Virtual Environments Using Video Capture for Social Phobia with Psychosis

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Abstract

A novel virtual environment (VE) system was developed and used as an adjunct to cognitive behavior therapy (CBT) with six socially anxious patients recovering from psychosis. The novel aspect of the VE system is that it uses video capture so the patients can see a life-size projection of themselves interacting with a specially scripted and digitally edited filmed environment played in real time on a screen in front of them. Within-session process outcomes (subjective units of distress and belief ratings on individual behavioral experiments), as well as patient feedback, generated the hypothesis that this type of virtual environment can potentially add value to CBT by helping patients understand the role of avoidance and safety behaviors in the maintenance of social anxiety and paranoia and by boosting their confidence to carry out “real-life” behavioral experiments.

Introduction

SOCIAL ANXIETY IS COMMON among people with psychosis and persists long after the remission of psychotic symptoms.^{1,2} Reported prevalence rates of social anxiety in psychosis vary from 8% in an in-patient sample³ to 36% in a group of outpatients⁴ and 40% in the U.S. National Comorbidity Survey.⁵ Clinical observations suggest that social anxiety may be present in up to 70% of people recovering from an early-onset acute psychotic episode.⁶ Social anxiety adds barriers to the functional recovery of people emerging from a psychotic illness because it increases their social and occupational disability and the likelihood of relapse.^{4,7}

People with social anxiety are afraid that they will draw attention to themselves and be negatively judged by others while in social situations.⁸ Consequently, they either avoid public places and social gatherings altogether, or they use safety behaviors to cope, such as not making eye contact; wearing bulky clothes, glasses, or a hat; and being guarded or hypervigilant toward others.⁹ Such behaviors paradoxically draw attention to those with social anxiety by making them appear “awkward” or socially unskilled, therefore feeding into their beliefs that they do not “fit in.” For patients recovering from psychosis, this compounds their social withdrawal and isolation and reinforces social stereotypes of being “odd” or “hostile.”

A distinctive feature of social anxiety in people with a history of psychosis is their self-perception of being vulnerable (“I stand out” or “I am an easy target”) and their view of

the world as threatening (“People can tell I am on medication” or “People will try to deliberately pick on me”). This is fueled partly by the stigma associated with psychosis, and partly by residual positive symptoms such as paranoia.^{1,6} Consequently, crowded, unfamiliar places are powerful triggers of social anxiety for people recovering from psychosis, and any residual paranoia reinforces their perception of the world as threatening and increases their selective attention to “threat cues” in social situations, such as a glare or a smirk.

Effective psychological therapies for social anxiety, particularly cognitive behavior therapy (CBT), require that patients confront anxiety-provoking social situations while dropping their safety behaviors, either within the context of exposure therapy or as part of exposure-type behavioral experiments to facilitate changes in belief.^{10–12} Exposure can take place either in real life (*in vivo exposure*) or in imagination (imaginal exposure). *In vivo* exposure is very effective but can be time-consuming or impractical due to logistical issues, for example, being able to stage and repeatedly rehearse talking with different people in different circumstances (shops, job interviews, dating). Using imaginal exposure, such as going over a script or running images in one’s mind, may lack realism and intensity because most people are not able to hold onto images for long enough and can easily disengage from them when they become distressed.

To overcome potential difficulties with *in vivo* or imaginal exposure, virtual environments have been used to simulate appropriate therapy conditions (*in virtuo exposure*), albeit not

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only for social anxiety.^{13–15} One example of *in virtuo* therapy uses virtual reality (VR) with a head-mounted display to immerse patients into a three-dimensional computer-generated world to treat conditions such as post-traumatic stress disorder,^{16,17} social phobia,¹⁸ and psychosis.^{19,20} Other virtual environments are similar to playing a computer game (virtual display or VD systems) and have been used for agoraphobia²¹ and obsessive-compulsive disorder (OCD).²² Some virtual environments use video or photographs, such as creating virtual audiences, to help with fear of public speaking.^{23,24}

This article presents for the first time a novel virtual environment system that uses video capture to project the patient's life-size image on screen to watch oneself interact with specially scripted and digitally edited video clips. The system is affordable because it does not require expensive software to produce three-dimensional computer-generated graphics (avatars). It is also free from a head-mounted display, which anxious people may find uncomfortable, and does not require technical expertise to set up and use. It is versatile and can be easily updated through a film library or by making a small video recording to capture the different types of exposure environments needed in day-to-day clinical practice.

