State-of-the-art

Virtual Reality Technology Treatment for Mental Illness

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Abstract

Virtual reality has already revolutionized the gaming industry allowing players to immerse themselves in incredible new worlds built with a dazzling attention to detail, but the technology is now being adapted to become a rather unlikely tool. Scientists across the globe have been experimenting with VR to provide therapy for some serious mental health issues and thanks to years of intricate research. Many issues are now being addressed in groundbreaking ways. Research papers based on virtual reality as a treatment for mental health issues, including the current scenario of the mental illness's treatment. In other words, mental illness can be classified under many headings, such as anxiety disorders, eating disorders, serious mental issue like schizophrenia. This paper focuses on a state-of-the-art of the literature on virtual reality technology treatment for mental illness and what is the future about it. Along with this it introduces their merits and limitations under different mental health problems. Focusing on the technology rather than regular medications given to the psychosis patients. This paper is a through a general overview of the possible treatments using the emerged technology with a brief discussion of some possible applications.

Keywords— Exposure Therapy, Virtual Reality, Embodied VR, Cognitive Behavioral Therapy, Cognitive Enhancement Therapy, Mirror Therapy, Psychodynamic Therapy, Ruber Hand Illusion.

Introduction

Mental health is just an important as physical health. It is not only about mental illness or mental disorders this is just one part of a bigger picture. The best way to think about mental health as being on a continuum

rather than people being either mentally ill or mentally well. People are all on the continuum and they move up and down according to factors such as genetic makeup and upbringing our life circumstances and the stresses people are under. But one end of the continuum they have mental disorders like depression or anxiety and at the other end they have states of positive mental health when people are thriving the contempt and fulfilled. The aim of mental health interventions is to move people up the continuum so that they are able to reach their full potential and live satisfying lives [1]. The world health organization describes mental health as a state of well being in which every individual realizes his or her own potential can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to his or her community.

Being mentally healthy means being resilient and able to cope with difficult times, feeling in control, being confident, felling good about yourself, managing and expressing your emotions, building and maintain good relationships. People experience periods when they feel stressed, worried, anxious, sad, afraid, or angry. These are all normal emotions. However, when these emotions become severe enough that it interfaces with the person's ability to function daily and these feelings become persistent over time, then it can develop into a mental health problem. There are many types of mental disorders; when left untreated, mental disorders can be chronic and long-lasting and are associated with increased disability. They significantly have an impact on daily functioning and frequently interfere with family, social and work responsibilities.

Fortunately, there are effective treatments and evidence-based interventions available. The aim to have individuals understand and cope with symptoms of mental illness. However very few people with mental disorders access existing treatment services. This may be due to barriers such as the stigma attached to seeking, the lack of understanding of mental health problems, uncertainty of how to get help or the fear of disclosing mental health problems.

Research shows [71] that stigma remains one of the biggest factors preventing people from seeking help early for their mental health problems and getting the appropriate support they need. It is important to acknowledge that all have mental health and have a personal responsibility to learn how it can be improved and maintain our well-being in order to live meaningful and satisfying lives. VR is used an alternative to traditional exposure methods such as going out into the real world to face the fears where people are imaging the situations or the things that they fear. VR has many benefits over these traditional methods. For instance, using VR is much easier than imaging feared situations. It is a practical and efficient alternative to going out in the real world. VR increases privacy because exposure occurs right here in the therapist's office and finally the patient and the therapists have more control over the fear stimuli. Specially, Exposure environments can be personally tailored to suit patients need and patient can start with the parts that are easier for him and gradually work in their own way to the scariest elements.

1 Anxiety Disorder

One of the best treatments for anxiety is exposure therapy which entails gradually facing your fears until anyone realizes that the negative consequences that they expect not to occur, and the anxiety diminishes [1]. Virtual reality exposure therapy (VRET) is a promising intervention for the treatment of anxiety disorders. Virtual reality or VR is an application that allows users to interact with a 3d computer-generated environment where they can gradually experience stimuli related to their fears. For example, people who are afraid of flying will experience exposure to the elements associated with flying such as taxing, takeoff, flying and landing. Along with this, the therapist can manipulate the weather conditions like calm or stormy and the time of day like flying at night. Users wear a head mounted display or a helmet that contains a screen that shows a virtual environment. It also has earphones that provide audio feedback and emotion tracking technology that allows users to move around the environment. Between 74% and 94% of patients who receive virtual reality exposure therapy report significant improvement. Anxiety disorders are among the most common and disabling disorder among Americans, with 18% of adults suffering from one each year [2]. With the classical evidence-based treatments, in anxiety disorders Cognitive-behavioral therapy (CBT), specifically exposure therapy, has garnered a great deal of empirical support in the literature for the treatment of anxiety disorders [3]. Exposure therapy typically involves the patient repeatedly confronting the feared stimulus in a graded manner, either in imagination or in vivo. Using VR to treat FOPS (fear of public speaking) is a greater challenge, as it must elicit an interpersonal fear. Two case studies utilizing VR for FOPS treatment showed clinical improvement [12]. The possible treatments of anxiety disorders are discussed below with the currently available methods of treatment.

1.1 Psychotherapy

Psychotherapy can be a hugely effective choice to alleviate psychological pain and emotional suffering. There are many approaches within psychotherapy, but these are a few key ideas that psychotherapists might work with. Some researchers have estimated that there is anywhere between 400 and 500 different types of psychotherapy which is certainly an astounding number now. With the help of psychotherapist, crucial ideas and feelings form our unconscious can be made conscious through exposure, interpretation and contextualization. Most of these do fall into one of four broad types of psychotherapy.

1.1.1 Cognitive Behavioral Therapy

The first broad category is cognitive and behavioral therapies that came out of the work of Pavlov and Thorndike and of course Aaron Beck and many others. These therapies focus on learning good, new or more adequate behaviors and strategies. They focus on getting rid of inappropriate or bad or inadequate strategies and they focus on how people think, on our cognitive processes which is why people call them

cognitive therapies. Now most of all this is based on the idea that faulty thinking or cognitive disorders can cause, and they can maintain as well either anxiety disorders or mood disorders.

