DEVELOPMENT OF A VR BASED CONVERSATION TRAINING PROGRAM FOR PATIENTS WITH SCHIZOPHRENIA

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Abstract: Schizophrenia is at risk of interpersonal distress, chronic unemployment, and a diminished quality of life. Generally, social skill training designed to help patients develop social skills includes role playing, but this form of training has typical shortcomings, which are largely due to a trainer's difficulties to project emotion. Virtual Reality (VR) based techniques have the potential to solve these difficulties, because they provide a computer generated but realistic three-dimensional world, and human-like avatars that can provide emotional stimuli. In this paper, we report on a method of implementing virtual environments (VEs), in order to train people with schizophrenia to develop conversational skills in specific situations, which could overcome the shortcomings of or complement conventional role-playing techniques. The paper reports a the efficacy of the proposed approach in a preliminary clinical trail with 10 patients with schizophrenia.

Introduction

Schizophrenia is one of the most devastating psychiatric disorders, as it seriously affects higher mental functions, such as thinking, feeling, and perceiving [1]. The Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV), states that schizophrenia involves problems in one or more major areas of functioning (e.g. interpersonal relations, work, or self-care) [2]. It is also characterized by symptoms such as hallucinations or disorganized thinking, a loss of goal-directed behavior, and a deterioration in social role functioning. The prevalence of schizophrenia remains about 1% worldwide, which translates into an enormous burden.

Although psychotropic medications have a beneficial effect on the symptoms of schizophrenia patients, such as their hallucinations and delusions, they have less impact on their social and instrumental deficits. As a result, even individuals that respond well to pharmacotherapy are at risk of interpersonal distress, chronic unemployment and a diminished quality of life [3]. In addition patients with schizophrenia usually have social skills deficits, which include an inability to communicate effectively with people, to confirm and express their feelings, and to understand interpersonal boundaries.

Therefore, it is necessary to provide schizophrenic patients with social skill training, in a manner adapted to the state of illness. Such training encourages human interaction and is intended to improve a patient's conversational skills and assertiveness. Indeed, previous research has demonstrated that that social skills training is effective at improving a patient's social life and occupational skills [3-5].

Typical approaches to social skill training are based on social learning theory [6]. According to this theory, social behaviors are acquired through by observing the actions of others and by being exposed to the naturally occurring consequences (both positive and negative) of one's own actions. Therefore, many therapists add role-playing to training programs designed to develop social skills. This makes it possible to perform a certain task in a mimicked situation and to observe its consequences immediately [7].

The role playing method usually has a particular shortcoming in that it requires several persons. Also, the effectiveness of the training in bringing about learning is dependent on the players' immersion, the time available to conduct the role-play, the acting ability of the trainers, and the observations made by both the trainer and the coach or tutor. In a given role-playing situation, a trainer may have difficulty acting out the role in a proper way, because for example, he or she is of a specific gender/age/ethnicity. Due to these difficulties, it is difficult for trainers to provide suitable modeling and to train patients in a consistent way. Therefore, the instructor must rely on 'an actor' to assess and train the student, which means that the assessment tends to be subjective, and thus patients do not always benefit from a training program that is adapted to their specific needs. In order to facilitate role-playing, various media or tools such as games, have been incorporated into training programs. However, training assisted by media as several major limitations, which stem from its passive characteristics, due to it being non-interactive and non-immersive.

The Virtual Reality (VR) technique could provide an answer to these problems, because it has the means of solve difficulties that other media or tools cannot

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overcome. This is because VR has the potential to provide a realistic three dimensional world generated by computer graphics, with which the user can interact, so that he or she can navigate within and manage the virtual world and obtain computerized objective scores. Moreover, technological advances have recently been made that enable computer-generated entities to mimic both the appearance and behavior of humans. Thus, Virtual Environments (VEs) can look realistic, and can include representations of people as well as objects. Due to their capacity to provide realistic three dimensional environments, VEs have already been used to treat several types of mental disorder, such as, phobias [8-10], and attention deficit disorders (ADD) [11, 12], to assess cognitive functions[13], and to provide activities of daily living training for stroke patients (ADL) [14].