The aim of this small study was to explore the feasibility of the VE system as a therapy tool when used during a single session halfway through a 12-week CBT intervention with six patients who were recovering from psychosis and who had residual paranoia and comorbid social anxiety. This is a particularly complex patient group that has received relatively little clinical and research attention. The study's aim was to generate hypotheses about salient aspects of the VE system, which can be useful or hindering in therapy. Specifically, the study aimed to explore (a) whether an artificial environment can feel "real," evoke emotional responses, and prime patients for "real-life" exposure and (b) whether observing oneself on screen can create a sense of immersion and presence in the environment.

Methods

Study design

This case series reports narrative data on the therapeutic use of a VE system during a single CBT session and clinical outcomes following the CBT intervention as a whole. Data collection was carried out between March 2010 (when the first patient entered the study) and September 2011 (when 24-week outcome measures were collected for the last patient) as part of an ongoing trial that investigates the efficacy of guided CBT self-help with face-to-face support from graduate psychologists. A national research ethics committee and a local research governance body approved the use of the virtual environments to assist the delivery of CBT as part of the trial.

Participants

Patients were under the care of an outpatient service for early intervention of psychosis and were assessed for eligibility by the onsite clinical psychology team following a routine mental health assessment. Patients were eligible if they had received treatment for an acute psychotic episode; had residual positive psychotic symptoms that were mild-to-moderate (not scoring more than 4 on the positive symptoms

subscale of the Positive and Negative Syndrome Scale [PANSS]);²⁵ and scored a minimum of 30 on the Social Interaction Anxiety Scale (SIAS),²⁶ denoting the presence of clinical social anxiety (Peters, 2000).²⁷ Six eligible patients were given information about the study, and they all entered the study following written consent to participate. Neither personal identifiers (including individual age, background history, and formulations) nor direct quotes have been used here in order to protect patients' identities.

The VE system

The novel aspect of the VE system is that users see a life-size projection of themselves (an inverse and not a mirror image) verbally interacting with custom-scripted and digitally edited filmed environments played in real time on a screen in front of them. The user goes into a portable booth, within which are enclosed a video-processing unit with a camera linked to a computer and video recorder, a screen monitor, and an adjustable sitting stool (Fig. 1). Ambient lighting is integrated into the system's camera unit in order to capture the patient's image and combine it with a filmed environment displayed in real time on a video screen facing them. Patients are able to simultaneously view and interact with the characters of the film. The system needs 1.5×1.5 meters and does not require any technical expertise.

The virtual environments with which patients interact form a library of one hundred specially scripted video clips that last 2–10 minutes and depict a variety of social situations. The characters in these situations could be hostile (e.g., a fellow customer at a bar who insists on being served first), rude (e.g., a medical secretary with a condescending tone of voice who speaks on the phone and ignores the patient), neutral (e.g., a waitress taking an order), or friendly (e.g., a helpful bus driver). Some characters ask innocuous questions (e.g., at a job interview or a street survey) or personal questions (e.g., during speed dating or a medical survey). In some

FIG. 1. Example of virtual environment using video-capture.

environments, the patients have to initiate conversations that could vary from “safe” to highly embarrassing (e.g., asking the shopkeeper for products such as body wash, toilet paper, or condoms). Noninteractive scenes could also be used depicting familiar local scenes, such as the city center, a nearby bus route, and local cafes.