1.1.2 Psychodynamic Therapy

The second broad psychotherapy includes psychodynamic therapies which also aim to change behavior and thoughts and emotions. But this time they focus on motives and unconscious drives that may be behind these thoughts' behaviors or emotions. For example, when seeing cartoon depicting psychotherapy that involves a patient lying on a couch and the therapist sitting behind him taking notes well that image represents one type of psychodynamic therapy. They said it is not the only one, today most psychodynamic therapies are done face-to-face, many of them are very brief and very effective.

1.1.3 Humanistic Psychotherapy

Humanistic therapies focus on ability to make choices and to develop their potential. Humanistic therapies like all the others essentially come in different shapes and sizes but the most popular ones are certainly called Gestalt therapy and client centered therapy and also existential therapy.

1.1.4 Systemic Psychotherapy

The fourth and last broad type of therapy includes so-called systemic therapies that focus not only on the individual as do the others but also focus on the individual's interpersonal system. So how they relate to other people in their life, how they build and maintain interpersonal relationship and so on.

While there are four broad types of psychotherapies, many clinicians draw on more than one and they develop treatments that known as integrative and they do that in order to make sure they can meet anyone's specific needs. Virtual reality (VR) has recently emerged as a potentially effective way to provide general and specialty health care services and appears poised to enter mainstream psychotherapy delivery. Because VR could be part of the future of clinical psychology, it is critical to all psychotherapists that it be defined broadly. To ensure appropriate development of VR applications, clinicians must have a clear understanding of the opportunities and challenges it will provide in professional practice [4]. Recently, a panel of 62 psychotherapy experts using Delphi methodology tried to answer these questions.1 According to their answers, only 18 out of the 38 therapeutic interventions analyzed were predicted to increase in the next decade [5].Research in the VR field is moving fast. [5]. Checking the leading psychology database—PSYCINFO—using "virtual reality" as key words, Giuseppe Riva found 996 journal articles listed (quick search query, accessed April 18, 2005).

1.2 Medications

Self-medication is a common behavior among individuals with anxiety disorders, yet few studies have examined the correlates of this behavior. The current study addresses this issue by exploring the pattern of mental health service use and quality of life among people who self-medicate for anxiety. Data came from the National Epidemiologic Survey on Alcohol and Related Conditions and was limited to the sub sample of individuals meeting criteria for an anxiety disorder in the past 12 months (n 4880). Multiple regression analyses compared 3 groups– (1) no self-medication, (2) self-medication with alcohol, and (3) self-medication with drugs, on mental health service use and quality of life. After adjusting for potentially confounding covariates, individuals who engaged in self-medication had significantly higher service use compared with people with anxiety disorders who did not self-medicate (adjusted odds ratio 1.41, 95% CI 1.06– 1.89). Self-medication was also associated with a lower mental health-related quality of life compared with those who did not self-medicate. Clinicians should recognize and respond to the unique needs of this subpopulation of individuals with anxiety disorders [7].

1.3 Complementary health approaches

Complementary health approaches include stress and relaxation techniques, where stress is the physical aspect of anxiety, the fear emotion. Generalized anxiety disorder (GAD) is a common anxiety disorder characterized by 6 months of "excessive anxiety and worry" about a variety of events and situations. Anxiety and worry are often accompanied by additional symptoms like restlessness, being easily fatigued, difficulty concentrating, irritability, muscle tension and disturbed sleep. GAD is usually treated with medications and/or psychotherapy. Stress is how anxiety shows up in our bodies. It comes with things link an increased heart rate, shallow breathing, muscle tension, stomach problems and headaches. For example, if anyone feeling stressed out about feeling stressed out that is the paradox of emotions. The more it is forced to go away, the stronger they become. As anxiety is much more common and right now one in 14 people around the world have an anxiety disorder and each year costs over 42 billion dollars to treat this mental health problem.

Anxiety can lead to depression, school dropout, suicide. It makes it harder to focus and to hold down a job, and it can lead to relationship breakdown. But lot of people do not know this, that is why, a lot of times, people sweep anxiety under the rug as just nerves that it need to get over, as a weakness. But anxiety is so much more than that. Tweaking the way people with anxiety disorders are coping, then he can lower his anxiety. University of Cambridge showed that women living in poor areas have a higher risk for anxiety than women living in richer areas. Other study shows that the people who had faced extreme circumstances, faced adversity, been through wars and natural disasters they remained healthy and free of mental disorders. While others, facing the same hardships but without coping skills went on a downward spiral and developed mental disorders. There are three coping resources to lower the anxiety. The first one

is feeling like controlling own life. People who feel like they are more in control of their life have better mental health. The second coping strategy is forgiveness to their own. People with the anxiety think a lot about what they are doing wrong, their worries, and how bad they are feeling. People with anxiety do this to themselves all day long and they are not kind to themselves. If they start trying kind, supportive and forgive themselves, this disorder may be cured. Lastly, having a purpose and meaning in life is a very important coping mechanism. The famous neurologist DR. Victor Frankel said, "For people who think there's nothing to live for and nothing more to expect from life, the question is getting people to realize that life is still expecting something from them". People do not have money for therapy, and they are usually the ones with highest rates of anxiety disorders. Another way it can be done something with someone else in mind is finishing work that might benefit future generations.