In addition, recent improvements in graphics and animation technology have made it possible for the avatars used in these visual images to appear increasingly human-like. Moreover, studies have shown that people report feeling some level of presence in almost all mediated environments, and even respond socially to both human and nonhuman entities, as well as to the computer interfaces themselves [15]. These results support the hypothesis that people respond socially to a virtual avatar, and that participants interacting with an anthropomorphic image report copresence and social presence, although different results are obtained when using high or low quality graphics, dependent on the user's expectations. These results provide us with the rationale for using the virtual reality technique, particularly virtual humans, in order to provide training in social skills that require practical social interactions, such as conversation. Actually, many training application trials have been conducted using these virtual humans and VEs[16-18]. In particular, a VR system for autistic spectrum disorders (ASD), reported by Anja Rutten, et. al. is representative such a system used for social skills training, and demonstrates that the VR technique can be effective and that the skills learnt can be transferred to other media [17].

In this paper, therefore, we present the implementation of VEs designed to train people with schizophrenia to develop conversational skills in specific situations, in order to overcome the shortcomings of or to complement the conventional role playing method; to provide a tool for the effective training and the objective assessment of patients with schizophrenia; and to investigate the usability of the developed system through subjective evaluation and objective responsive characteristic analysis.

Materials and Methods

1. VR system

The VR system developed in this study was designed to allow patients to be trained in a comfortable environment where they could concentrate on the task, because we observed that many patients felt uncomfortable wearing a Head Mount Display (HMD) and holding a joystick. This was based on observations made during a previous study of VR for schizophrenic [13] and stroke patients [14]. Therefore, in order for the patients to feel free to experience and concentrate on the tasks involved in the VEs, a big screen was chosen, so that the patients could stand or sit in front of it in order to interact with the computer generated avatars. Moreover, the use of the VR interface was minimized in this system, therefore a button and a lever was used to command the avatars in the VEs. The VEs and avatars were rendered on a PC by "3D Game Studio" (Conitec Datasystems Corporation), which is a commercial game engine. The voices of the avatars were recorded previously and avatars' lip movements were synchronized with speech as closely as possible. Their behaviors and facial expressions were also created using previously designed data

2. VR Scenarios

The scenario has four steps, which mimic those involved in normal conversation, and they contain 10 tasks, which force a patient to respond. Each task involves several types of conversational skills, for example understanding, expression, and management of the conversation.

These four steps are "Step 1: Greetings and introduction", "Step 2: Managing the conversation after thinking of possible topics", "Step 3: Listening and speaking ", and "Step 4: Ending the conversation".

3. Clinical Experiment

This experiment was designed to evaluate how patients with schizophrenia feel this conversation skills training program and to investigate the relationships between schizophrenic patients' conversational response characteristic as represented by 'silence breaking time' and patient's positive and negative symptoms, and between conversational response characteristic and patient's symptoms, and between 'presence scores' and 'patient symptoms'.

Subjects

Twelve patients at the Severance Mental Health Hospital in Korea, diagnosed as having schizophrenia were recruited for this experiment, and all were capable using a joystick. However, 2 subjects failed to complete the conversation training program and were excluded. Therefore, the data of 10 patients (5 men and 5 women; mean age 28.8 ± 9.07 years) with a mean PANSS score of 22.1 ± 4.77 for Positive symptoms, 19.2 ±3.76 for Negative symptoms, and 41.3 ±5.67 for General psychopathology score were used.

Procedure

Before experiencing the virtual environment, a clinician determined the patients' PANSS scores [19],

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which represent a schizophrenic patient's positive & negative syndrome severity. These scores were used to compare their symptoms with behavioral characteristics and presence scores. PANSS is composed of three subscales; the negative syndrome scale, the positive syndrome scale, and the general psychopathology scale. And each subscale is determined by assessing several representative schizophrenic symptoms. For example, the negative syndrome scale contains seven characteristics of schizophrenia, namely, a blunted affect, emotional withdrawal, poor rapport, passive apathetic social withdrawal, difficulty in abstract thinking, lack of spontaneity & flow of conversation and stereotyped thinking [19].