The CBT intervention

The CBT intervention aimed to identify unhelpful behaviors and beliefs that maintained the patients’ social anxiety and paranoia and taught patients more helpful ways of thinking about and responding to social situations. The intervention was based on a published CBT manual,²⁸ which patients used as “guided self-help” with support from graduate psychologists who had no formal CBT training but were supervised closely by CBT-trained health professionals (weekly individual and group supervision to guide the psychologists’ session-by-session preparation for each patient and give them feedback following each therapy session with a patient).

The CBT intervention consisted of four stages. The first stage included a detailed assessment of social anxiety, goal setting, rapport building, psycho-education about social anxiety, and socialization to the CBT model. The second stage helped patients develop an individualized CBT formulation²⁹ demonstrating how their thoughts (cognitive distortions) and behaviors (avoidance and safety behaviors) maintained their fear and anxiety about social situations. The third stage of the CBT intervention involved exposure-type behavioral experiments to anxiety-provoking social situations. The experiments were used to explore the patients’ thoughts, beliefs, predictions, and feared outcomes; to challenge the usefulness of their safety behaviors; and to modify their way of responding to other people during social situations. The final stage of the CBT intervention focused on maximizing patients’ gains and preventing relapse by planning further exposure-type behavioral experiments.

Use of the VE system

Patients used the VE system halfway through a 12-week CBT intervention during a single therapy session that lasted for about an hour. They physically visited the early intervention for psychosis outpatients clinic where the VE system was set up and their support psychologist was there to help them use it. Though each virtual interaction was brief, they all happen repeatedly and in quick succession so the overall length of the virtual interactions could vary as required and had an average length of 30 minutes. Video clips could be paused, restarted, and recorded so that patients could go over them to either rehearse their answers or discuss how the situation made them feel and what thoughts it triggered.

Before using the VE system, the patients were introduced to the technology and received a short description of the scene they were about to enter and were encouraged to respond spontaneously to the characters featured in the video clips who would ask questions and make small talk with the patients. For example, patients’ instructions read: “You are getting on board a bus whose driver is a friendly woman. You need a return ticket to the city center. You don’t have a bus pass and you’ll pay in cash.”

Outcome measures

Behavioral experiment forms, including a description of the task to be completed and the patient’s pre-post task predictions and anxiety ratings, were used to provide narrative data about the within-session use of the VE system. Narrative data were also extracted from therapist field notes detailing which VE scenes were used, how they were used within the context of CBT, and what patients thought of, and learnt from, the VE-assisted CBT session.

Clinical outcomes from the CBT intervention as a whole were assessed at baseline (week 0) and at 12 and 24 weeks post-baseline using standardized self-report measures for social anxiety (Social Interaction Anxiety Scale),²⁶ ideas of social reference and persecution (Green et al. Paranoid Thought Scales [GPTS]),³⁰ and beliefs about self and others (Brief Core Schema Scales [BCSS]).³¹

Analysis

Because of the small sample size, we described both individual and pooled clinical outcomes as a measure of the effect of the CBT intervention. Narrative data from patient behavioral experiment forms and therapist field notes were summarized into a template that included key elements of the patients’ individualized formulations, the virtual environments used during their *in virtuo* sessions, details on how the environments were used within the context of CBT, and what the outcome was of the VE-assisted sessions.

Results

Patient characteristics

Six young men (age range 20 to 36 years) who were outpatients at an early intervention service for psychosis were approached to take part in the study; they all accepted and completed our intervention and relevant outcome measures. Three patients had part-time work, two were unemployed, and one was a full-time father. All patients but one were taking oral antipsychotic medication and two patients had long-term physical health problems. Four patients were single and living at home with their parents or in shared houses with friends, one was in an unstable relationship, and one was living with a long-term partner and children in council accommodation.

At baseline, our participants had moderate-to-high social anxiety (SIAS: median = 61.5, range = 42–76; min-max: 0–80 with higher scores denoting more social anxiety) and moderate paranoia (GPTS: median = 65, range = 32–121; min-max: 0–160 with higher scores denoting more paranoia). On the pooled BCSS subscale scores for the group at baseline, we did not observe the high levels expected of negative self-evaluation, which is typical of social anxiety; instead, patients scored higher on the negative evaluations of others (median = 11, range = 0–24), which is more in line with paranoia (social reference).