2 Eating disorder

Virtual Reality (VR) is a beneficial tool for the treatment Eating Behavior Disorders (EBD), especially Bulimia Nervosa (BN), Anorexia Nervosa (AN) and Binge Eating Disorder (BED). Studies suggest that 1 in 20 people will be affected at some point in their lives. Eating disorders can take over a person's life and lead to serious problems. Potentially fatal medical complications. The actual situation is pushing obesity and eating disorder researchers to begin a collaboration. In particular, their common effort is focused on the identification of risk factors that are shared between these disturbances: apparently, stress and unhealthful weight-control behaviors—such as fasting (going without eating for 24 hours for weight control), vomiting, or laxative abuse—are the common antecedents of both obesity and eating disorders. More, an open challenge is the quest for improving the effectiveness of the available evidence-based interventions.This Special Issue will focus on the two leading virtual technologies—augmented reality (AR) and virtual reality (VR)—exploring their clinical potential for EWDs. As suggested by many studies, these technologies may have a big impact on clinical practice. There are three primary feeding and eating disorders, including medication. Binge Eating Disorder (BED) is a large amount of food in a short time. The most effective and best studied treatments are discussed below:

2.1 Cognitive Behavioral Therapy (CBT)

Cognitive-behavioral therapy (CBT) is effective for treatment of social phobia, with good long-term follow-up. Common barriers to treatment include uncertainty over where to go and fear of what others might think [9], so alternative treatments may improve treatment utilization among social phobic. Virtual reality (VR) technology may offer an alternative for exposure therapy for FOPS. Two controlled studies support the use of VR in treating specific phobias (heights and flying) with good long-term follow-up [10][11]. CBT is often successfully used in the treatment of eating disorders because it helps people understand relationship

between their thoughts like feelings and behaviors. CBT that is developed for the treatment of bulimia is very effective at changing the binge-purge behaviors and eating attitudes. Considering the available evidence, the use of VR in the assessment of those conditions showed some promise in identifying: (1) how those patients experienced their body image; and (2) environments or specific kind of foods that may trigger binge–purging cycle. VR-based environments associated to cognitive behavioral techniques showed their potential utility in improving motivation for change, self-esteem, body image disturbances and in reducing binge eating and purging behavior.

2.2 Wellness and Nutrition Counselling

It involves professionals helping a patient return to a normal weight. Dietitians and other health care providers can help change old habits and beliefs about food, dieting and exercise with healthy nutrition and eating information and planning. Sometimes planning and monitoring responsibilities are shared with mental health professionals or family members [13]. In undertaking a nutrition assessment of someone who might have an eating disorder, it is really important to follow the main principals that a dietitian would with any nutrition assessment. It can be starting off with considering the person's age and who lives with them at home and what their living situations is like, thinking through if they have any medical history that is relevant, social history, work situation, life and surroundings. Then moving through to looking at their weight history like the highest and lowest weight that they have ever weighted. Usually, a patient is suffering from eating disorder, have got a lot of anxiety around food and they have lost touch with how to eat properly, they are often not able to listen to their hunger and fullness cues. They struggle to eat foods that they previously enjoyed. So, the dietitian's role is really around trying to help that person to learn to eat well to nourish their mind and body again. But on the top of that they had any nutritional comorbidities that might be going on or comorbidities that have impacts on their nutrition, it can impact on their physical and mental wellbeing, such as if they had something like coeliac disease or diabetics that might impact on their eating and the dietitian is in a great position to be able to bring all of those things into play when discussing food with the patient. Also other markers that would be important like the biochemical markers and perhaps medical markers that they have got from their GP. When a person is malnourished, it is important for them to gain weight so that their body can repair the cells that have been damaged during the malnutrition period. During the malnutrition, the brain is severely starved, bone health is affected, organs are even starting to break down. During weight gain those cells can be re-nourished again and repair can occur.

Virtual reality has moved from science fiction to marketable consumer product astonishingly quickly. Because the incorporation of the smartphone into the technology makes it accessible. It's looking more like those who bet that virtual reality is here to stay, and not a flash-in-the-pan trend, made the smart bet. Virtual reality is showing promise in treating pain, phobias, post-traumatic stress disorder, smoking cessation, and even at the dentist's office. A few years ago, the Microsoft Kinect and similar 3D motion tracking cameras were set to revolutionize physical therapy. By tracking and gamifying movement, the Kinect could be used

to send patients home with exercises, motivate them to do those exercises, and collect hard data on things like range of motion. Virtual reality enhances that capability even further. VRPhysio is a Boston-based company that offers immersive, interactive virtual reality environments that trick patients into doing physical therapy exercises without even knowing it.

3 Schizophrenia

Schizophrenia is a stress-related, neurobiological disorder characterized by disturbances in the form and content of an individual's thought and perceptual processes, affect, social, and instrumental role behavior. The pervasive impact of schizophrenia across perceptual, cognitive, emotional, and behavioral domains, as well as the heterogeneity within those domains requires a multimodal and comprehensive approach to treatment and rehabilitation which involves the individual and his or her environment [14]. Therapy is essential in treating psychosis. Common therapies include the following:

3.1 Cognitive Behavioral Therapy (CBT)

Cognitive-behavioral therapy (CBT) has a proven role as an adjunct to antipsychotic medication and remediate approaches such as social skills training in the management of residual symptoms of chronic schizophrenia [15]. Healthcare teams who are trained in the Personal Therapy described by Hogarty etal [16] would also find the implementation of CBT relatively straightforward, since the concept of individual psychological treatment is already accepted and practiced by such teams. Positive symptoms, depression, and overall symptoms appear to be viable treatment targets for CBT with a less pronounced effect on negative symptoms. CBT can be used safely in patients with schizophrenia, and caregivers can help with homework exercises. It teaches people to observe and change ineffective patterns of thinking. For psychosis, CBT teaches someone to critically evaluate an experience to determine whether or not the experience is real. (Reappraisal). CBT usually ends with the development of a clear understanding of the individualized relapse signature and action plan. To maintain benefits over the long term, booster sessions are likely to be needed [17]. A full description of the techniques involved is beyond the scope of this review, but a flow chart of the various stages of therapy and basic techniques is provided in Figure. 1.

