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A virtual reality application in role-plays of social skills training for schizophrenia: A randomized, controlled trial

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ABSTRACT

Although social skills training (SST) is an effective approach for improving social skills for schizophrenia, the motivational deficit attenuates its efficacy. Virtual reality (VR) applications have allowed individuals with mental disabilities to enhance their motivation for rehabilitations. We compared SST using VR role-playing (SST-VR) to SST using traditional role-playing (SST-TR). This randomized, controlled trial included 91 inpatients with schizophrenia who were assigned to either SST-VR ($n=46$) or SST-TR ($n=45$). Both groups were administered over 10 semiweekly group sessions. An experienced, blinded rater assessed vocal, nonverbal and conversational skills. We also obtained data on motivation for SST and various social abilities. Throughout the 10 sessions, the SST-VR group ($n=33$) showed greater interest in SST and generalization of the skills than the SST-TR group ($n=31$). After SST, the SST-VR group improved more in conversational skills and assertiveness than the SST-TR group, but less in nonverbal skills. The VR application in role-plays of SST for schizophrenia may be particularly beneficial in terms of improving the conversational skills and assertiveness, possibly through its advantages in enhancing motivation for SST and generalization of the skills, and thus it may be a useful supplement to traditional SST.

1. Introduction

Although there is general agreement that social skills training (SST) is one of the beneficial approaches in improving social functioning in patients with schizophrenia, the motivational deficit attenuates its efficacy (Bustillo et al., 2001; Kopelowicz et al., 2006; Pfammatter et al., 2006; Kurtz and Mueser, 2008). Some board-game featured SST programs have been developed to overcome this difficulty and have been suggested to be effective (Liberman, 1972; Torres et al., 2002). Furthermore, it was suggested that using virtual reality (VR) technology during SST might be effective in improving the motivational problem (Ku et al., 2007).

A VR system has been recognized as a promising tool for assessment and treatment of mental illnesses (Gregg and Tarrier, 2007). For example, the virtual environment can facilitate role-playing as participants do not have to rely on imagination for the given social context of the scenario. A user of the VR system feels like he/she is in the virtual environment rather than his/her actual physical location, a feature called the "presence". Thus, VR technology creates not simply "look-like" but rather "real-like" environments and allows social interaction with avatars or virtual humans (Tarr and Warren, 2002; Riva et al., 2004; Rizzo et al., 2004; Sanchez-Vives and Slater, 2005).

Our group has shown that VR can be used to assess cognitive (Ku et al., 2003), emotional (Ku et al., 2005), and behavioral (Ku et al., 2006) characteristics of patients with schizophrenia. Furthermore, it is also useful for enhancing attention (Cho et al., 2002) and daily living activities (Lee et al., 2003). Other researchers have proposed that VR can provide a tool for cognitive training in individuals with physical or mental disabilities to improve attention, memory and learning abilities (Riva et al., 2004; Jiang et al., 2005).

In order to examine the usefulness of VR in social rehabilitation, this study was designed to compare SST using VR role-playing (SST-VR) to that using traditional role-playing (SST-TR). A learning method focused on motivational enhancement is a well-established approach to improve attention and the outcomes of skills training in patients with schizophrenia (Silverstein et al., 2009). Our pilot study (Ku et al., 2007) addressed that the VR application in role-playing of skills training for schizophrenia was beneficial in terms of enhancing their motivations.

The aim of this study was to find advantages of the use of VR in social rehabilitation for patients with schizophrenia. Based on our previous study, we hypothesized that the use of VR role-play for SST for schizophrenia could enhance training outcomes by boosting the participants' motivation for SST. In addition, we expected to find some

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advantages of the VR application in other social behaviors such as voice, nonverbal and conversational skills or social abilities such as assertiveness, interpersonal relationship skills, social problem solving, and generalization.

2. Methods

2.1. Participants

This study enrolled 91 participants with schizophrenia who were all inpatients of the Severance Mental Health Hospital, Yonsei University College of Medicine. They were evaluated using the Structural Clinical Interview for DSM-IV Axis I, Patient Edition (SCID-P) (First et al., 1996), administered by a trained psychiatrist. In order to select subjects who were most likely to benefit from the use of VR technology, all participants were recruited between the ages of 18 and 45 years old. They had no problems such as substance abuse or dependence, head trauma history, neurological illness, or physical illness that could affect brain functioning as well as other Axis I diagnosis.