Subjects were instructed how to control the joystick and what to do during the experiment, and were then given an exercise session to familiarize them with the interfaces such as joystick and virtual environment. The exercise session was composed of a virtual avatar standing in a virtual room, and subjects were asked to approach the avatar and initiate a short conversation played according a fixed scenario. The subjects then started the main conversation skills training program. After completing the program they were asked to complete several questionnaires that contained questions on copresence, social presence, and usability.

Measurements

In this study, we acquired both objective and subjective measurements. The 'silence breaking time' was measured by measuring the duration from the beginning of a silence during a conversation to talk button pressing.

And, as subjective measurements, various questionnaires were used to investigate general opinions, usability, and presence. The questionnaires regarding copresence and social presence have been previously described by Nowak and Biocca [15], but were translated into the Korean language for this study.

Actually, the questionnaire regarding copresence and social presence is composed of four parts, namely, self-reported copresence, perceived other's copresence, telepresence, and social presence. However, only three parts of the questionnaire, self-reported copresence, perceived other's copresence, and social presence were used for this study, because our focus was on the avatar not on the virtual environment. The questionnaire concerning the usability of the developed system was composed of questions about usefulness of the system, the subject's interest, the subject's willingness to re-experience the program, and the influence of the program on anxiety reduction.

Results

Fig. 1 and Fig. 2 shows rating scores to questions about subjective experience and level of presence for each. Mean scores to questions regarding subjective interest and usability were scored 6.3±1.67 for the evaluated usefulness, 7.3±2.01 for subject's interest, 5.7±2.1 for subject's anxiety reduce, and 7.5±2.7 for subject's willingness, which could be regarded as positive.

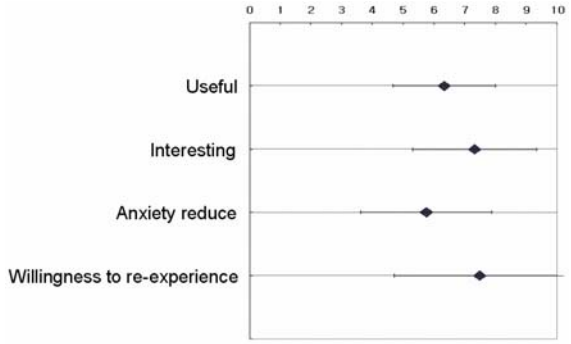

Figure 1: The subjective scoring of questions regarding subjective interesting and usability.

All three presence score percentages were 68.6±18.9 for self-reported copresence, 71.67±18.0 for perceived other's copresence, and 67.5±16.9 for social presence, which could be also regarded high.

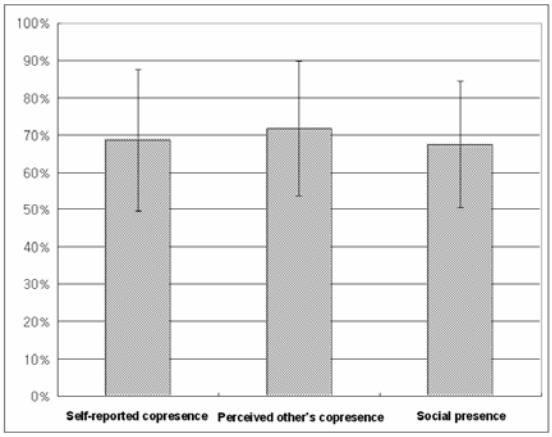

Figure 2: Percentage presence scores.

No significant correlations between measurements and PANSS were observed in this study. However, when correlations between the presence scores and sub-items of the negative symptom scale, which is one subscale of PANSS, were investigated, the Emotional withdrawal symptom, which is one of the negative symptoms, was found to be significantly correlated with social presence($r=-0.649$, $p=0.042$) and perceived-other's copresence($r=-0.709$, $p=0.022$).

In addition, a significant negative correlation was found between social presence score and silence-breaking time ($r=-0.632$, $p=0.050$), while perceived-other's presence score, self-reported copresence, and perceived-other's copresence, show no correlation.

Although no significant correlation was observed between silence breaking time and positive, negative symptoms and general psychopathology scores, a significant correlation was obtained between the silence breaking time and Lack of spontaneity & flow of conversation ($r=0.676$, $p=0.032$).

