



Experimental variation of social stress in virtual reality – Feasibility and first results in patients with psychotic disorders



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ABSTRACT

Background and objectives: Social interaction might lead to increased stress levels in patients with psychotic disorders. Impaired social stress tolerance is critical for social functioning and closely linked with symptom relapse and hospitalization. We present an interactive office built-up in virtual reality (VR).

Methods: Patients with psychotic disorders (PP, N = 26 including N = 5 dropouts) and matched healthy controls (HC, N = 20) were examined with a VR simulating an open-plan office. In a randomized, controlled cross-over design, participants were introduced to virtual co-workers (avatars) and requested to ask them for task assistance. Social feedback in each of the two sessions was either cooperative or rejective in randomized order.

Results: The office environment was tolerable for most PP and all HC, five PP and none of the HC dropped out for any reason. Drop-outs reported simulator sickness, influence on thoughts and symptom exacerbations. Statistical trends indicated heightened paranoid ideations for PP after social rejection. State measures of paranoid ideations showed high convergent validity with conventional measures of delusions. Of note, measures of presence were higher for PP than for HC.

Limitations: The exploratory design limits the robustness of the findings. Only statistical trends on paranoid ideation were found.

Conclusion: The use of VR to assess the effects of social rejection is feasible and tolerable for most PP (87%). However, its implementation for PP is challenged by increased simulator sickness and an additional stress load for some patients. Further studies continuing on these first results that point towards an increased paranoid ideation evoked by negative social feedback and generally higher subjective presence are needed.

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1. Introduction

The intention for this study was grounded on the clinical finding that patients with psychosis (PP) have lower chance for work functioning, irrespective of the available pharmacological and psychological treatments. Interpersonal problems are the most common reason for unsatisfactory job terminations for PP (Becker et al., 1998). Psychological therapies like cognitive behavioral therapy for psychosis (CBTp) can be a starting point to improve social adaptation. Proof-of-concept studies to improve CBTp for the

purpose of work-related stress are needed.

1.1. Stress and paranoia

PP tend to experience more psychotic symptoms in stressful environments (Myin-Germeys & van Os, 2007). For example, more paranoid ideations are reported, when faced with “stress of the street” (entering a busy local shopping street) compared to staying indoors (Freeman et al., 2015).

Memory is a good predictor for work functioning (Allott et al., 2013; Green, Kern, Braff, & Mintz, 2000). Further, there is evidence that healthy controls (HC) show an impaired working memory after exposure to acute stress (Schoofs, Preuss, & Wolf, 2008), but this effect is not shown for PP yet. Neurocognition,

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notably the working memory, could be one target when work functioning is investigated (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011).

Different cognitive models have been suggested to explain the occurrence and maintenance of paranoia. (Bentall, Kinderman, & Kaney, 1994; Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002; Kesting & Lincoln, 2013; Salvatore et al., 2012). All of them propose an association between stress and paranoid ideation. On the longer run an association to social functioning, like job performance, can be drawn. When subjects are facing a daily stressor, it is proposed that they tend to react with negative emotions, hyper-arousal and decreased self-esteem. Further, cognitive biases like attributional bias and jumping-to-conclusion facilitate the experience of paranoid ideations.

1.2. Cognitive behavioral therapy to manage social stress

CBTp is closely linked to the development of stress-vulnerability models of psychosis (Tarrier, 2014). One key-issue in CBTp is recognizing and managing social stress. The treatment rationale is derived from cognitive models (Freeman et al., 2002) with the common goals to reduce (positive) symptoms, to strengthen self-esteem and help patients to achieve personal life-goals as far as possible. CBTp is a disorder-specific adaptation of general principles of CBT for the treatment of PP. It draws on individualized cognitive models to identify treatment targets. The CBTp rationale is grounded on basic research of coping, attributions and other cognitive biases (Klingberg & Hesse, 2013; Mueser, Deavers, Penn, & Cassisi, 2013). CBTp is a first-line psychological intervention in most clinical guidelines (DGPPN, 2006; National Institute for Health and Clinical Excellence, 2014). Yet, the effects are small to medium (Turner, van der Gaag, Karyotaki, & Cuijpers, 2014), thus research on its basic mechanisms could inform to improve these interventions. RCTs are expensive methods. Other less costly techniques are necessary to investigate new approaches for CBTp, especially to manage social stress in a working environment and therefore prevent premature job termination or symptom exacerbation.

