Virtual reality-based cognitive behavioural therapy for patients with generalized social anxiety disorder: a pilot study

Chris N.W. Geraets[1]*, Wim Veling[1], Maartje Witlox[2], Anton B.P. Staring[3],
Suzy J.M.A. Matthijssen[3,4] and Danielle Cath[1,4,5]

[1]University of Groningen, University Medical Center Groningen, Department of Psychiatry, PO Box 30.001, 9700 RB Groningen, the Netherlands, [2]Leiden University, Department of Clinical Psychology, Leiden, the Netherlands, [3]Altrecht Academic Anxiety Center, Utrecht, the Netherlands, [4]Utrecht University, Department of Clinical Psychology, Utrecht, the Netherlands and [5]GGZ-Drenthe, Assen, the Netherlands
*Corresponding author. Email: c.n.w.geraets@umcg.nl

Abstract

Background: Patients with generalized social anxiety disorder (SAD) avoid various social situations and can be reluctant to engage in *in vivo* exposure therapy. Highly personalized practising can be required before patients are ready to perform *in vivo* exposure. Virtual reality-based therapy could be beneficial for this group.
Aims: To assess the feasibility and potential effect of virtual reality-based cognitive behavioural therapy (VR-CBT) for patients with severe generalized SAD.
Methods: Fifteen patients with generalized SAD attended up to 16 VR-CBT sessions. Questionnaires on clinical and functional outcomes, and diary assessments on social activity, social anxiety and paranoia were completed at baseline, post-treatment and at 6-months follow-up.
Results: Two patients dropped out of treatment. Improvements in social anxiety and quality of life were found at post-treatment. At follow-up, depressive symptoms had decreased, and the effect on social anxiety was maintained. With respect to diary assessments, social anxiety in company and paranoia were significantly reduced by post-treatment. These improvements were maintained at follow-up. No increase was observed in social activity.
Conclusions: This uncontrolled pilot study demonstrates the feasibility and treatment potential of VR-CBT in a difficult-to-treat group of patients with generalized SAD. Results suggest that VR-CBT may be effective in reducing anxiety as well as depression, and can increase quality of life.

Keywords: cognitive behavioral therapy; exposure; psychopathology; social anxiety; virtual reality (VR)

Introduction

People with generalized social anxiety disorder (SAD) experience extreme anxiety in a broad range of social situations in which they have to interact with other people and are exposed to potential criticism. Cognitive behavioural therapy (CBT) is the most effective psychological treatment for SAD (Mayo-Wilson *et al.*, 2014). However, CBT with *in vivo* exposure has limitations. Generalized SAD is characterized by severe avoidance, therefore the threshold to engage in *in vivo* exposure can be too high. Moreover, it can be challenging and time consuming for therapists to find appropriate situations for exposure with the right amount of personalized triggers. Finally,

exposures are often performed as homework exercises, on which feedback is given retrospectively and highly dependent on patient's subjective reports.

Virtual reality (VR)-based therapy may offer a solution to these limitations (Freeman *et al.*, 2017). VR environments can be personally tailored to fit the specific triggers of a patient, and enables practising social behaviour in relevant environments. Moreover, behaviour can be practised repeatedly within VR, and therapists can provide direct feedback. Furthermore, VR therapy can be performed within the treatment room, which lowers thresholds to engage in therapy.

Similar effectiveness of conventional (exposure therapies as well as CBT) and VR-based therapies have been reported for specific phobias such as fear of flying and public speaking anxiety (Valmaggia *et al.*, 2016). Only two VR studies have been performed in patients with (generalized) SAD using VR exercises with semi-structured scenarios (Bouchard *et al.*, 2017; Kampmann *et al.*, 2016). Kampmann and colleagues (2016) showed with a randomized controlled trial (RCT) that VR exposure therapy with solely behavioural elements was effective in reducing social anxiety and stress in patients with generalized SAD. However, *in vivo* exposure therapy was superior to VR exposure. Bouchard *et al.* (2017) used both cognitive and behavioural elements. In their RCT, they found VR-CBT to be more effective than CBT with *in vivo* exposure. In addition, therapists experienced VR-CBT as more practical, and therapeutic alliance, a known factor related to treatment outcome, was reported to be similar for both therapies.

Recently a novel VR-CBT intervention with complex adjustable VR environments was developed for patients with a psychotic disorder who avoided social engagement (Pot-Kolder *et al.*, 2018). VR-CBT successfully reduced paranoia and anxiety in the company of others. In this pilot study, we tested the feasibility and potential effects of this VR-CBT intervention in patients with generalized SAD.

Method

Participants

This pilot study included patients with a diagnosis of generalized SAD, aged 18–65 years, and a Social Interaction Anxiety Scale score higher than 25. Exclusion criteria were: IQ < 70, neurological conditions, and psychiatric co-morbidities that prevented therapy adherence (e.g. addictions).