Clinical outcomes with CBT intervention

Our CBT intervention as a whole significantly reduced social anxiety and paranoia at 24-weeks follow-up and showed the potential to change people’s negative beliefs about themselves and others, especially the stronger these beliefs were to begin with (high baseline scores on BCSS

negative-self and negative-others subscales). Table 1 illustrates individual patients' scores at baseline, post-treatment, and follow-up.

Symptom improvement for the group was significant, from baseline to 24-weeks follow-up on social anxiety scores (SIAS: median=44.5, range=19–68, $p=0.04$) and paranoia (GPTS: median=44.5, range=19–68, $p=0.04$) but not from baseline to 12-weeks post-treatment in either outcome measures. Individual paranoia scores dropped noticeably from baseline to 24 weeks follow-up for those at the high end of the scale whereas for those at the lower end remained at similar levels. There was no significant change in the group's negative or positive beliefs about self or others from baseline to 12- or 24-weeks follow-up, though we noted a trend for less negative beliefs about others from baseline to 24 weeks (median=4, range=0–15, $p=0.06$).

Value of VE system

Table 2 illustrates how the virtual environments were used within the context of a CBT intervention. Within-session process outcomes (subjective units of distress and belief ratings on individual behavioral experiments) as well as patient narrative feedback generated the hypothesis that the potential value of the VE system for CBT with this complex clinical population lies in helping patients achieve the following in a single session:

(1) Understand the role of avoidance and safety behaviors in maintaining anxiety and paranoia: For example, participant 3 had the strong feeling that someone on the screen was "looking at him funny," which made him feel anxious and paranoid. Talking about the virtual experience afterward, the participant said that because he knew it was an artificial environment, the person on the screen could not have been looking at him with bad intentions. This demonstrated to him that his social anxiety was heightened by looking out for, and deliberately focusing on, certain "threatening" signs in other people's behavior, even if they were not *actually* threatening. In another example, participant 2 felt really anxious while carrying out an *in vivo* experiment because the environment related to his two worst-case scenarios: public transport and young women (sitting on bus while a young woman initiated

conversation). His anxiety was made worse because he perceived that the (virtual) young woman on the bus was flirting with him. He would usually become very self-conscious and cope with the situation by either walking away or looking out the window; nevertheless, he stayed in the environment and practiced talking to her while maintaining eye contact until his anxiety started to fade away.

(2) Gain the impetus to engage in real-life social interactions and feel prepared for *in vivo* behavioral experiments. As an example, participant 1 stated that his confidence about going to the pub and socializing with people "in real life" increased from 30% at the beginning of the first *in vivo* behavioral experiment to 50% at the end of the last experiment; therefore, holding a conversation in "real life" at the pub was set as a "homework" task at the end of the VE-assisted CBT session. Participant 6 said that using the VE system was useful because the clips made him feel anxious but were not as overwhelming as real life. After using the VE system, this participant agreed to carry out *in vivo* experiments with his therapist, which was something he was hitherto unwilling to do because of fear and apprehension about the experiments.

Hindering aspects of the VE system

Participant 3 was initially embarrassed at the prospect of "talking to a video" and sceptical as to whether it was going to make him feel anxious. Participant 4 said that he surprisingly felt better without safety behaviors during his virtual social encounters (he was less preoccupied with what people were doing when he was looking up and making eye contact rather than when he was looking at the floor), but he predicted that this may not be the same in "real life."

