

A Real Environment Based Virtual Reality Psychosocial Treatment May Help Patients with Schizophrenia to Increase Social Functioning: A Preliminary Study



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SUMMARY

Objective: VR (Virtual Reality) is a novel treatment method for mental disorders. The aim of the study is to investigate the impact of the VR Psychosocial Treatment Program (PTP) on psychosocial functioning and symptoms in people with schizophrenia.

Method: Seven schizophrenia patients who have been admitted to the Schizophrenia Outpatient Unit of Dokuz Eylül University School of Medicine and met the diagnosis of schizophrenia according to DSM-V diagnostic criteria were included in the study. Psychosocial functionality level was assessed by PSP (Personal and Social Performance Scale), positive and negative symptom severity with PANSS (Positive and Negative Syndrome Scale), and social skills with SSC (Social Skills Checklist). VR-PTP was continued for a total of 10 sessions and twice a week for five weeks. In this study, a real-environment-based VR-PTP for schizophrenia patients was developed. In the sessions, there were different real-environment-based VR contents including social interaction components such as cafe, market, bazaar, public transportation.

Results: There was a statistically significant difference between the PSP scores before and after the VR application ($p=0.018$). None of the patients reported motion sickness during VR sessions due to the immersive nature of VR. There was no significant difference in PANSS total and subscale scores before and after VR-PTP.

Conclusion: In this preliminary study, we discovered that real-environment-based VR-PTP is effective for improving the social skills of patients with schizophrenia. Cognitive enhancement programs and psychosocial functionality therapies may be carried out using virtual reality in the near future. VR can assist patients in coping with their symptoms and day-to-day challenges.

Keywords: Schizophrenia, Psychosocial Functioning, Virtual Reality, Positive Symptoms, Negative Symptoms

INTRODUCTION

Schizophrenia is defined as a “network illness” in which neural networks are disrupted at the biological level in the brain, and social relations and networks are disrupted at the social level (Torous and Keshavan 2016). Psychosocial dysfunctions that cause disruption of social networks are one of the main areas of deterioration in schizophrenia. Social activities,

personal and social relationships and self-care are important components of psychosocial functioning (Suttajit et al. 2015). Studies have shown that structured social skill training programs are effective in enhancing social skills and increasing interpersonal communication in patients with schizophrenia (Kurtz and Mueser 2008). Interventions to prevent/improve psychosocial dysfunctions are possible with social skill training,

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METHODS

Sample

cognitive behavioral therapy (CBT), cognitive remediation programs and social cognitive trainings; pharmacotherapy alone is insufficient to improve the deterioration in this area. Since social skill training is the only intervention strategy which demonstrates that social cognition and psychosocial functioning develop in a consistent, long-term, and systematic manner, establishing programs that are easily accessible to patients is an important priority (Bellack et al. 2004). Social interaction and involvement in social activities are accepted as an improvement criterion in determining the success of treatment (Burns and Patrick 2007).

Existing treatments are insufficient to improve social functionality in patients with schizophrenia, hence new methods are required. With the use of technology-based therapies in psychiatry, virtual reality (VR) has taken a prominent and notable place among the methods that address this need. In a virtual reality setting, the physical environment or scenarios that patients avoid in reality can be reproduced, allowing the patient to experience situations they avoid in a safe environment under the observation of researchers and professionals (Eichenberg and Wolters 2012). Virtual reality is created in digital environment and built on hardware that allows users to see virtual reality in three dimensions immersively, hear virtual sounds, and move virtual objects using specially designed materials for the system such as glasses, gloves, and joysticks. It represents a real place or situation with a combination of real images and sounds. Virtual reality includes three main characteristics: immersion, interaction, and sense of presence (Macedo et al. 2015). While pioneering studies assess impairments in attention, memory, executive function, psychosocial skills in schizophrenia (emotion recognition, social perception, etc.) and whether VR has an effect on schizophrenia symptoms, (Han, Heo et al. 2012, Han, Young Kim et al. 2012, Josman et al. 2009, Kim et al. 2007, Ku et al. 2003, Ku et al. 2006;) subsequent studies show that VR programs developed to increase cognitive skills, social and occupational functionality, to plan drug use, and to reduce auditory hallucinations can be considered as an effective technology-based intervention for schizophrenia (Dellazizzo et al. 2018, du Sert et al. 2018, Fornells-Ambrojo et al. 2008, Freeman et al. 2019, Kurtz et al. 2007, Sohn et al. 2016).