Intervention

A virtual street, bus, café and supermarket environments were available. Participants viewed the environments through a head-mounted display (Sony HMZ-T1), and moved around with a joystick. Software enabled therapists to manipulate the environments in terms of crowdedness [0–40 virtual humans ('avatars') could be present], ethnicity (% Caucasian or North-African appearance), gender, intensity and frequency of hostile looks, interpersonal distance, and watching/staring behaviour. Pre-recorded sentences could be uttered by avatars. Sounds such as sirens and laughing were also available. Before each exercise therapists and patients agreed upon the environment, crowdedness, and avatar characteristics.

VR-CBT entailed a maximum of 16 one-hour individual sessions, delivered once or twice a week by psychologists. The treatment manual was constructed by adapting existing CBT protocols (Pot-Kolder *et al.*, 2018). The most important adaptation was that all *in vivo* exposures and behavioural experiments were done in VR. During sessions 1 and 2 the VR system was introduced, a personal case conceptualization was developed, and treatment goals were defined. From session 3 onwards, participants practiced within VR for 40 min each session. During VR exercises patients tested their beliefs, approach behaviours were elicited, and feedback was given on cognitions and behaviour. Further therapy strategies included psycho-education, and cognitive restructuring of dysfunctional beliefs. If learning goals were achieved and no distress was triggered any longer, the therapy was considered successful and terminated prior to the 16th session. No homework assignments were given.

Measures

Assessments were completed at baseline, post-treatment (3 months after baseline), and follow-up (6 months after baseline). Outcomes included the Social Interaction Anxiety Scale, Green *et al.* Paranoid Thought Scales, Beck Depression-II Inventory, and Manchester Short Assessment of Quality of Life.

Mental states and experiences were measured with a diary technique called experience sampling method (ESM). Participants carried an iPod with the ESM app for 6 days during each assessment period (baseline, post-treatment and follow-up). The app signalled at ten random moments per day between 07.30 and 22.30 h. After the signal, a self-assessment was completed on the app. Participants had to complete at least 1/3 of the assessments on four consecutive days for analyses. Items on mental states were rated on a 7-point Likert scale ranging from 1 (not at all) to 7 (very). The following subscales were assessed: *Social activity*: the proportion of time that participants were in company of others during the signal (excluding being with healthcare workers) (binary scale); *Momentary anxiety in company*: the score on the item 'I feel anxious' when someone was in company of others; *Perceived social threat*: the average of the items: 'I like this company (reversed score)', 'In this company, I feel accepted (reversed score)', 'I would rather be alone', and 'In this company, I feel threatened'; *Momentary paranoia*: the average of the items: 'I feel that others might hurt me', 'I feel that others dislike me' and 'I feel suspicious'; *ESM acceptability*: the score on the item 'this beep disturbed me'.

Analyses

Paired samples *t*-tests (two-sided) were performed on questionnaire data comparing post-treatment and follow-up to baseline. Multilevel analyses (SPSS MIXED) were performed on ESM data as these have a hierarchical structure; repeated measures (level 1) are nested within individuals (level 2). Binary ESM social activity data were analysed with logistic multilevel analysis (Stata XTLOGIT). Separate models were estimated for post-treatment and follow-up, comparing both with baseline. Multilevel models included time as a fixed effect, and a random intercept for participant. Models were estimated with restricted maximum likelihood and an identity covariance structure. Significance was accepted at .025. We calculated odds ratios (OR) and effect sizes with Cohen's *d* for repeated measures.

Results

Fifteen participants (seven male) with a mean age of 34.9 years ($SD = 12.4$) and an average illness duration of 9.4 years ($SD = 7.8$) were enrolled. The level of education ranged from vocational/lower ($n = 4$) to higher tertiary education ($n = 10$). Eight participants had a co-morbid axis I disorder. Six participants were prescribed psychiatric medication (SNRI, $n = 4$; SSRI, $n = 1$; benzodiazepine, $n = 1$). Twelve participants had received previous treatment for SAD.

Two participants stopped after session 7 because of: (1) too high anxiety during exposure and (2) the VR equipment was too distracting and the avatars too unrealistic. The mean number of sessions of VR-CBT completers was 15 (range 13–16).

Results are shown in Table 1. Social interaction anxiety was significantly reduced at post-treatment. This improvement was maintained at follow-up. Depression scores were significantly lower at follow-up compared with baseline. Quality of life increased between baseline and post-treatment; at follow-up the difference was only marginally significant. No significant time effect was found for persecutory ideation and ideas of social reference. However, by follow-up the mean score on ideas of social references had decreased by 25% compared with baseline.