1.3. Virtual reality and social stress

Virtual Reality (VR), as we use the term here, provides a computer-controlled environment and immerses participants' senses by a head-mounted-display (HMD) and headphones, coupled with a head-tracker to simulate head movements within HMD egocentric view. The method thus allows the presentation of and interactions with complex scenarios in a well-controlled way. Comparable to role-play interventions, VR also allows for interactions with virtually-generated humans (avatars) whose behavior, however, can be predefined in miniscule detail, allowing for maximal standardized experimental manipulations. In contrast to conventional computer displays, HMD-guided VR exposure produces stronger feelings of immersion and presence (the feeling of being-there) in the cyber world. This is especially true for integration of relevant emotional cues (Diemer, Alpers, Peperkorn, Shiban, & Mühlberger, 2015), in our example, social interactions (Bombari, Schmid Mast, Canadas, & Bachmann, 2015). These stronger feelings of immersion in the VR could be used to improve CBTp (Park et al., 2011) and to decrease the number of sessions needed to be led by a trained CBT therapist (Broome et al., 2013). In contrast, photorealistic graphics do not seem to enhance presence significantly (i.e. Lugin, Wiedemann, Bieberstein, & Latoschik, 2015; McDonnell, Breidt, & Bühlhoff, 2012).

In VR, research on social interaction and perception can achieve higher ecological validity, necessary to induce stress and make it therapeutically useful. The first results are promising that VRs can

be used for studying psychosis and social perception (Kim et al., 2007). In this respect, we set up an open-plan office VR scenario with implemented negative and neutral avatar colleague interactions to investigate the effects of standardized social feedback on paranoia, neurocognitive performance, and presence.

1.4. Aims of the study

With this study, we set out to delineate psychosocial mechanisms for paranoid ideations and lay grounds for paradigms to test elements of psychological interventions against paranoia.

In the present study we report on the method's feasibility and present the first results of the office based VR. The virtual scenario was developed to simulate social interaction in a workplace environment. Systematic variations of visual-auditory social feedback are implemented in the form of preregistered virtual agent answers to natural interactions (questions), triggered by the experimenter (wizard-of-Oz design). The emotional, cognitive and behavioral consequences of HC and PP can be studied.

Hypotheses derived from cognitive models of paranoid delusions and the VR-literature will be tested. 1. The scenario with rejection produces higher feelings of presence in PP. 2. Rejections from colleagues cause higher paranoid ideations in PP, not in HC. 3. Rejections cause diminished working memory performance in PP, not in HC. All three Hypotheses propose an interaction of time, group and condition.

2. Methods

2.1. Sample

Patients with psychotic disorder (PP, N = 26) and matched healthy controls (HC, N = 21) participated in the experiment. Inclusion criteria were an age between 18 and 65 years, literacy in the German language and the ability to give consent. We informed the legal guardian in writing, if a patient was under legal care. We recruited PP from in- and outpatient treatment at the Department of Psychiatry and Psychotherapy of the University of Tübingen. PP were eligible for participation when they fulfilled the diagnostic criteria of schizophrenia or schizoaffective disorder according to DSM-IV and had a stable medication for at least one week or no medication. Further inclusion criteria were no mental retardation or current substance use disorder, the medication was stable for at least one week and no benzodiazepines should be taken for at least 3 days before the VR-sessions. HC were matched to the PP in regard of gender and age. Participants of this group required lifelong absence of psychotic experience or any other current psychiatric diagnosis and were recruited through postings. Subjects gave written consent about their participation after they were informed about the study. Every participant was compensated with 40 Euro for the whole testing. Five PP were not able to finish the experiment and were therefore excluded from quantitative analyses. One HC had to be removed from the analyses due to experimental error. More detailed exploration of reasons for dropping out can be found in the results section.

2.2. Procedure

Subjects were informed about the procedure and gave written informed consent. They were invited to a first encounter in order to check the inclusion criteria (SKID-I) as approved by the local ethic committee (742/2014BO2). The appointment was used to rate the psychopathology and to get self-reports. At approximately one week intervals subjects were invited to the VR-sessions. A graphical presentation of the procedure is in Fig. 1.

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