Participants were treated with intensive psychiatric care for two to four weeks, and stabilized enough to learn the skills without disrupting a session at the time when the baseline assessment was performed. Then, they were randomly assigned to either SST-TR ($n=45$) or SST-VR ($n=46$). Prior to and after SST, severities of symptoms were assessed by an experienced psychiatrist using the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). This study was conducted under the guidelines established by the institutional review board. After completely describing this study to participants, written consent was obtained.

2.2. Interventions

For each session of the two types of SST, rationale, steps of the skill, scenes used in role-plays, and special considerations were manualized on the basis of the guides suggested by Bellack et al. (2004). Both types of SST were administered over 10 semiweekly sessions for five weeks, which were a modified version to complete the training in the inpatient setting. The sessions consisted of three consecutive trainings: five sessions of conversation skills training ("Introduce yourself", "Find a common concern and listen to the other person", "Start a conversation", "Maintain a conversation", and "End a conversation"), three sessions of assertiveness skills training ("Make a demand", "Reject a demand of another person", and "Make a compromise"), and two sessions of emotional expression skills training ("Express positive emotions" and "Express negative emotions"). Homework from the previous session was reviewed in the beginning of the next session. Every session included a therapist modeling followed by the participant's role-playing, and then positive and corrective feedback from the therapists. After identifying deficient skills, the participant was engaged again in another role-play of the same scene, and also was provided with feedback. Every session included three role-plays with different scenes per participant. Therapists consisted of a main therapist (HJJ) and co-therapists who were skilled social workers, and the main therapist performed both types of SST.

A difference between the two SST types was in the method for a role-play. The virtual environments as simulators of the scenes and avatars as the actors were used in VR role-plays, whereas verbal, writing, picture, and video supplies as simulators of the scenes and SST therapists as the actors were used in TR role-plays. Thus, except for the materials used in role-plays, there were no differences in the details of training including time spent for instructions, orientation, and contact with the main therapist. To examine the effects of role-plays (VR vs. TR), we controlled potential confounding effects of the other SST constituents. For example, both types of SST were conducted within 90 min with a similar number of group members (four to five) in every session. Because the attendance rate reflects motivation for SST, we controlled the effects of passive attendance by performing the same sequential processes to encourage attendance: waiting until the set time, broadcasting of announcements, and a therapist's simple recommendation.

2.3. VR devices and VR role-plays

The VR system included a personal computer for rendering and providing the virtual environment, a head mounted display (HMD; Eye Trek FMD 250W, OLYMPUS) for displaying the virtual environment in a more immersive manner, and a position tracker (InterTrax2, InterSense) for following the head direction in real time. The participants were able to move their heads to direct their gaze in a natural manner, and the display of the virtual environment depended on the orientation data obtained from the participants' head direction as measured by the fixed tracker attached to the HMD. VR role-plays were displayed through two different panels: an HMD and a 120 inch-screen. The participant wore the HMD and the position tracker, which provided "immersive" virtual environments, and the rest of the group members observed the same scenes on the big screen.

SST-VR was different from SST-TR in that it included core features of role-playing games. For example, the participant wearing the HMD was provided with a joystick and buttons to operate his/her avatar, which produced the first-person perspective view. By using the joystick and buttons, he/she freely moved and interacted with avatars in the virtual space.

Fig. 1 presents the examples of SST with VR role-plays. Some parts of conversation skills training provided multiple choices on the questions so that the participants searched through a list of possible answers and selected an answer using the button. Helper avatars were included for positive feedback when the participants performed an advisable play and corrective feedback for an unadvisable play. On the other hand, real execution such as speaking and expressing emotion toward avatars was encouraged as a response during other parts of conversation skills training and whole parts of assertiveness and emotional expression skills trainings. After the role-playing part was completed, additional feedback was provided by the therapists as was given in SST-TR. After each session, "simulator sickness" which consists of autonomic symptoms such as nausea, sweating, and dizziness related to the use of an immersive HMD was checked, and a post-session questionnaire and test were performed.