Implementation of CBT:

An excellent base exists for implementing individual CBT for patients with schizophrenia in treatment settings where clinicians are already working with high quality psychoeducational materials to improve adherence [16]. Once the concept of using CBT for patients with schizophrenia is accepted, the question remains as to just how much training is needed. A basic understanding of CBT and practice in its use with nonpsychotic patients are necessary. Increasingly, CBT courses run psychosis modules and a variety of training schemes of variable length are possible. Delivery of CBT to patients with schizophrenia does depend on

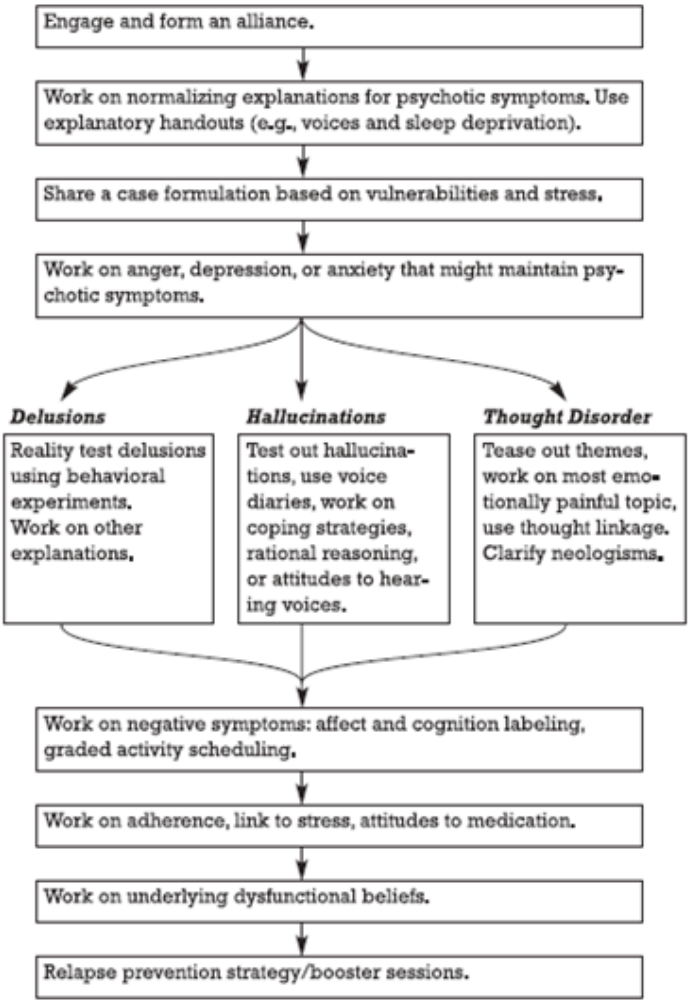

Figure 1: *Process of CBT Therapy for Schizophrenia [15]*

the availability of local supervision and an ongoing commitment from health service managers to support and facilitate training and supervision. The realization that patients can be helped to work directly with psychotic symptoms is encouraging to patients, caregivers, and case managers. The evidence base supports increasing attempts at implementation.

3.2 Supportive psychotherapy (Distress tolerance)

Distress tolerance is an important but under studied construct for those with schizophrenia spectrum disorders [18]. People who have low distress tolerance may experience distress as unbearable and/or have the belief that they are unable to cope with being upset or distressed. Research suggests that people with schizophrenia have reduced distress tolerance as compared to healthy control samples [19]. Greater distress intolerance was associated with reduced functional capacity and worse cognitive performance in schizophre-

nia [20].

Kelsey A. Bonfils Paul H. Lysaker [18] compared levels of distress tolerance between people diagnosed with schizophrenia and borderline personality disorder (BPD) to better characterize distress tolerance in schizophrenia spectrum disorders. Results indicate that, in their data, distress tolerance did not differ between those with schizophrenia and those with BPD and was in fact statistically equivalent between groups. In contrast, those with BPD tended to report more difficulty on some aspects of emotion regulation. Supportive psychotherapy teaches a person to cope with developing and living with psychosis. The therapist attempts to reinforce a person's healthy ways of thinking and reduce internal conflict.

3.3 Cognitive enhancement therapy (CET)

Cognitive Enhancement Therapy (CET) is a developmental approach to the rehabilitation of schizophrenia patients that attempts to facilitate an abstracting and "gistful" social cognition as a compensatory alternative to the more demanding and controlled cognitive strategies that often characterize schizophrenia as well as much of its treatment [21]. This therapy is a multidimensional, developmental approach that integrates computer-assisted training in neurocognition with social cognitive group exercises. Enriched supportive therapy fosters illness management through applied coping strategies and education. It builds brain capacity using computer exercises and group work. Increasing cognitive functions, such as the ability to organize thoughts, is the goal (executive functioning).

3.3.1 Method

To determine the differential effects of cognitive enhancement therapy (a recovery-phase intervention) on cognition and behavior compared with state-of- the-art enriched supportive therapy, a 2-year, randomized controlled trial was designed with neuropsychological and behavioral assessments which was completed at baseline between 12 and 24 months. The setting of this method was set on an outpatient research clinic housed in a medical center's comprehensive care service for patients with severe mental illness. There was a total of 121 symptomatically stable, non– substance-abusing but cognitively disabled and chronically ill patients with schizophrenia or schizoaffective disorder. Partially correlated behavioral assessments of social cognition, cognitive style, symptoms, and adjustment were selected (or developed) before the study that reflected the observations of clinicians, patients, and family members. Cognitive enhancement therapy is a small-group approach that combines approximately 75 hours of progressive software training exercises in attention, memory, and problem solving with 1.5 hours per week of social cognitive group exercises (approximately 56 sessions). A group (6 patients) began to meet 4 to 6 months after the initiation of attention training [22].

3.3.2 Result

As expected, no differences were observed on the residual Symptoms composite. Effects were unrelated to the type of antipsychotic medication received. Enriched supportive therapy also demonstrated statistically significant within-group effect sizes, suggesting that supportive psychotherapy can also have positive, although more modest, effects on cognitive deficits [22]. Many cognitive deficits and related behaviors of patients with stable schizophrenia are improved when sufficient exposure to relevant rehabilitation is provided.

3.4 Mirror therapy

Mirror therapy is a low-cost invention that uses vision to treat the pain that people with amputated limbs sometimes feel in their missing limbs. Mirror therapy does this by tricking the brain: it gives the illusion that the missing limb is moving, as the person looks at the real, remaining limb in a mirror [23].