While the current virtual reality practice sessions are based on computer-generated animation-like environments and virtual people (avatars), the sessions in this research were created with the use of devices such as cameras and voice recorders suitable for creating virtual reality content including images of real environment and people. The aim of the study was to determine the effect of real environment-based VR settings on the social functionality of patients.

The volunteers consisted of patients who applied to the Psychosis Outpatient Unit at Dokuz Eylül University Hospital, Department of Psychiatry, and signed the consent form. Inclusion criteria are being diagnosed with schizophrenia according to DSM-5 (American Psychiatric Association 2013) diagnostic criteria and being between the ages of 18-55, getting a maximum score of 80 on the Positive and Negative Syndrome Scale; exclusion criteria were defined as being diagnosed with a serious physical or neurological disorder affecting clinical functionality, having a history of alcohol and substance abuse, and receiving ECT (electroconvulsive therapy) treatment in the last 6 months. Patients who did not meet the inclusion criteria were excluded from the study. The study was approved by the Dokuz Eylül University School of Medicine Non-Interventional Ethics Committee on 03.03.2016 with the approval number 2016/06-05.

Nine schizophrenic patients were included in the study, randomly selected between July and October 2019. Patients with schizophrenia who were being followed up in the psychosis outpatient unit between July and October 2019 and met the inclusion and exclusion criteria, were informed about the study. Patients who agreed to participate in the study were enrolled in the study.

Two out of nine schizophrenia patients stated that they could not continue the VR sessions after a certain time due to personal reasons. Seven patients attended VR sessions semiweekly for 5 weeks. Patients who participated in the study received TRY 20 (Turkish Lira) as travel and meal allowance after each session.

Study Materials

After collecting sociodemographic data before the first session, the clinical symptoms and psychosocial functioning of all participants were assessed at baseline. The second clinical and psychosocial assessment of the participants was performed at the end of the 5th week after 10 sessions were applied.

Sociodemographic Data Form: The sociodemographic data form assessed participants for age, sex, marital status, education level, duration of illness, medications taken, family characteristics, and forensic history.

PANSS (Positive and Negative Syndrome Scale): It is a semi-structured scale aimed at assessing the symptoms and functionality of patients with schizophrenia in the last week. It consists of a total of 30 items and 3 subscales (positive symptoms scale, negative symptoms scale, and general psychopathology scale). Each item is scored by the interviewer between 1 and 7 depending on the severity of symptoms (Kay et al. 1987, Kostakoğlu et al. 1999).

PSP (Personal and Social Performance Scale): PSP is a scale evaluated by the interviewer. It provides a rating in four social and individual domains, namely socially useful activities (including work and study), personal and social relationships, self-care, and disturbing and aggressive behaviors. The PSP is a Likert-type scale that can be categorized into six levels ranging from absent to very severe. The scale was developed by Morosini et al. in 2000, and Turkish validity and reliability study was conducted by Aydemir et al. (2009).

Social Skills Checklist (SSC): It was designed to assess the patient's social skills and social functionality for the last month. There are a total of 12 skill areas that are assessed. The following skill areas are assessed: Looking at the other person while talking, maintaining appropriate social distance, making other people feel comfortable (listening to others, saying positive supportive things), initiating conversations, maintaining conversation, expressing positive feelings to others, being able to resolve conflicts without having arguments, having a social contact with other people, maintaining at least one close relationship (with a friend, family, etc.), speaking up for themselves assertively and politely, asking for help assertively and politely, communicating with members of the treatment team by asking questions and/or expressing concerns. These areas are rated on a Likert scale with levels of never or very rarely, sometimes, often or most of the time, and data not available (Bellack et al. 2004 p.308). There is no existing scoring criterion in this checklist. For this study, it was converted to numeric data by scoring it as 1 for never or very rarely, 2 for sometimes, 3 for often or frequently, and 0 for data not available during its use. An increasing score indicates an improvement in skills. The book was translated into Turkish by Esra Akı et al. (2015).

Social Functioning Assessment Form: It was created for this study to assess patients' daily lives and activities, including going out, interacting with others, frequency of transportation use, self-care skills, and frequency of telephone calls.

