), 85–93.
Parsons, T.D., Courtney, C.G., Arizmendi, B., Dawson, M., 2011. Virtual Reality Stroop Task for neurocognitive assessment. Stud. Health Technol. Inf. 163, 433–439.
Pelissolo, A., Zaoui, M., Aguayo, G., Yao, S.N., Roche, S., Ecochard, R., Gueyffier, F.,

Pull, M., Berthoz, A., Jouvent, R., Cottraux, J., 2012. Virtual reality exposure therapy versus cognitive behavior therapy for panic disorder with agoraphobia: a randomized comparison study. J. Cybertherapy Rehabil. 5 (1), 35–43.
Penate-Castro, W., Sanchez, M.J.R., Gonzalez, C.T.P., Bethencourt, J.M., de la Fuente Portero, J.A., Marco, R.G., 2014. Cognitive-behavioral treatment and antidepressants combined with virtual reality exposure for patients with chronic agoraphobia. Int. J. Clin. Health Psychol. 14 (1), 9–17.
Pitti, C.T., Penate, W., de la Fuente, J., Bethencourt, J.M., Roca-Sanchez, M.J., Acosta, L., Villaverde, M.L., Gracia, R., 2015. The combined use of virtual reality exposure in the treatment of agoraphobia. Actas Esp. De. Psiquiatr. 43 (4), 133–141.
Rizzo, A., Buckwalter, G., Forbell, E., Reist, C., Difede, J., Rothbaum, B.O., lange, B., Koenig, S., Talbot, S., 2013. Virtual reality applications to address the wounds of war. Psychiatr. Ann. 43, 3.
Rizzo, A., Kim, G.J., 2005. A SWOT analysis of the field of virtual reality rehabilitation and therapy. Presence Teleperators Virtual Environ. 14, 119–146.
Rothbaum, B.O., Price, M., Jovanovic, T., Norrholm, S.D., Gerardi, M., Dunlop, B., Davis, M., Bradley, B., Duncan, E.J., Rizzo, A., Ressler, K.J., 2014. A randomized, double-blind evaluation of D-cycloserine or alprazolam combined with virtual reality exposure therapy for posttraumatic stress disorder in Iraq and Afghanistan war veterans. Am. J. Psychiatry 171 (6), 640–648.
Rus-Calafell, M., Gutierrez-Maldonado, J., Ribas-Sabate, J., 2013. A brief cognitive-behavioural social skills training for stabilised outpatients with schizophrenia: a preliminary study. Schizophr. Res. 143 (2), 327–336.
Safir, M.P., Wallach, H.S., Bar-Zvi, M., 2012. Virtual reality cognitive-behavior therapy for public speaking anxiety: one-year follow-Up. Behav. Modif. 36 (2), 235–246.
Shiban, Y., Bruetting, J., Pauli, P., Muehlberger, A., 2015a. Fear reactivation prior to exposure therapy: Does it facilitate the effects of VR exposure in a randomized clinical sample? J. Behav. Ther. Exp. Psychiatry 46, 133–140.
Shiban, Y., Pauli, P., Muehlberger, A., 2013. Effect of multiple context exposure on renewal in spider phobia. Behav. Res. Ther. 51 (2), 68–74.
Shiban, Y., Schelhorn, I., Pauli, P., Muehlberger, A., 2015b. Effect of combined multiple contexts and multiple stimuli exposure in spider phobia: a randomized clinical trial in virtual reality. Behav. Res. Ther. 71, 45–53.
Slater, M., 2004. Presence and emotions. Cyberpsychol Behav. 7 (1), 121, author reply 123.
Smith, M.J., Boteler Humm, L., Fleming, M.F., Jordan, N., Wright, M.A., Ginger, E.J., Wright, K., Olsen, D., Bell, M.D., 2015a. Virtual reality job interview training for veterans with posttraumatic stress disorder. J. Vocat. Rehabil. 42 (3), 271–279.
Smith, M.J., Fleming, M.F., Roberts, A.G., Wright, M., Bell, M.D., 2015b. Virtual reality job interview training and 6-month employment outcomes for individuals with schizophrenia. Schizophr. Bull. 41, S190–S191.
Smith, M.J., Fleming, M.F., Wright, M.A., Losh, M., Humm, L.B., Olsen, D., Bell, M.D., 2015c. Brief report: vocational outcomes for young adults with autism spectrum disorders at six months after virtual reality job interview training. J. Autism Dev. Disord. 45, 3364–3369.
Smith, M.J., Ginger, E.J., Wright, K., Wright, M.A., Taylor, J.L., Humm, L.B., Olsen, D.E., Bell, M.D., Fleming, M.F., 2014a. Virtual reality job interview training in adults with autism spectrum disorder. J. Autism Dev. Disord. 44 (10), 2450–2463.
Smith, M.J., Ginger, E.J., Wright, M., Wright, K., Boteler Humm, L., Olsen, D., Bell, M. D., Fleming, M.F., 2014b. Virtual reality job interview training for individuals with psychiatric disabilities. J. Nerv. Ment. Dis. 202 (9), 659–667.
Tsang, M.M., Man, D.W., 2013. A virtual reality-based vocational training system (VRVTS) for people with schizophrenia in vocational rehabilitation. Schizophr. Res. 144, 51–62.
Valimaki, M., Hatonen, H.M., Lahti, M.E., Kurki, M., Hottinen, A., Metsaranta, K., Riihimaki, T., Adams, C.E., 2014. Virtual reality for treatment compliance for people with serious mental illness. Cochrane database Syst. Rev. 10, CD009928.
Veling, W., Moritz, S., van der Gaag, M., 2014. Brave new worlds-review and update on virtual reality assessment and treatment in psychosis. Schizophr. Bull. 40 (6), 1194–1197.