Stroke is a leading cause of acquired disability in the United States. According to the American Stroke Association, nearly 800,000 new cases are reported each year,[24] with approximately 80% of survivors experiencing motor impairment [25]. Motor impairments of the upper limb are particularly common and enduring. [26][27] Approximately 50% of individuals who experience upper limb paralysis after stroke continue to face functional deficits 4 years after injury [28]. Lynne M. Weber, MA, OTR/L designed to examine the feasibility of immersive virtual reality mirror therapy for upper limb paresis after stroke using a head-mounted display and provide preliminary evidence of efficacy [29].

3.4.1 Experimental Procedure

According to Lynne M. Weber, MA, OTR/L [29], they examined ten outpatients with chronic stroke, upper limb hemiparesis, and a low predisposition for motion sickness completed a 12-session program of 30 mins each of immersive virtual reality mirror therapy. The virtual reality system provided the illusion of movement in the hemiparetic upper limb while suppressing the visual representation of the non-paretic side. Feasibility was assessed via patient compliance, adverse event tracking, the System Usability Scale, and the Simulator Sickness Questionnaire. Preliminary efficacy was evaluated using the Fugl-Meyer Upper Extremity and Action Research Arm Test. Patients were positioned in an armless chair in the center of a private treatment room, with adequate space for safe movement. Treatment sessions were supervised by an occupational therapist or a trained assistant. Patients engaged in treatment by embodying a first-person view of a virtual avatar, represented by a man or woman wearing a short-sleeved shirt (Figure. 2). Virtual parameters were set to best match the patient's physical characteristics including sex, height, weight, and skin tone. One patient with extensive tattoos on his upper limbs used a custom avatar wearing a tight-fitting

Figure 2: *Comparison of conventional mirror box therapy with immersive VR mirror therapy. Note suppression of the non paretic upper limb within the enriched virtual environment. [29]*

long-sleeved shirt to ensure his physical form within the system provided a realistic representation of his upper limbs. Processes are given below:

Figure 3: *Screenshot of shoulder flexion exercise guided by avatar therapist, as seen through VR headset. [29]*

Segment I: Exercise (5 mins) In this treatment block, patients completed a basic range of motion exercises demonstrated and described by a human avatar. Exercises included shoulder flexion/extension, abduction/adduction, elbow flexion/extension, forearm pronation/supination, wrist flexion/extension, grasp/release, and composite motions such as punching. Patients completed each exercise for ten repetitions before moving onto the next exercise (Figure. 3).

Segment II: Rock Stacking (5 mins) In this treatment block, patients were asked to pick up rocks of vari-

ous shapes and sizes positioned on a virtual tabletop. Patients were asked to stack as many rocks as possible without knocking any over (Figure. 4).

Segment III: Functional Task (5 mins) In this treatment block, patients engaged in various functional tasks in the context of a dining room. Subjects were asked to stack plates, set up a tea set, right upturned objects such as a wine bottle or goblet, move fruit from one plate to another, and unset and reset a table. Patients completed tasks in the same sequence each time, moving onto the next after successfully demonstrating the previous task.

Figure 4: *Screenshot of rock stacking activity, as seen through VR headset. [29]*

3.4.2 Results

The results of this pilot study suggest that immersive VR mirror therapy is feasible for patients with chronic stroke with respect to safety, adherence, and tolerance. Immersive virtual reality mirror therapy for patients with chronic stroke was safe, well-tolerated, and without adverse events, such as simulator sickness. Motor outcomes revealed a small improvement for the Meyer Upper Extremity from 21.7 (SD = 8.68) to 22.8 (SD = 9.19) that did not achieve statistical significance (P = 0.084).

3.5 Rubber Hand Illusion (RBH)

In the Rubber Hand Illusion, the feeling of ownership of a rubber hand displaced from a participant's real occluded hand is evoked by synchronously stroking both hands with paint brushes [30]. According to Bleuler [31], schizophrenia is the splitting of mental functions.Such "splitting" is probably correlated with disturbances of neural brain organizations, for example, disconnection syndromes [32] and other deregulations

[33] of the neural networks spread in the brain. Schizophrenia patients had significant alterations in long latency evoked responses during the illusion. Somatosensory evoked responses of the illusion were compared between schizophrenia patients and normal control subjects. These findings support the hypothesis of alterations in associative higher-level neuronal activity in schizophrenia. The findings support previous results pointing to alterations in associative brain regions in schizophrenia [34].

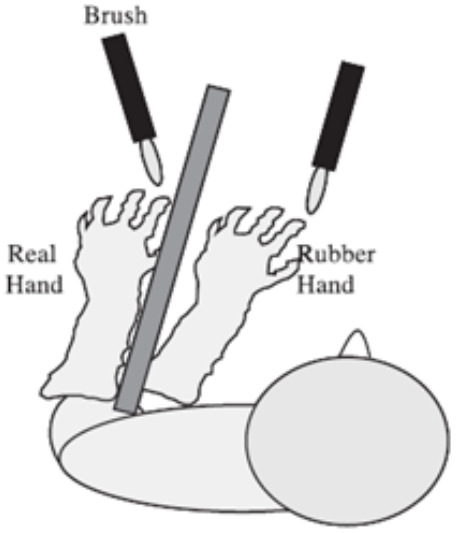

Figure 5: *Experimental setting involved subjects seated with their left arm resting upon a small table. A standing screen was positioned beside the arm to hide it from the subject's view and a life-sized rubber model of a left hand and arm was placed on the table directly in front of the subject. The subject sat with eyes fixed on the artificial hand while two small paint brushes were used to stroke (synchronous brushing) the rubber hand and the subject's hidden hand.[34]*

3.5.1 Experimental Procedures

Avi Peleda, Assaf Pressman [35] experimented a total of 38 right-handed adult subjects participated in the study (19 schizophrenia inpatients and 19 healthy controls). Subjects with a history of neurologic disorders or drug abuse were excluded. Procedures of the experiment were like those of Botvinick and Cohen [35] (Figure. 5). Subjects were instructed to indicate verbally if any change in sensation occurred during the procedure. To exclude suggestibility, they were not offered any leading instructions that could refer to the illusion. Typically, the onset of the illusion was signaled by the verbal reaction of astonishment that was time recorded and documented (since verbal report of transition from pre-illusion to illusion conditions was not reliable enough for the signal analysis, the EEG pre-illusion periods were separated from the illusion periods with the help of a clustering technique, Figure. 6).