Developing Virtual Reality Session Scenes

Session Scenes and the Characteristics of the Study Team: Psychologists, psychiatrists, and neurologists have participated in the creation of virtual reality content. Psychologists who continued their research on schizophrenia during graduate and doctoral education in the neuroscience program contributed to the creation of the scene content. Final approval of the session content was given by professors working in the field of psychiatry and neurology. The content was filmed by members of the Film Design Department of the Faculty of Fine Arts using technical methods mentioned in 2.3.2. Initially, the topics of the session contents were determined, then the scenarios were written, the filming took place, the scenes were watched by the whole team, and the final changes were made in line with the feedback. During the

filming of the session scenes, volunteer theater actors helped the researchers.

Virtual reality content was created using specialized equipment and recording techniques.

Equipment: Virtual reality content was filmed using VR video systems, cameras, and equipment (GP Fusion and Kodak) in 360° high resolution (5.2-4 K). For sound recording, microphones and recording devices (Zoom-Rode-Azden) capable of simultaneously recording VR sounds were used during video recording. Portable, battery-powered lighting systems were used during filming to properly illuminate the environment.

Final Cut - Adobe for VR video and sound editing programs were used as software. Maya, Blender, Cinem 4D and Unity were used as software for 3D animation and game production.

Filming the Scenarios: More than 6000 hours of footage recorded with VR cameras selected according to the content configuration of the scenarios, more than 2500 hours of VR audio recordings and 4K videos were combined in sessions with appropriate software on workstations with high-speed storage and display card. 3D animations and texts were added as needed to make them compatible with the glasses to be used, and their printouts were created.

Many new methods in terms of sound, lighting, camera movements and editing were used in the 360 video shoots and tried out for the first time for the project.

The filming of the virtual reality content, the necessary editing and revisions were completed between January and July 2019.

Implementation and Sessions

A total of 10 sessions were created for the program, which aimed to improve the psychosocial functionality of patients with schizophrenia through virtual reality. After the sessions were prepared with the development of the application and the content for the participants, the virtual reality application was performed on the participants and was completed in the two months between October and November 2019. Participants were enrolled in a total of 10 sessions, which were held twice a week, on Tuesdays and Fridays, for 5 weeks.

In these applications, head-mounted display (HMD) and touch controllers were used in the required scenes to create an immersive effect.

Virtual reality content aimed at improving psychosocial functionality was planned to help participants improve their self-care skills, get out of the house, use public transportation, go out to join a social environment, be in a crowded environment, and interact with vendors (Detailed in Table 1). Virtual environments included physical environments such as a house, bathroom, market, cafe, various public

Table 1. Contents of Virtual Reality-Assisted Psychosocial Skills Development Sessions

| | Targeted Social Skills | Behaviour that is Targeted to Develop |
|-------------|---|--|
| 1. Session | Orientation to virtual environment | Being able to use HMD, visuospatial awareness of virtual environment, |
| 2. Session | Self-care | Being able to wake up in the morning, taking a shower |
| 3. Session | Social Interaction | Standing with everyone at a crowded public transport stop and allowing others to interact with oneself |
| 4. Session | Using public transportation | Being able to travel on the tram with other people / experiencing that it is safe |
| 5. Session | Using public transportation | Being able to travel on the ferry with other people / experiencing that it is safe |
| 6. Session | Using public transportation | Being able to travel on the ferry with other people while listening to pleasant music / experiencing that it is safe and enjoyable |
| 7. Session | Shopping – Social Interaction | Bazaar shopping (being in a crowded environment, staying as long as possible, thinking about what he/she wants-deciding, shopping) |
| 8. Session | Social Interaction – Communication – Expression oneself | Going to a cafe by oneself, ordering, and sitting with other people/strangers |
| 9. Session | Shopping | Having a market shopping experience |
| 10. Session | Social Interaction | Listening to music and engaging in social interaction in a pleasant environment of family and friends |

**Figure 1.** A scene from session 8.**Figure 2.** A scene from session 4.**Figure 3.** A scene from session 9.**Figure 4.** A scene from session 10.

transportations to develop these skills. (Images from sessions are shown on Figure 1, Figure 2, Figure 3 and Figure 4).