Two other participants (5 and 6) also commented on the fact that their VE experience was not "real" and seeing oneself interact live on screen was unusual. Participant 5 said that the virtual environments were not as good as doing it in "real life" and that the whole experience was "weird." When asked what was weird about it, he replied that the VE system could not replace doing it for real; he elaborated by saying that he thought it would be more useful for people whose anxiety prevents them from leaving the house (in order to do *in vivo* behavioral experiments). Participant 6 said that using the VE system was

TABLE 1. INDIVIDUAL PARTICIPANT SCORES ON SOCIAL ANXIETY, PARANOIA, AND BELIEFS ABOUT SELF AND OTHERS AT BASELINE (PRE: WEEK 0), END-OF-TREATMENT (POST: WEEK 12), AND AT FOLLOW-UP (FU: WEEK 24)

Participant no.	SIAS			GPTS			BCSS											
	(0–80, higher scores indicate more social anxiety)			(0–160, higher scores indicate more paranoia)			Negative self (0–24, higher scores indicate more negative self-evaluation)						Positive self (0–24, higher scores indicate more positive self-evaluation)					
	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU
1	60	44	40	32	36	38	0	0	0	12	19	15	0	0	0	19	18	18
2	66	57	49	121	56	67	7	7	8	5	5	7	12	10	12	5	5	8
3	63	37	25	83	65	40	16	12	12	8	11	9	24	12	15	6	12	6
4	76	73	68	95	84	66	18	13	11	3	2	2	17	8	8	5	9	12
5	42	31	19	39	39	32	4	5	2	0	0	0	10	8	0	0	1	0
6	56	61	62	47	34	33	1	2	0	10	6	8	0	0	0	18	9	14

SIAS: Social Interaction Anxiety Scale; GPTS: Green et al. Paranoid Thought Scales; BCSS: Brief Core Schema Scales.

TABLE 2. USE OF VIRTUAL ENVIRONMENTS WITHIN THE CONTEXT OF COGNITIVE BEHAVIOR THERAPY

<i>Participant</i>	<i>Which virtual environments were used</i>	<i>How virtual environments were used</i>
1	<ul style="list-style-type: none"> -Traveling on the bus where a young woman sits opposite and makes friendly conversation -At a bar having to order a drink while another customer takes his turn to order -At a party where two different people initiate small talk and ask personal questions 	<ul style="list-style-type: none"> -Practice small-talk and maintain eye contact -Test belief that he might stutter or not know what to say during spontaneous one-to-one social interactions
2	<ul style="list-style-type: none"> -Traveling on the bus where a young woman sits opposite and makes friendly conversation. 	<ul style="list-style-type: none"> -Drop safety behavior of looking out of the window and maintain eye contact with the woman
3	<ul style="list-style-type: none"> -Environments that feature hostile and inconsiderate people (a fellow customer who demands to be served first; interacting with a rude doctor's receptionist) -Environments that featured friendly people (in a cafe interacting with a polite waiter; buying a ticket from a helpful bus driver) 	<ul style="list-style-type: none"> -Test whether an artificial social situation can make the participant anxious -Creating a hierarchy of triggers by ranking the environments according to the level of anxiety they evoke
4	<ul style="list-style-type: none"> -Standing in a supermarket. -“Hanging around” at an arts exhibition -Waiting in a busy street in the middle of the city 	<ul style="list-style-type: none"> -Compare anxiety levels when using safety behavior (looking at the floor) vs. dropping safety behavior (looking at eye level)
5	<ul style="list-style-type: none"> -Traveling on the bus with a man sitting opposite the participant -Traveling on the train with a woman sitting opposite the participant; the woman is challenged by a ticket guard 	<ul style="list-style-type: none"> -Switching between using safety behaviors such as “looking out for trouble” (hypervigilance) or “staring at others” (possible threats) and dropping safety behaviors by shifting his attention to something else (e.g., observing shops and traffic out the window)
6	<ul style="list-style-type: none"> -Talking to a stranger in an art gallery 	<ul style="list-style-type: none"> -Capture automatic thoughts and identify behaviors that the participant would commonly use to cope with the situation

an enjoyable experience, but going out with his therapist in real life was more helpful. The same participant also commented on the fact that he found the system “surreal” as seeing oneself from the outside was a very unusual experience.

Discussion

Six young men recovering from early psychosis who also had severe social anxiety and moderate paranoia used a VE system for a 1-hour single session halfway through a 12-week CBT intervention. The patients' significant collective improvement in social anxiety and paranoia at 24-weeks post-baseline reflects the outcome of the whole CBT intervention and provides the context within which a novel VE system was used.