After 15 min, subjects completed a two-part questionnaire that included an open–ended description

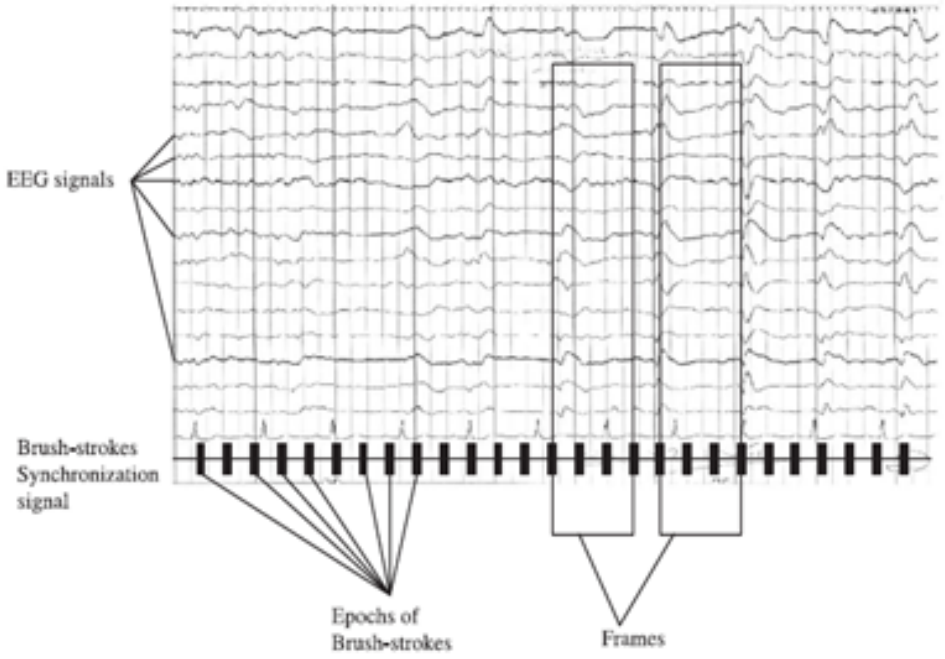

Figure 6: *EEG recording and synchronization. The stroke of the subject's finger triggered a synchronization pulse, which served as the reference for the sensory evoke potential (SEP) epochs. For each subject, SEP's were arranged into frames including a number of SEP's epochs each.[34]*

of their experiences and asked subjects to affirm or deny the occurrence of three specific perceptual effects [34]. The three perceptual effects that were found significantly altered by schizophrenia patients in their previous study were the following: (1) It seemed as if patient was feeling the touch of the paintbrush in the location where he saw the rubber hand touched. (2) It seemed as though the touch he felt was caused by the paintbrush touching the rubber hand. (3) The rubber hand began to resemble my own (real) hand in terms of shape, skin tone, freckles or some other visual feature. Thus, in this study, Avi Peleda, Assaf Pressman [35] concentrated on these three perceptual effects.

3.5.2 Results

The data included 37 subjects (19 controls and 18 schizophrenia patients, 1 subject from the schizophrenia group had to be excluded as an outlier). For each subject, there were 1152 records corresponding to 11 electrodes, 5 time points and 2 states (pre-illusion and illusion). As a preliminary step, before the statistical analysis, Avi Peleda, Assaf Pressman [35] formed an 115 matrix of SEP differences (illusion pre-illusion) for each subject. There were thus 55 correlated records, and the records between subjects are independent. Figure. 7(a,b) illustrate square signs mark the electrode scalp locations where statistically significant differences between pre-illusion and illusion SEPs were found. For the control group (Figure. 7a) at C3 scalp location, during both 80 and 100 ms time point, the difference was significantly positive indicating