At the very beginning, patients were taught how to wear the Head Mounted Display and how to use the touch controller to go forwards and backwards, turn right and left, select one of the options displayed on the screen, purchase a product, or return it. During the orientation sessions, participants were shown a relaxation scene comprised of nature images in order to introduce the virtual reality application and facilitate their adaptation to the application environment. At the end of the session, patients were asked if they were comfortable with the VR experience. It was determined whether the patient experienced motion sickness. Each

session continued for the duration of the session, only the seventh session, in which the bazaar shopping was done, was not time-limited in order to evaluate how long the patient could remain in a crowded environment and to expose the patient to a safe environment which is as crowded as they avoid in their daily lives. The patient was allowed to stay in the virtual environment for as long as she/he wanted.

Patients answered the questions displayed on the screen by using the touch controller in interactive sessions (7th and 8th sessions). For instance, the patient who was shopping at the market, proceeded in the preferred direction and was able to buy a desired product or gave up the product by using the touch controller in the 7th session. In the eighth session,

the patient was asked which drink she/he preferred among the options. In the next step, the patient answered by using the touch controller, the person in the virtual cafe made eye contact and gave the patient the drink she/he had chosen. Patients were involved in the environment only as observers in some sessions. However, players made eye contact with the patient in the virtual environment and involved the patient in the interactive environment by using the immersive effect of the virtual environment.

Statistical Analysis

Data of the study was analyzed with the SPSS 24.0 (IBM Corporation, Armonk, NY, USA) software.

Sociodemographic data of the participants were analyzed by using descriptive statistics. Categorical variables were analyzed with frequency test, and continuous variables were analyzed with descriptive statistics.

The Wilcoxon signed-rank test, a nonparametric test, was used to examine baseline and follow-up scale scores due to the sample size including less than 30 subjects (n=7).

RESULTS

Sociodemographic Data

The study consisted of 5 males and 2 females. According to the inclusion criteria, the ages of the patients in the study ranged from 33 to 52 years old (mean=43±7). The participants' disease onset age ranged between 18 and 42 years old (mean=29.43±8.97). Only one of the patients in the study did not apply to the psychiatry service, whereas other patients had at least one admission to the psychiatry service. Two of the participants were married, four have never married, and one was divorced. Only one of the participants had a family history of schizophrenia.

Table 2. Sociodemographic characteristics of the participants

| | (n=7) | | |
|---|--------------|------|------|
| | | Min. | Max. |
| Gender (M/F) | 5 / 2 | | |
| Age | 43 ± 7 | 33 | 52 |
| Marital status (M/S) | 2 / 5 | | |
| Duration of education (year) | 10.43 / 2.50 | 7 | 13 |
| Age of illness onset | 29.43 ± 9 | 18 | 42 |
| Number of hospitalization | 6 | 0 | 6 |
| Patient number of family history with schizophrenia/Psychosis | 1 | | |

*For gender: M: Male, F: Female; For marital status: M, married; S, Single

Clinical and Social Functioning Findings

The Wilcoxon signed-rank test for PSP scores indicated that the patients' median post-test ranks (Mdn=63) were significantly higher than the median pre-test ranks (Mdn=59) $Z=-2.37$, $p=0.018$, $r=0.63$ (Table 3). Although post-test PANSS subscales and total scores decreased compared to that of the pre-test following the VR intervention, the difference was not statistically significant, $p>0.05$ (Table 3).

The Wilcoxon signed-rank test for SSC scores indicated that the patients' median post-test ranks (Mdn=21) were higher than the median pre-test ranks (Mdn=16). SSC scores were not statistically significant but showed a trend to significance $Z=-1.866$, $p=0.062$ (See Table 3).

The pre- and post-application VR-PTP averages of clinical and psychosocial scale scores are shown in Figure 5. The pre- and post-test PSP scores of each patient are shown in Figure 6.

