

Annual Review of Cybertherapy and Telemedicine

Volume 3 Year 2005 ISSN: 1554-8716

Interactive Media in Training and Therapeutic Intervention

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Investigation of Social Anxiety of Patients with Schizophrenia Using Virtual Avatar

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Abstract: *Backgrounds: Patients with schizophrenia show a tendency to avoid social interaction because they feel great anxiety during their social interactions. As a result, they have trouble in making social relationships. This trouble is largely due to the fact that these patients show emotional withdrawal as well as passive/apathetic social withdrawal. Social deficits of these patients have been overcome through social skills training programs, which provide them opportunities to experience various social situations by role play method. Objectives: This study was conducted in order to investigate whether an interaction with a virtual avatar can evoke patient's social anxiety and the relationship between patient's symptom severity and social anxiety traits. Method/Tools: Fifteen patients with schizophrenia and fifteen controls were recruited. A male and a female avatar were generated. 2x2x3 (group, avatar's gender and avatar's emotional expression) was used in this experiment. Each avatar has three emotional expressions: are happy, neutral and angry. Subjects performed an introduction task in six conditions (gender x emotional expression) in random order. The task was composed of "approach", "listening to avatar's introduction" and "introduce oneself to the avatar". After all six tasks were performed, subjects completed a State-Trait Anxiety Inventory (STAI) questionnaire. In addition, patients' symptom severity was evaluated using the Positive and Negative Syndrome Scale (PANSS). Results: The social anxiety level to avatar's emotional representation was significantly different in the two group ($p < .001$). In the control group, the level was lowest when subjects coped with an avatar expressing "happy," while the highest anxiety level was shown when they faced an avatar expressing "angry." However, in the patient group, the level difference was not significant between "neutral" and "happy" avatar. Patients only showed a significantly high anxiety level when they experience the "angry" avatar condition compared to other two conditions. In a correlation analysis between patient's anxiety level and their symptom severity, social anxiety for "happy" and "neutral" avatars was positively correlated with the negative syndrome of PANSS (happy : $r = .539$, $p = .038$, neutral : $r = .533$, $p = .041$). Particularly, the anxiety level for "happy" and "neutral" avatars was positively correlated with two subscales (N1: blunted affect, N4: passive/apathetic social withdrawal) of the negative syndrome of PANSS (N1. happy: $r = .549$, $p = .034$ / neutral: $r = .536$, $p = .039$) (N4. happy: $r = .536$, $p = .039$ / neutral: $r = .658$, $p = .008$). Conclusion: Through this study, we discovered that virtual avatar displaying emotional expression can cause social anxiety in patients with schizophrenia and that a patient's symptom severity was correlated with social anxiety level. It could be said, from these results, that the more severe the negative symptoms a patient has, the greater social anxiety they will feel. This might be due to their passive, apathetic and isolated trait. They may tend to recognize socially positive emotion as fearful stimuli. This inference could be supported by the relationship between anxiety and subscales of negative symptom of PANSS. In this sense, we could say that a virtual avatar could provide an opportunity for patients to experience emotionally induced social situation. In addition, it could be used for training patients to cope effectively by experiencing emotions close to reality as well as to find out the clinical characteristics related to patient's symptoms.*

INTRODUCTION

Since it seriously affects higher mental functions, such as thinking, feeling, and perceiving,¹ schizophrenia can be considered one of the most devastating psychiatric disorders. The clinical course of schizophrenic patients is characterized by higher rates of relapse, disability and suicide when anxiety symptoms are concurrently experienced.^{2,3} Although social anxiety symptoms are common in patients with schizophrenia,⁴ they often goes unrecognized, or are considered to be part and parcel of the schizophrenic symptomatology.⁵