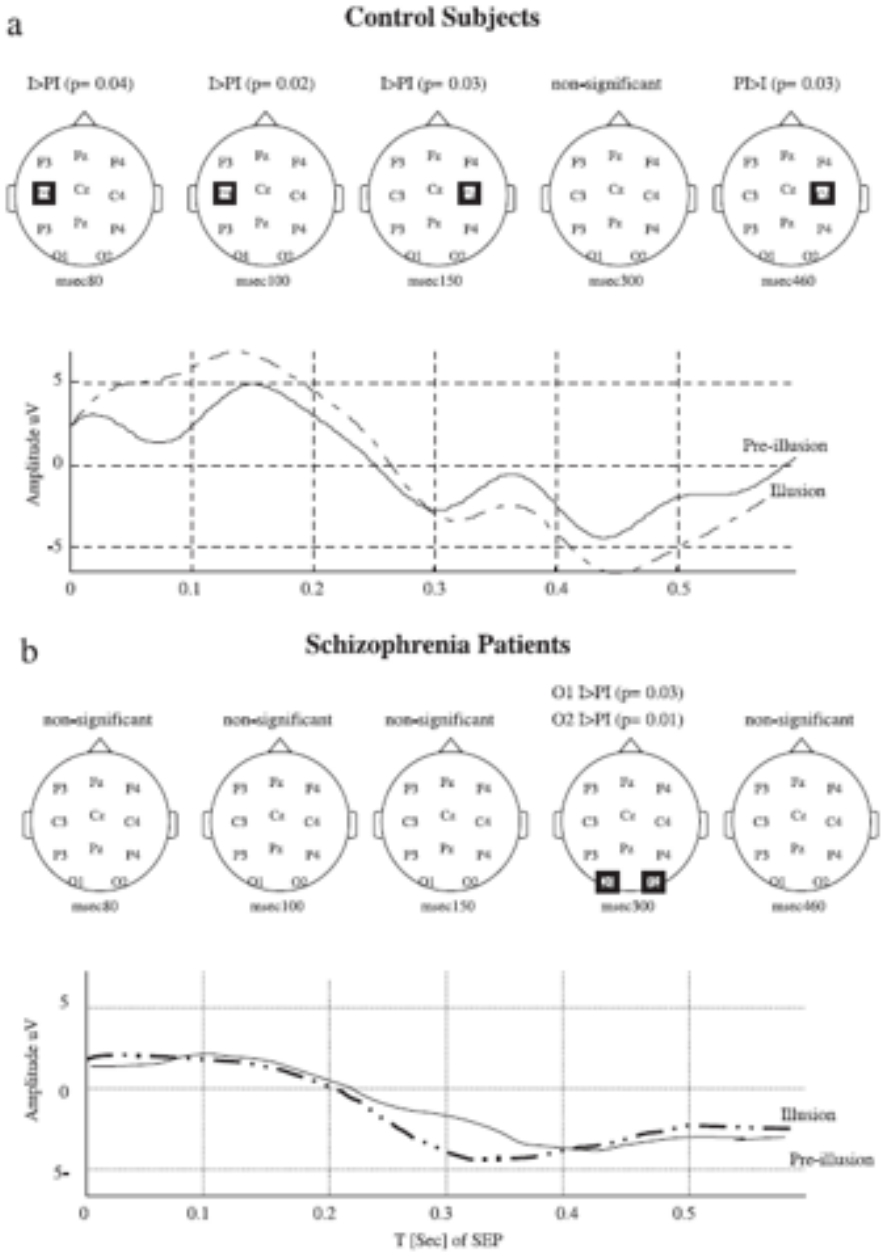

Figure 7: *(a) and (b). Square signs mark the electrode scalp locations where statistically significant differences between pre-illusion and illusion SEPs were found in patients and controls. Bottom graphs in each figure plot the SEPs of pre-illusion and illusion from C4 locations and provide a visual example of the differences.[34]*

illusion>pre-illusion values (P= 0.04 for 80 ms, P= 0.027 for 1000 ms). For C4 scalp location at 150 ms time point, there was still a significant positive difference, P= 0.03, while at 460 ms time point, there was a significant negative difference indicating pre illusion> illusion (P= 0.038).No such significant dif-ferences

were found for the schizophrenia patient group (Figure. 7b); the only significant difference (Illusion> pre-illusion) was at 300 ms for O1 and O2 scalp locations (P= 0.03 P= 0.01, respectively). Bottom graphs at Figure.. 7(a,b) plots the SEP of pre-illusion and illusion from C4 locations and provides a visual example of the differences.

4 Applications

There is such a growing demand for mental health services all the while, the number of providers in the world has remained relatively flat. For example, there is a company named "Limbax" makes apps in VR for treating mental health disorders. They chose virtual reality because they found VR has probably 20 years' worth of research, 300 peer review publications and researcher showed VR play some sort of meaningful role within mental health care. With a cognitive therapy, there is a technique called exposure therapy. Exposure therapy is the idea of flooding someone with the thing that causes them to stress. So a simple example could be if anyone afraid of drive, could not get behind the wheel. Once that therapists knows that the candidate is ready and comfortable to do this exposure, the therapist might start the candidate off on a quite street. Also, the candidate is in his virtual reality headset as a patient, and as the therapist next to the patient. And all of the things that patient see on VR; therapist can also see the same thing on tablet interface. There are options to choose the quit street or they can also choose a busy road, like a highway or tunnel or something much more anxiety including the bridge. And the therapist will gradually take the VR frame gradually to the more stressful scenario. This process is also teaching the patient about coping techniques. There are two major applications for treatment of mental illness and those are explained below:

4.1 Embodied VR

Embodied virtual reality faithfully renders users' movements onto an avatar in a virtual 3D environment, supporting nuanced nonverbal behavior alongside verbal communication [36]. VR is an embodied technology for its ability to modify the experience of the body. However, the body is not simply an object like any other; it has a special status [37],[38],[39]. Embodied learning is an educational concept that has been applied to various aspects of education, but only touched on in medical education, largely in relation to the teaching and learning of anatomy. Thus far, the medical literature has not addressed embodied learning as it specifically relates to learning to operate and be a surgeon [40].

4.1.1 Stroke Rehabilitation

In the past two decades, researchers have demonstrated the potential for virtual reality (VR) technologies to provide engaging and motivating environments for stroke rehabilitation interventions. Physical therapy for

stroke often involves strength and mobility training and range-of-motion exercises. A physical therapist can help patient to improve the function of impaired limbs with motor relearning techniques and ambulation. They may also incorporate e-stimulation and other therapies into their treatment plans. Much of the research has been focused on the exploratory phase and jumps to intervention efficacy trials and scale-up evaluation have been made with limited understanding of the active ingredients in a VR intervention for stroke. Most of these systems are still in the exploratory phase of research and have not progressed beyond user testing and feasibility and small case studies. Pairing low-cost sensors, such as the Microsoft Kinect sensor, with customized software has allowed researchers to design, describe, and control the active ingredients in VR interventions for stroke rehabilitation. Since 2010, research has circled back around through the phases of research to better understand the mechanisms of impact on people with stroke for both upper limb function and balance and mobility. [41]

4.1.2 Motor Skills Training for Surgeons

A motor skill is a learned ability to cause a predetermined movement outcome with maximum certainty. Motor learning is the relatively permanent change in the ability to perform a skill as a result of practice or experience. The training of a surgeon takes years. In addition to the cognitive training that all novice physicians must undergo, surgeons must also develop a refined set of technical skills based on what they see and feel. Development of the fine motor skills along with the ability to make meaning of what trainees see and feel requires a great deal of practice coupled with feedback from an expert. This paper proposes that much of this learning and training can be conceptualized as embodied learning [41]. Embodied cognition is highly relevant to learning to be a surgeon as many of the key skills to be learned involve executing various movements; further, learning to pay attention to embodied cues can clearly enhance decision making in a community of practice like the operating room. Using the principles of embodied learning as a framework through which to design anatomy education and overall surgical learning can likely improve instruction effectiveness and student engagement in the lesson by offering embodied experiences that enable trainees to more fully conceptualize key concepts related to surgical issues.