Table 3. Comparison of Clinical and Social Functioning Findings

| | n=7 | | | |
|-------------|-------------------------------|--------------------------------|--------|-------|
| | Pre-test Median (min. / max.) | Post-test Median (min. / max.) | Z | P |
| PSP | 59 (52/65) | 63 (57/78) | -2.366 | 0.018 |
| PANSS Tot. | 57 (44/76) | 61 (40/76) | -0.848 | 0.396 |
| -PANSS Pos. | 14 (9/23) | 12 (9/22) | -0.604 | 0.546 |
| -PANSS Neg. | 14 (10/18) | 15 (8/18) | -0.412 | 0.680 |
| -PANSS GP. | 29 (24/38) | 30 (22/40) | -0.604 | 0.546 |
| SSC | 16 (10/24) | 21 (18/23) | -1.866 | 0.062 |

Wilcoxon signed-rank test, PSP: Personal and Social Performance Scale; PANSS: Positive and Negative Syndrome Scale; PANSS Tot: PANSS Total Score; PANSS Pos., PANSS Positive Symptoms Subscale; PANSS Neg.: PANSS Negative Symptoms Subscale; PANSS GP: PANSS General Psychopathology subscale, SSC: Social Skills Checklist, $p<0.05$

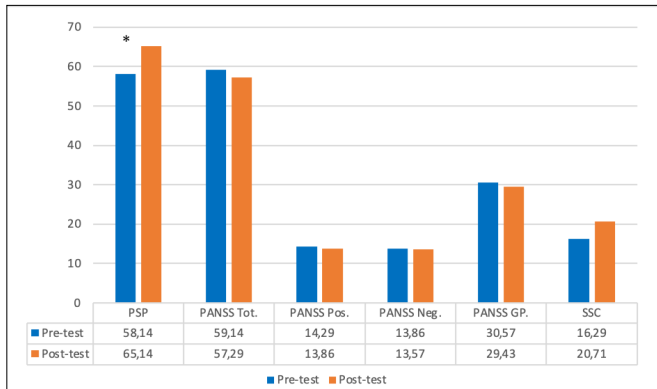


Figure 5. Pre-test and post-test mean scores of clinical and psychosocial findings.

*According to Wilcoxon signed-rank test, there is a statistically significant difference in pre-test and post-test.

Abbreviations: PSP: Personal and Social Performance Scale; PANSS: Positive and Negative Syndrome Scale; PANSS Tot: PANSS Total Score; PANSS Pos., PANSS Positive Symptoms Subscale; PANSS Neg.: PANSS Negative Symptoms Subscale; PANSS GP: PANSS General Psychopathology subscale, SSC: Social Skills Checklist

Evaluation of Daily Life Activities of Schizophrenia Patients

Another goal of the study was to increase daily life activities of the patients and to enable them to develop coping strategies in areas where they were having difficulty.

Primarily, for how long and which purposes the patients go out of the house in a week, the situations that challenge them while interacting with others, transportation vehicles they prefer, challenging aspects of their self-care have been evaluated.

While only one participant stated in the pre-test evaluation that she/he took a daily walk on a regular basis, others stated that they did not take a walk on a regular basis despite going outside. Patients were going out for a variety of reasons, including paying bills, picking up prescribed medicine from pharmacies, getting medical examinations, and acquiring house supplies. Only one patient reported that he never used railway transportation because he found it dangerous, and he also stated that he did not want to use it because he did not know the route. His attitude did not change after the VR intervention. The behaviors of spending time with family and making phone calls increased at the end of the VR intervention, but there was no statistically significant changes. ($p>0.05$).

DISCUSSION

This research was conducted to investigate the safety, feasibility and efficacy of real environment-based VR-PTP application on patients with schizophrenia. A real-environment-based VR-PTP session was applied to improve psychosocial skills of the individuals diagnosed with schizophrenia for over 10 sessions for a total of 5 weeks, semiweekly.

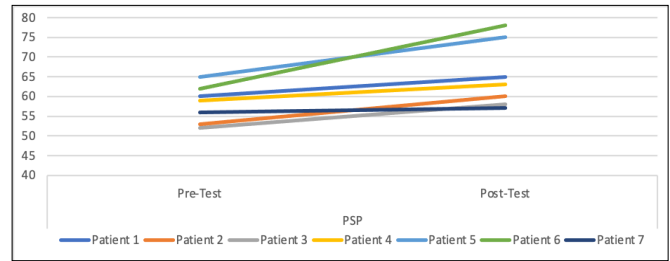


Figure 6. Pre-test and post-test comparison for PSP for each participant. PSP, Personal and Social Performance Scale

When the participants' pre- and post-test psychosocial functionality scale scores were compared, a statistically significant difference was found in the total PSP scores, but no significant difference was found in the PSP scale sub-domains. The level of psychosocial functionality of the patients increased after the VR-PTP. Patients also improved and scored higher after the VR-PTP in areas of SSC such as being able to look at the other person while talking, maintain appropriate social distance, make other people feel comfortable (listening to others, saying positive supportive things), initiating conversations, maintaining the conversation, expressing positive feelings to others, being able to resolve conflicts without arguments, having social contacts with other people, maintaining at least one close relationship (with friend, family, etc.), speaking up for themselves assertively and politely, asking for help assertively and politely, communicating with members of the treatment team by asking questions and/or expressing concerns. It was thought that the regular participation of the patients in the program twice a week for five weeks as well as their contact with the researchers might also have an impact on this result.