Eleven participants had both baseline ESM and post-treatment and/or follow-up data and were included in analyses. Reasons for missing data were technical app problems ($n = 4$), and

Table 1. (Weighted) means, standard deviations and test results of outcomes over time

	Baseline	Post-treatment	Follow-up	Baseline to post-treatment			Baseline to follow-up		
	Mean (SD)	Mean (SD)	Mean (SD)		p	d		p	d
Clinical and functional outcomes	n = 15	n = 13	n = 11		p	d		p	d
Social interaction anxiety	59.9 (8.1)	47.8 (10.1)	43.1 (13.9)	t (12) = 3.2	.008	0.9	t (10) = 3.9	.003	1.3
Depressive symptoms	27.7 (9.3)	21.4 (12.8)	17.0 (12.4)	t (12) = 2.1	.06	0.5	t (10) = 3.2	.01	1.1
Ideas of social reference	37.3 (14.8)	33.1 (12.5)	27.9 (12.2)	t (12) = 1.6	.13	0.4	t (10) = 1.3	.24	0.8
Persecutory ideation	24.3 (11.2)	25.5 (15.8)	19.9 (9.3)	z = 0.25	.80	−0.2	z = −0.52	.60	0.4
Quality of life	47.5 (9.9)	50.5 (10.8)	54.4 (11.1)	t (12) = −2.7	.02	−0.5	t (10) = −2.1	.06	−0.8
ESM	n = 11	n = 10	n = 7						
Social activity (binary)	0.53 (0.20)*	0.48 (0.31)	0.47 (0.22)	z = −2.3	.02	0.2	z = −3.2	.002	0.3
Momentary anxiety in company	2.81 (1.24)	2.32 (0.99)	1.31 (0.19)	F (1,352) = 35.9	.000	0.4	F (1,328) = 74.0	.000	3.4
Perceived social threat	2.52 (0.46)	2.46 (0.78)	2.34 (0.23)	F (1,409) = 2.2	.14	0.1	F (1,349) = 3.3	.07	0.4
Momentary paranoia	2.03 (1.35)	1.78 (1.27)	1.11 (0.11)	F (1,769) = 36.0	.000	0.3	F (1,658) = 16.0	.000	1.7

The Green *et al.* Paranoid Thought Scales persecutory ideation subscale was right skewed and analysed with the non-parametric related sampled Wilcoxon signed rank test. *For ESM social activity, n = 10.

unwillingness to participate during post-treatment or follow-up ($n = 7$). ESM seemed acceptable; participants rated the disturbance of the dairy measurements on average with 2.3 ($SD = 1.7$; $n = 1011$). Momentary anxiety in company and momentary paranoia reduced from baseline to post-treatment; these improvements were maintained at follow-up. There was no time effect for perceived social threat. Participants showed less social activity at post-treatment and follow-up compared with baseline.

Discussion

This was the first VR-CBT study for generalized SAD using an intervention with both behavioural and cognitive elements and adjustable environments. Therapy drop-out rates were low; two patients did not complete VR-CBT. On average, VR-CBT took 15 sessions. This suggests that the therapy was well tolerated. After VR-CBT, patients experienced social encounters more positively; less anxiety at social encounters and less paranoia were reported in everyday life. Furthermore, patients reported less social interaction anxiety, fewer depressive symptoms and an improved quality of life after VR-CBT. No improvements were observed in perceived social threat in daily life or social activity.

Results suggest that VR-CBT can be of added value for patients with generalized SAD. Although patients had high levels of social anxiety, co-morbidities and long illness durations, VR-CBT was acceptable for most. Getting people with SAD engaged in exposures is challenging. The present programme enabled gradual exposure. It was possible to start exposure in an almost empty street, and gradually increase the difficulty level. *In vivo* exposure does not allow for this amount of control, as therapists and patients cannot control everyday environments. Here VR can be a useful tool as a first step. One of the most important techniques that may have caused reductions in anxiety and paranoia was the challenging of negative expectations. By exposing individuals to feared situations in VR using personalized relevant triggers, patients experienced through exposure that the consequence they feared did not happen (expectation violation). This in turn can diminish anxiety and related symptoms.

The lack of improvement in time spent with others (social activity) and perceived social threat was unexpected. Similar lacks of improvement were observed in the VR-CBT study with psychosis patients (Pot-Kolder et al., 2018). Possibly more time is needed before positive social encounters translate into more social contacts. Alternatively, the measure may be too insensitive to pick up increased social activity. Social activity was measured only at the moment of the signal, and intervals between signals could last several hours. Because of these limitations, future research should not only ask for *present* company, but also inform about company *since* the previous signal with an extra ESM item. With regard to the perceived social threat subscale Pot-Kolder et al. (2018) suggest that this subscale may reflect a preference of being alone instead of threat feelings, and needs more validation.

Important limitations were the uncontrolled nature and small sample size. Therefore, statistical analyses were exploratory and provide only preliminary evidence. Furthermore, the amount of verbal interactions was limited. Sentences had to be pre-recorded with restricted role-playing options as a result. Therapists reported this to be the most restrictive limitation of the VR software. To compensate, therapists also spoke short sentences when the situation required interaction. Finally, no homework assignments were given. Larger effects and generalization are to be expected if patients are encouraged to practise in real life situations.

Future directions

VR-CBT seems a feasible and promising treatment for patients with severe generalized SAD. Whereas large improvements were made following VR-CBT, there still remains room for improvement. Therefore future studies should combine VR-CBT with *in vivo* (homework)

exercises; this may increase the efficacy. Moreover, options allowing more complex verbal interactions with virtual characters need to be incorporated into the VR software. With regard to outcomes, ESM seems a good addition to classical measures although there are some technical issues that need to be overcome. Finally, many participants reported paranoid ideations, indicating that future treatment studies can benefit from specifically paying attention to paranoia in SAD.

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