Some patients perceived the virtual environments as “not real” and commented that they were less useful than real life. Knowing that the virtual environments are “not real” may prevent patients from feeling anxious; therefore, a powerful enough sense of presence and immersion is needed to overcome cognitive barriers (feeling that the situation is real despite knowing that it is not). A sense of presence in virtual reality has been suggested as a necessary ingredient for successful exposure therapy,^{32,33} though not all studies have supported this.³⁴

The usefulness of our VE system may depend not on how real it feels but on whether it can help patients capture thoughts and change behaviors associated with anxiety or

paranoia in social situations while maintaining a certain degree of control in the knowledge that the situation is indeed artificial. For example, the VE system's artificial nature may make patients more willing to take “risks” (e.g., overcoming avoidance and dropping safety behaviors) and to question their interpretation of social cues (e.g., having a sense that an artificial character is looking at you in a funny way cannot possibly mean that they intend to harm you or think badly of you, so there must be an alternative explanation).

Another useful aspect of the VE system for this particular patient population was that it could be tailored to the patient's attention focus (whether someone focuses on oneself or others) and to their feared consequences in relation to social situations (the worst case scenario that someone fears may happen). Some patients had an “internal” attention focus (being preoccupied with how they appear to others),²⁹ which is a typical response in social anxiety because of fear of appearing socially inept. For those patients, *in virtuo* behavioral experiments were designed to relate to situations of intimacy, performance, or scrutiny, such as making small talk with a young woman on the bus. For other patients, attention focus during social interactions was “external,” a response seen in both paranoia and social anxiety, by scanning other people for potential signs of a social threat, like a disapproving look,³⁵ or of an actual threat, such as being pushed over or attacked. For those patients, *in virtuo* behavioral experiments were designed to relate to situations where the patient had to

express assertiveness or tolerate the uncomfortable feeling of crowded places and of threatening or rude people.

A point for future consideration, captured by two patients' comments that the system felt "weird" or "surreal," is whether having a "self-observation" view by watching a full-size image of oneself interact live on-screen may resemble an out-of-body experience or depersonalization.³⁶ This in itself can be a symptom of anxiety or psychosis, and we do not know whether, in the context of CBT with patients who have both conditions, inducing such a feeling could be helpful (e.g., as a symptom-provocation behavioral experiment) or counter-productive. The feeling of an "out-of-body experience" or depersonalization while using this novel VE system deserves further study as it differs from the first-person perspective of conventional VR systems (watching the environment through goggles) and from the vicarious experience of computer games (identifying with a small avatar on the screen).

Limitations and recommendations

As a cases series, we did not aim to produce definitive conclusions but to generate hypotheses about the potential added value of VE for CBT in terms of enhancing clinical outcomes or expediting achievement of therapy goals. The lack of a control group makes it difficult to demonstrate here whether the patients' improvement in social anxiety and paranoia at the end of the whole 12-week CBT intervention was boosted by the use of the VE system. Nevertheless, demonstrating the effectiveness of the whole CBT intervention provides a context for the use of the VE system. The next step would be to carry out a randomized, controlled comparison of CBT with versus without the use of virtual environments.

Completion of self-efficacy measures and standardized real-life behavioral tests in future studies will test the hypothesis that patients feel more confident confronting their feared social situations "in vivo" after doing it "in *virtuo*." Also, standardized measures of presence and immersion will assess whether the VE system feels real and absorbing to the patients compared to just watching a video without seeing themselves on screen or with seeing only part of their body (e.g., an arm or a leg). Finally, we need to establish the acceptability of our intervention by offering it to a large cohort of patients and monitoring refusal and dropout rates.

Conclusions

This case series suggests that virtual environments using video capture can potentially add value to CBT for social anxiety in psychosis by helping patients understand the role of avoidance and safety behaviors in the maintenance of social anxiety and paranoia and by boosting their confidence to carry out "real-life" behavioral experiments.

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