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Discussion

In this study, we proposed a social skill training system, and focused particularly on conversational skills training as implemented by the developed VR technique. This system contains a conversational scenario based on the theory of social skills training.

Patients evaluated this program positively after the clinical experiment had been conducted. These overall positive reports concerning copresence, social presence, and usability indicate that patients with schizophrenia underwent the virtual conversation program without problem, and that the virtual conversation situations populated by virtual avatars would be effectively exposed to patients with schizophrenia. Moreover, according to the patients' verbal reports on this system, some reported that they felt less fearful to converse with avatars compared to do with real people. These findings support the notion that VR based conversational training system could be used for conventional social skills training.

In particular, the negative correlations between presence scores and emotional withdrawal, which is one of negative symptoms of patients with schizophrenia, are interesting. Emotional withdrawal is characterizes by the fact that someone is not interested in, does not participate in or project their own emotion into a meaningful life-event. And, perceives other's copresence, derived from a combination of intimacy, involvement, and immediacy, and the social presence represent the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship [15]. Therefore, the more emotional withdrawn a schizophrenia patient, the less they felt the presence of an avatar, and the less involved and interested the patient was in interacting with the avatar. This may make sense in terms of the findings of a study which found that a participant's emotion influences the feeling of presence [20]. In the present study, indicates that subjects feel presence in virtual environments.

The negative correlations also indicate that the effects of the VR system including the avatars, may vary with disease severity in schizophrenia. This is supported by reports that the effectiveness of social skills training is dependent on symptoms [21], and cognitive level [22], and that it may be correlated with various factors [23]. Therefore, the developed system should be able to provide various levels of difficulty in each situation, so that each patient can obtain effective training. Therefore, a method for increasing a patient's participation is needed to maximizing benefits derived from VR applications by schizophrenia patients.

In addition, the negative correlation observed between social presence score and silence breaking time could be considered as evidence showing that the patient's response characteristics in a virtual task could be influenced by the patient's feeling of a social presence. This could mean that response characteristics could represent the patient's feeling of presence during an interaction with a virtual avatar and the patient's symptoms.

In the correlation analysis between the subscales of PANSS and subjects' silence breaking time, a Lack of spontaneity & flow of conversation scale in PANSS was positively correlated.

Lack of spontaneity & flow of conversation characteristic score represents the lack of flow of conversation due to anhedonia, avolition, a defensive attitude or cognitive deficit. This symptom appears as a reduction in flexibility and productivity during the process of a linguistic interaction [19].

The relationship between silence breaking time and PANSS subscales may be explained by the meaning of subscale characteristic. Therefore, it means that patients with more anhedonia, avolition, a defensive attitude, or a cognitive deficit, have longer silence breaking times. It could be said that this result is directly consistent with the original objectives of the talk button, because the talk button was created to determine whether a subject participates in an active manner or not. Therefore, this result supports the notion that silence braking by pressing the talk button is related to the conversational characteristics of schizophrenia patients.

Conclusions

The VR based conversation training program developed during this study was positively evaluated by clinical experiments on patients with schizophrenia. The objective parameter 'silence breaking time' was found to be related to patients' symptoms regarding the flow of conversation.

These results demonstrate that the system could be used for conversation training and indicates that schizophrenia patient show symptom variation, particularly with regard to emotion. 'Silence breaking time', which was obtained during experiencing conversation training program, was found to be able to predict patient characteristics, although this parameter is not enough to fully represent a subject's conversational skills.

As you know and can catch from this study, one of the advantages of VR is its capacity to provide objective measurements, and the developed system was able to provide us with an objective clinical measurement. However, the range of its application may be limited by the fact that the patients with schizophrenia had different symptoms, levels of cognitive and executive function, and social deficits. Moreover, this was demonstrated by the results of this study by the correlation between silence breaking time and symptoms of patients with schizophrenia.

In spite of these limitations and shortcomings, this VR system could also be used on people who don't know how to communicate well with others for many reasons, e.g., autism, ADD/ADHD, stroke, learning disabilities, or a lack of education.

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