In fact, many patients with schizophrenia suffer from anxiety symptoms.³ As a result, they actively avoid social interactions and appear to have little motivation to develop social relationships. Social interaction is often very anxiety provoking and leads to avoidance; patients often seek to escape from interactions initiated by others.⁶ Existent research suggests that schizophrenic patients are particularly sensitive to conflict and criticism and will withdraw from potential conflict situations even when they are being taken advantage of or unjustly accused of things they have not done.⁷

In order to treat these patients with schizophrenia, effective psychological treatment studies for social anxiety have been developed and evaluated.^{8,9} A combined program including exposure treatment together with cognitive therapy delivered in a group format has had significant outcomes.^{10,11} Cognitive behavioral group treatment (CBGT) for social anxiety in schizophrenia was demonstrated to be effective as an adjunctive treatment¹² The important factors in the established therapeutic techniques are ex-

posure to an anxiety evoking situation (gradual confrontation of feared event/situation) and to learning coping strategies for a situations through role-play (behavioral acting out). It is very important that patients experience social anxiety in treatment or in evaluation session. However, the existing therapeutic programs depend on patient’s imagination ability.¹²

Therefore, virtual reality could be a powerful tool to provide patients with schizophrenia suffering from social anxiety to be immersed in a specific situation and feel and experienced social anxiety. Accordingly, the aims of this study were to develop a virtual avatar that could interact with patients with schizophrenia, and to evaluate whether a virtual avatar could evoke patient’s social anxiety. In addition, this study was conducted in order to investigate the relationship between patient’s symptom severity and social anxiety traits.

MATERIALS AND METHODS

Apparatus for this study

The apparatus for this study was composed of a personal computer, a 6 DOF (Degrees of Freedom) position sensor, an HMD (Head Mounted Display) and tracker. It could provide a user an immersive virtual environment. The position sensor was composed of a transmitter and receiver. The transmitter worked as an origin creating a surrounding magnetic around it, in order for the receiver to detect its position and orientation from the transmitter by calculating strength of the magnetic field. The receiver attached on the user’s head could detect the user’s head position and orientation so that the

	Schizophrenia	Normal
Age	28.69 ± 7.064	25.1 ± 1.553
Gender	M : 10 / F : 5	M : 9 / F : 6
<u>PANSS</u>		
Negative Syndrome	18.85 ± 3.23	
Positive Syndrome	19.78 ± 4.66	
General Psychopathology	38.21 ± 5.80	

Table 1. Demographic data of participants

computer could render a virtual environment according to the user's head position and orientation.

Virtual Environment and Virtual avatars

Six avatars were designed for this study. They were divided into two categories, by emotion expression (happy, neutral, and angry) and gender (male and female). The arousal and valence level to the avatars' facial expression was matched through a previous study.

Clinical Experiment

Subjects

Fifteen patients with schizophrenia participated in this experiment. They were inpatients in the Severance Mental Hospital at Yonsei University. Fifteen normal control subjects were recruited for this study. The age ($p=.222$) and gender ratio ($p=.891$) of subjects were not significantly different between normal and patient group.

Experimental design

2 (group) \times 2 (avatar's gender) \times 3 (avatar's emotional expressions) mixed AVOVA experimental design was used for this experiment. Each subject experienced all 6 tasks in random order.

VR Task description

The task was composed of "approach," "listening to avatar's introduction," and "introduce oneself to the avatar" scenarios. A subject was instructed to walk up to an avatar until he or she felt comfortable to talk with the avatar. The subject was asked to say "hello" first. In response, the avatar's introduction was played. At the end of avatar's introduction, the avatar asked for subject's introduction. Then, the subject was to introduce him/herself to the avatar according to his feelings towards the avatar at that time.

Experimental Procedure

When a subject entered the experimental room, the subject completed a demographic information sheet and a consent form. Subsequently, s/he was given a brief introduction to the VR devices (HMD and tracker) and s/he was fitted into the equipment and positioned about 2.5 meter from an avatar. After the sub-

ject was positioned, the position sensor was calibrated so that all subjects could see the same direction in virtual environment before the experiment started. Then, a practice task was performed prior to the six main tasks. An avatar expressing "neutral" was provided as a practice session so that the subject could try to approach and look around. After all six main tasks were performed, the subject filled out the social anxiety questionnaire while seeing the same avatar again in order to recall his or her feelings during the task.