This study has the feature of being the first real-environment-based VR study worldwide, and the first VR program designed in Turkey to develop psychosocial skills of schizophrenia patients. In this regard, it has many shortcomings and limitations. The weakness of the study is that the sample size does not represent a large population. This limits the generalizability of the findings. Due to pandemic conditions, the number of patients was limited. If more patients were included, it could have been investigated whether the patients' clinical symptom scores would change. The fact that the real environment-based virtual reality application was used for the first time, the patients were introduced to this method for the first time, and the frequency of sessions was twice a week may have made participation in the study difficult for the volunteer participants. Because the evaluation of daily and weekly activities was based on the patients' retrospective and verbal statements, the clarity of the information received was limited. In future studies, the research team may overcome this limitation by following the patients' weekly activities with a chart. Another significant limitation of the study is the lack of a control group. However, enabling the patient to experience

the VR contents we developed (waiting at the bus stop, tram travel, market shopping, grocery shopping, ferry travel) in real life with a therapist/consultant as part of a routine intervention would have made an objective comparison of the two groups extremely difficult. While the number of samples and the lack of a control group were reported as limitations in some VR studies (Rus-Calafell et al. 2014a, Sohn et al. 2016, Adery et al. 2018), it was not discussed whether they constitute a limitation or not in some other studies (Peyroux and Franck 2016), the cause of which could be a conflict between the nature of VR practice and the difficulties caused by the nature of schizophrenia in patients (negative symptom severity, difficulty waking up in the morning, particularly persecution and reference delusions), such as requiring the patient to come to the application center at regular intervals and waiting in a crowded area when necessary. It may be easier to eliminate this limitation when the effects of virtual reality studies begin to be noticed by the patients. The strength of the research is that for the first time, a real environment-based virtual reality application included content for developing psychosocial skills with schizophrenia patients and was used for the first time both globally and in Turkey. Previous studies aimed at developing psychosocial skills through VR used computer-based animation-like environments rather than real environmental content, and virtual characters representing people rather than real people (Adery et al. 2018, Dyck et al. 2010, Rus-Calafell et al. 2012). Unlike previous studies, patients in this study experienced real transportation environment (bus, ferry, tram), a real marketplace, a real cafe environment, and interaction with real people in VR sessions.

For another study, a VR-based program (SOSKITRAIN) was created to develop social skills with an immersive effect which was applied with a head-mounted display that aims to improve social perception, social information processing, response skills, assertive communication, instrumental role skills, conversational skills. The study included 12 schizophrenia patients and the pre-test and post-test data of the participants were compared (Rus-Calafell et al. 2014a). According to the findings of this study, which consisted of two sessions per week for a total of 16 sessions lasting eight weeks, there was a significant decrease in the patients' avoidance behaviors, social anxiety, and discomfort findings; a significant increase in their social functionality was observed; and the patients maintained their achievements in the 4-month follow-up. A randomized controlled study aimed at improving social skills through role-playing enrolled an immersive VR-based role-playing group, which is the experiment group (n=33), and a traditional role-playing group, which is the control group (n=31), as the two groups to be included in each group sessions out of a total of 10 sessions, namely twice a week for 5 weeks (Park et al. 2011). Both groups showed an increase in general social skills at the end of the study,