2.4. Outcome measures

2.4.1. Social skills

In terms of primary outcomes, we measured social skills such as voice quality, nonverbal skill and conversational properties using a performance-based measure of social competence. Social skills were assessed in the laboratory with unstructured role-play tests. An unstructured role-play test was used in the present study because a prior study suggested that such a format provided a more ecologically valid measure of social competence than briefer, highly structured role-play test (Torgrud and Holbom, 1992).

After one of the two therapists described the scenes, the participants were asked to perform the role-plays with the other therapist. We used the 10 role-play tests, of which each resembled one of the three scenes that were used in the role-plays in the corresponding session. An assistant was given a list of prompt lines (e.g., "Tell me about yourself" and "What are you going to do?") to be delivered should there been silence lasting more than 10 s. All participants' performances on the 10 role-plays were recorded on videotapes (audio and video). Behavioral ratings of social skills on the role-plays were made by another research assistant (JYP) who was with masters-level education in mental health social work. The two therapists knew the participants' SST conditions, whereas the behavioral rater was blind to the conditions.

Voice, nonverbal and conversational skills were rated using 29-items of the Trower's Social Behavior Scales (SBS) (Trower et al., 1978). The SBS used in this study consisted of six items on voice quality (volume, tone, pitch, clarity, pace, and speech disturbance), nine items on nonverbal skills (proximity, orientation, appearance, face, gaze, posture tonus, position, gesture, and autistic gesture of the nonverbal behaviors), and 14 items on conversational properties (length, generality, formality, variety, humor, nonverbal grammar, feedback, meshing, turn tasking, question, supportive routines, assertive routines, behavior in public, and situation-specific routines). The conversational skills represent the characteristics of contents and the contextual processing of conversation and are separate from the vocal or nonverbal skills during conversation. Overall skill was defined as an average of the three skill categories. Each item was rated on a scale of one to five. Scores on the overall skill and the three skill categories were converted into a 100-point scale, with higher scores indicating better skills.

For secondary outcomes, we selected three self-reports, each of which reflects a particular social ability with a weighted proximity to the site of the intervention. The first one was the Rathus Assertiveness Schedule (RAS) for assessing assertiveness (Rathus, 1973) on a six-point Likert scale. The report included 30 items such as "Most people seem to be more aggressive and assertive than I am." The next one was the Relationship Change Scale (RCS), which measures interpersonal relationship skills (Schlein and Guerney, 1977) on a five-point Likert scale. The report consisted of 25 items such as "In comparison with four weeks ago, my satisfaction with myself as a person is ( )." The last one was a short version of the Social Problem Solving Inventory-Revised (SPSI-R) to measure the individual's cognitive, affective, or behavioral responses to real life problem-solving situations (D'Zurilla et al., 2002). It was also a five-point Likert scale questionnaire with 25 items such as "When I have a problem, I usually believe that there is a solution for it." Scores on the three self reports were converted into a 100-point scale, with higher scores corresponding to better abilities.

2.4.2. Proxy measures of motivation and generalization

We made the post-session questionnaires and tests to obtain participants' opinions on motivation and generalization for each session. The two-item Interest-in-Participation Questionnaire evaluated participants' interest in the current session and their expectation for the next session on a scale of one to five, and the average score of the two items was used as a proxy measure of motivation. The post-session test of five questions with right-or-wrong answers related to the topics of the corresponding sessions was performed for a proxy measure of generalization (e.g., "You can get to know each other better when you share a conversation on a common subject", "The final goal of a compromise is to find a solution that can be accepted by both parties"). Higher scores on the post-session tests indicated that the participant more efficiently applied the learned skills into specific social knowledge. The scores of the two post-session measures were also converted into a 100-point scale, and were defined as the interest-in-participation score and the generalization score, respectively. Each of them was used as an index of motivation for SST or application of the skills to social knowledge.

2.4.3. Measures of overall skill changes

Using the post-SST questionnaire, we obtained scores on the contribution of four SST constituents (material, content, therapist, and structure) to overall skill