Measurements

* Social Anxiety Questionnaire

The social anxiety questionnaire data was acquired. It was initially developed by Spielberger et al.¹⁷ and translated into Korean and validated¹⁸ It is a self-report assessment device that is composed of questions reflecting state anxiety and trait anxiety. According to Spielberger, state anxiety reflects a "transitory emotional state or condition of the human organism that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity." Therefore, state anxiety may fluctuate over time and can vary in intensity. In contrast, trait anxiety denotes "relatively stable individual differences in anxiety proneness." This study

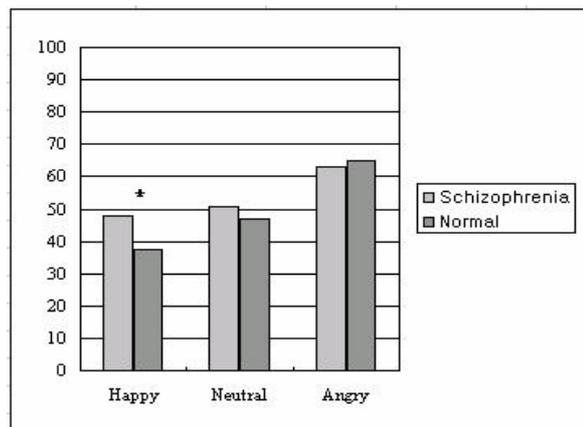


Figure 1. Comparison of social anxiety between patient group and normal group at each avatar's emotional representation. (* represents the significant difference at the 0.05 level)

excluded the measurement regarding the trait anxiety, because state anxiety would better represent social anxiety induced by experiencing of emotional virtual environment which was of interest in this study.

RESULTS

The main effect of the avatar’s emotional expression was observed in both group ($p < .001$), while a main effect towards the avatar’s gender was not observed.

An interaction effect between avatar’s expressing emotion and the subject group was observed ($p = .007$). It means that social anxiety level to avatar’s expressing emotion showed a significantly different pattern between the two groups. In the control group, the level was the lowest when they faced an avatar expressing “happy”, and the highest when they met an avatar expressing “angry”. However, members of the patient group did not show any anxiety level difference between “happy” and “neutral” avatar. In addition, they only showed a significantly higher social anxiety level when they experienced an avatar expressing “angry” compared to other emotional conditions.

In short, normal control subjects felt less social anxiety in happy and neutral condition than patients did (happy: $p = .016$ / neutral: $p = .332$), while normal subjects felt more social anxiety in angry emotion than patients did (angry: $p = .490$).

In order to learn how a patient’s symptom severity affects their social anxiety level, a correlation analysis was performed between PANSS

and their social anxiety level. As a result, the negative syndrome score of PANSS was positively correlated with social anxiety on “happy” and “neutral” avatars (happy: $r = .539$, $p = .038$, neutral: $r = .533$, $p = .041$).

In particular, a significant positive correlation was found between the social anxiety level evoked by “happy” and “neutral” avatars and two subscales (N1: blunted affect, N4: passive/apathetic social withdrawal) of the negative syndrome of PANSS (N1. happy: $r = .549$, $p = .034$ / neutral: $r = .536$, $p = .039$; N4. happy: $r = .536$, $p = .039$ / neutral: $r = .658$, $p = .008$), but there were no correlations with other subscales, such as positive syndrome and general psychopathology score.

DISCUSSION

Schizophrenia is a multi-dimensional disorder and necessitates a comprehensive treatment approach.¹³ Social anxiety symptom are described especially frequently by patients with schizophrenia in their clinical course.¹⁴ Patients tend to avoid social interactions and appear to have little motivation to develop social relationships because social interaction often is very anxiety provoking.⁶ This study explored whether an interaction with virtual avatar can provoke patient’s social anxiety and investigated the relationship between patient’ symptoms severity and social anxiety.