with the VR-based role-playing group showing a significant improvement in general assertiveness and conversation skills, as well as significantly higher motivation for participation, and the traditional role-playing group showing a significant increase in nonverbal skills. This study differs from other VR studies in the aspect that it is conducted in groups of 4-5 people, rather than individually in each session, for both VR and traditional role-playing groups. Adery et al. (2018) conducted a preliminary study with 16 schizophrenia patients using a non-immersive 2D-VR program, developing a total of 10 sessions to be applied twice a week with a background sound being added to the market, cafe/food, and bus stop environments after the first five sessions. Only clinical features were evaluated in this study, and a significant decrease in the Negative Symptoms Rating Scale (SANS) and Brief Psychiatric Rating Scale scores was found when status before and after the VR application were compared. A non-immersive VR program aimed at improving social cognitive skill was used on two schizophrenia patients for 90-120 minutes each, for a total of 14 weekly sessions (Peyroux and Franck 2016). Cognitive remediation techniques were used in the study to improve social cognition and social functioning skills, and the pre-test and post-test scores of the scales administered on the patients were compared. Results of the study indicated that theory of mind skills of both patients improved significantly, and their scores on the Ambiguous Intentions Hostility Questionnaire score decreased significantly. Rus-Calafell et al. (2012) included one woman with schizophrenia in their case study of the integrated VR program (SOSKITRAIN), which is aimed at social skills training but does not specify whether it is immersive or not. The program was implemented as a total of 16 sessions for 8 weeks, twice a week. In this study, it was aimed to improve three social skills, which are recognizing facial emotions, social anxiety, and improvement in speech duration, in addition, symptoms and social functionality variables were evaluated. The study's findings revealed a positive change, significant improvement in interpersonal communication, and significant improvement in negative symptoms in the three skill areas that were studied. In addition to these findings, the patient stated that they felt more confident in real life while employing methods they encountered in VR.

Schizophrenia patients who work show a decrease in negative symptoms and an increase in social functioning skills (Erol et al. 2009). Therefore, vocational skills training plays a critical role in improving social functioning. Improvement in occupational skills of schizophrenia patients supports patients to engage in professional and social life. The improvement in the occupational skills of patients with schizophrenia also supports their participation to professional and social life. In this regard, some VR programs were aimed directly at vocational skills training. The non-immersive 3D-VR-based

vocational rehabilitation training program, designed to provide vocational skills to schizophrenia patients, was applied to 9 patients once a week for 8 weeks, in two scenarios in which the patient played the roles of convenience store and supermarket employees (Sohn et al. 2016). Clinical evaluation scales and neuropsychological tests were administered as pre- and post-tests to the patients participating in the study. There was a significant increase in the post test scores for social functionality, visual and verbal memory performance after the VR application compared to the pre-test scores. Tsang et al. (2013) conducted a study aimed at vocational training with a non-immersive 2-dimensional-VR which uses materials such as a computer screen, keyboard, mouse, speakers, and joystick with three groups: VR vocational training group (n=25), therapist-directed group (n=25), and conventional group (n=25). The VR-based vocational training group and the group directed by the therapist carried out a total of 10 sessions with common contents in 5 weeks, gathering twice a week. This VR-based vocational rehabilitation program began with an orientation in the first session and in the following sessions included tasks such as recognizing the clothes in a clothing store, matching the clothes according to their categories, arranging the clothes, answering the questions of a customer, settling disputes and problem solving according to the context of each session. The VR group performed better in cognitive functions, improved problem-solving and categorization skills, and showed an increase in self-efficacy perception in pre-test and post-test comparisons within and between groups. In a randomized controlled study to improve the job interview skills of schizophrenia patients using a computer-based non-immersive VR program, 21 people were included to the VR program and 11 people were included to the control group that received no intervention (Smith et al. 2015). In this study, the patients participating in the VR program experienced approximately 20 acted job interviews with 10 hours of applications in 5 sessions within 5-10 days. A post-test evaluation was performed 10 business days after the last session, and the patients who participated in the VR application demonstrated a significant improvement in their role-playing skills when compared to the control group. Furthermore, at the 6-month follow-up, patients who participated in the VR program were significantly more likely to receive a job offer compared to the controls.

Virtual reality programs are a promising new method to support the improvement of social skills impairment in patients with schizophrenia. There is no study comparing immersive and non-immersive VR applications, hence it is unknown whether there is a difference between these two methods in terms of patient benefit. However, the findings show that both methods significantly contribute to the development of social skills in patients when compared to traditional methods.

According to the studies in the literature, session duration of VR programs developed for improvement range between 5 and 16 weeks. Nevertheless, for the majority of the studies, 10-session programs were used. More research is needed to determine whether the number of sessions and the quality of the sessions in the programs are adequate, and whether or not the desired skills are retained with follow-up studies.