The observed result of a variation of anxiety level to a virtual avatar’s emotional expression shows that an interaction with a virtual avatar can induce social anxiety of patients with schizophrenia. It means that a virtual reality or

	Positive syndrome	Negative syndrome	General Psychopathology
happy	-.020 ($p = .944$)	.539 ($p = .038$)*	.591 ($p = .020$)*
neutral	-.038 ($p = .893$)	.533 ($p = .041$)*	.474 ($p = .074$)
angry	-.323 ($p = .240$)	-.163 ($p = .563$)	.013 ($p = .964$)

Table 2. The correlations between the social anxiety level to avatar’s emotional representation (happy, neutral, angry) and PANSS

() : p-value,

* : correlation is significant at the 0.05 level (2-tailed)

	Social anxiety level		
	happy	neutral	angry
N1. Blunted affect	.549*(p=.034)	.536*(p=.039)	.021(p=.942)
N2. Emotional withdrawal	.305(p=.269)	.194(p=.490)	-.304(p=.271)
N3. Poor rapport	.409(p=.130)	.374(p=.170)	-.335(p=.222)
N4. Passive/apathetic social withdrawal	.670**(p=.006)	.658**(p=.008)	-.054(p=.849)
N5. Difficulty in abstract thinking	.315(p=.253)	.318(p=.249)	-.155(p=.581)
N6. Lack of spontaneity & flow of conversation	.347(p=.206)	-.155(p=.581)	-.166(p=.554)
N7. Stereotyped thinking	.294(p=.287)	.320(p=.245)	.015(p=.958)

Table 3. The correlation between the social anxiety level to avatar's emotional representation and the subscales in negative symptoms of PANSS

() : p-value,

* : correlation is significant at the 0.05 level (2-tailed)

** : correlation is significant at the 0.01 level (2-tailed)

a virtual avatar can evoke social anxiety of patients with schizophrenia so that the characteristics of their social anxiety can be assessed or they can be trained in a socially stressful situation.

The positive correlation between the negative symptom score of PANSS and social anxiety level shows that the more severe negative symptoms a patients has, the higher the social anxiety that they experience. The negative symptoms include characteristics of avolition and anergia, a generalized lack of motivation, energy, and initiative; and anhedonia, an inability to experience pleasure and positive emotions. Therefore, the result can support the fact that the patients with schizophrenia avoid social interaction because the negative symptom mostly appear to reflect a diminution or loss of normal functions and this could amplify the anxiety in a social situation. However, there was no correlation between anxiety and the negative symptom severity in "anger" condition. It can be explained by an assumption that the avatar expressing "anger" evokes an anxiety too intense to be influenced by the negative symptoms.

The positive correlation between subscales of Negative symptom revealed in the further analysis can explain which characteristics in negative symptom influence patient's social

anxiety. The results showed that blunted affect and passive/apathetic social withdrawal characteristics were correlated with the social anxiety. Therefore, patients with schizophrenia may feel anxious in social interactions because of their inability to perceive and respond properly to other's emotions.

CONCLUSION

Through this study, we found out that virtual emotionally expressive avatars can cause social anxiety to patients with schizophrenia and that patient's symptom severity was correlated with social anxiety during coping with avatar. From these results, it could be said that the severer negative symptoms the patient has, the higher social anxiety they feel. This might be due to their passive, apathetic and isolated trait. Therefore, they even tend to recognize socially positive emotion as fearful stimuli. This inference could be supported by the relationship between anxiety and subscales of negative symptom of PANSS. In this sense, we could say that a virtual avatar could provide an opportunity for patients to experience emotion induced social situation. In addition, it could be used for training them to cope effectively by experiencing emotions close to reality as well as to find out the clinical characteristics related to patient's symptoms.

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