The mean of PANSS scores of the patients decreased, but this decrease was not statistically significant when before and after status of the VR-PTP are compared. Similar to previous studies, no significant difference in PANSS positive symptom subscale scores was observed between pre- and post-VR-program evaluations (Rus-Calafell et al. 2012, Sohn et al. 2016). Another significant finding was that the patients did not report any delusions or hallucinations caused by the virtual reality environment and content. Previous research has found a statistically significant decrease in negative symptoms (Adery et al. 2018, Rus-Calafell et al 2014a), but no statistical difference was found in this study.

Deteriorations in psychosocial skills of patients with schizophrenia are associated with cognitive impairments, negative symptoms and a variety of neurochemical causes. However, these skills can be learned and taught (Bellack et al. 2004).

The findings of our study and previous studies show that virtual reality applications support the improvement of psychosocial functioning in schizophrenia patients (Rus-Calafell et al 2014a), (Rus-Calafell 2014b), (Rus-Calafell et al. 2012, Sohn et al. 2016, Adery et al. 2018). The acquired skills have been shown to be generalizable to the patients' daily functioning (Rus-Calafell et al. 2014a). On the other hand, it can be determined with follow-up studies whether achievements are sustained or not (Adery et al. 2018).

The working principle of virtual reality can be defined as creating a simulation of the body and the space around the body, such as the brain, trying to predict the outcomes of the individual's movements and presenting the scene in the sensory, emotional and motion areas that the person will experience in the real world as perceived by the brain (Riva et al. 2019). Some of the previous works were created using immersive features of virtual reality, but animations and avatars were used in these virtual environments (Bisso et al. 2020), which revealed the importance of investigating the working principle of VR and its impact on real-life experiences of schizophrenia patients. This study differs from previous studies in that it was created by transferring real-world spaces to the virtual environment after filming with a 360-degree camera and is immersive in the virtual environment. The use of real-life footage may have had a very positive impact on experiences of the patients. No motion sickness was observed in the patients participating in this study. Patients in this

study, like those in previous VR studies, expressed a high level of willingness to participate in VR sessions (Park et al. 2011) and shared their own life experiences. Virtual reality applications simulating real-world social environments help patients with schizophrenia develop reactions and emotions in their minds similar to those they would experience in these environments (Fornells-Ambrojo et al. 2008, Freeman 2008, Freeman et al. 2016). It was observed that reactions of patients to real life experiences and VR experiences were similar (Veling et al. 2014).

This study showed that VR practice with footages from real-life is suitable to support the improvement of psychosocial skills and daily activities of schizophrenic patients. Also, it may be argued that it allows patients to experience the real world without actually being there and encourages them to “really” be there. In the near future, cognitive improvement programs and psychosocial functioning treatments may be provided through VR and help patients cope with their symptoms and day-to-day challenges.

Although schizophrenia patients recognize the emotions in the facial expressions of virtual characters at a similar level to the emotions in the facial expressions of actual characters (Dyck et al. 2010), they may have difficulties in adapting their experiences in environments created with virtual animations to the real world. In this regard, it is critical to investigate the characteristics of social perceptions of patients concerning VR applications created with real-life characters. Thus, it is possible to benefit from the advantages of VR applications that target diagnostic and therapeutic interventions as a reliable and ecologically valid technique (Dyck et al. 2010, Jongeneel et al. 2018), through content created using real environment and real people. Furthermore, the technical infrastructure and application criteria of virtual reality applications provide standard environmental conditions in the virtual environment for each patient participating in the program, and the setting to which the patient is exposed in the virtual environment can be recreated identically for another patient or at a different time (Jongeneel et al. 2018). It is promising that VR systems can be used in further research by integrating physiological and behavioral changes such as kinesthetic movements, heart rhythm, eye movements, and brain activations such as EEG (electroencephalogram), fMRI (functional magnetic resonance imaging) (Veling et al. 2014).

The major limitation of the study is the limited sample size. In future studies, it may be possible to evaluate how and in what other dimensions virtual reality applications affect the psychosocial functioning of schizophrenia patients by including a larger sample, creating experiment and control groups, creating sessions for different sub-fields that support the increase of psychosocial functionality, making all sessions interactive, assigning tasks with definite/indefinite duration to the patients in the sessions, and examining different parameters.

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