4.1.3 Parkinson's Disease

Parkinson's disease is a brain disorder that leads to shaking, stiffness, and difficulty with walking, balance, and coordination. Parkinson's symptoms usually begin gradually and get worse over time. As the disease progresses, people may have difficulty walking and talking. The dynamic nature of VR, its technical qualities, and the decrease of technology's costs have allowed the researchers and therapists to successfully develop VR-based clinical assessments and treatments. So far, the VR clinical applications cover a wide range of areas including the pain management [40],[43], specific phobia, eating disorders [44], as well as the cognitive and motor rehabilitation of patients who are affected, for example, by Parkinson's [45] and

Alzheimer's disease [46].

Brain stimulation one of the problems with deep brain stimulation is the surgical technique needs to be extremely precise in order to have the best therapies for the patient with the smallest amount of side effects. So, in Ottawa Hospital, surgeons use surgical navigation preoperative imaging and operative planning in order to get in the close neighborhood of the target. But they must refine the target by recording from the actual brain activity during surgery and move the surgeon's position accordingly. There is a virtual reality intraoperative imaging system that is developed with the realized lab with Justin Sutherland that allows to utilize all the information that is acquire in surgery with a map of the patient's anatomy and specific targets that surgeons are looking at. So that they can make most rational decisions about where to move the micro electrodes and where to place the deep brain stimulation electrode. The accuracy and the precision of the technique that Dr. Sachs uses currently is what makes this such a great application for virtual reality. Because the positioning is accurate that it is possible to create a faithful model in the virtual environment that he can use to plan and further refine the treatment as he is doing it. This application of virtual reality with respect to deep brain stimulation would be a world's first as no one else is pursuing this type of thing and it could have a global impact.

4.1.4 Cerebral Palsy

Cerebral palsy (CP) is a group of permanent movement disorders that appear in early childhood. Signs and symptoms vary among people and over time. Often, symptoms include poor coordination, stiff muscles, weak muscles, and tremors. There may be problems with sensation, vision, hearing, swallowing, and speaking. The psychosocial concepts of embodiment, environmental centralization, and environmental personalization are illustrated with examples of virtual reality applications with children with disabilities. Through these, the advantages of using virtual reality to influence the person–environment relationship are discussed. Disadvantages of implementing this virtual reality approach are also presented as well as recommendations for future work in this area [47].

4.1.5 Skills Acquisition

Skill acquisition refers to voluntary control over movements of joints and body segments in an effort to solve a motor skill problem and achieve a task goal. Increased memory retention from level of engagement, multi-sensory learning, specific and immediate feedback, gamifying practice to increase motivation. Virtual reality (VR) can be used to immerse students in deliberate and repetitive skills practice. Subjects using VR recorded more practice time than students who practiced traditionally. VR may be used as a tool to enhance mastery learning and retention[57]. As technology develops, people are presented with many options beyond the more traditionally accepted learning tools and pedagogies. To truly transform nursing education, it is imperative that nurse educators use current technology and related pedagogy to the students' advantage

whenever appropriate. The VR system piloted in this study was well received by students; usability ratings demonstrated student willingness, and in most cases, eagerness to use this tool for skill practice. Observation and the user-reaction survey results revealed students who were excited and motivated to practice virtually.

4.1.6 Proteus effect

The Proteus effect describes a phenomenon in which the behavior of an individual, within virtual worlds, is changed by the characteristics of their avatar. This change is due to the individual's knowledge about the behaviors that other users who are part of that virtual environment typically associate with those characteristics. Like the adjective protean (meaning versatile or mutable), the concept's name is an allusion to the shape changing abilities of the Greek god Proteus. The Proteus effect [48] was first introduced by researchers Nick Yee and Jeremy Bailenson at Stanford University in June 2007 [49].

The Proteus effect proposes that the visual characteristics and traits of an avatar are associated with specific behavioral stereotypes and expectations. When an individual believes that others will expect certain behaviors from them because of their avatars' appearance, they will engage in those expected behaviors. Support for the Proteus effect comes from past research in real world scenarios that has shown how certain physical characteristics, like attractiveness and height, are often associated with more positive social and professional outcomes. Moreover, experimental manipulations of these characteristics in virtual environments have shown that individuals engage in stereotype-confirming behaviors.This is part of a larger field of research that looks at the behavior of individuals who engage in computer-mediated communication (CMC). Although CMC comes in many forms (text, audio, video, etc.), the Proteus effect is particularly relevant to CMC in which individuals interact by using avatars. This effect is driven by the increased ability to control one's appearance in an online virtual environment. Virtual world environments allow users to control many aspects of their appearance that they cannot easily change in the real world (e.g., height, weight, facial features). Three psychological concepts that led to the development of the Proteus effect are behavioral confirmation, self-perception theory, and deindividuation [70].

Behavioral confirmation refers to the effects that a perceiver's actions can have on the resulting behavior of an individual. Specifically, this concept proposes that interacting with individuals who hold preexisting stereotypes will lead the target of those stereotypes to engage in behaviors that will confirm the perceiver's expectations. The Proteus effect differs from behavioral confirmation in that it does not consider the actions of a perceiver. Instead, its goal is to explain how the individual's own stereotypes and expectations drives the change in behavior, independent of any social interactions that take place. Self-perception theory states that individuals determine their attitudes and emotions by making observations about both their own behavior and the circumstances that led to those behaviors. It was first introduced as an alternative to cognitive dissonance, which argued that changes in behavior can result from an individual's attempt to eliminate tension from contradicting behaviors and beliefs. A series of studies on self-perception theory that looked at changes in behavior as a result of wearing black, a color associated with negative concepts

like death and evil, were influential in the development of the Proteus effect. In these studies, by Mark G. Frank and Thomas Gilovich, participants who watched video recordings of sports rated NFL and NHL players wore black uniforms as being more aggressive. Furthermore, participants who were instructed to wear black jerseys reported greater preferences for engaging in aggressive behaviors against competitors. The argument across these studies was that how participants perceived themselves (i.e., wearing a color that has negative associations) led them to adopt negative behaviors. The Proteus effect carries this idea into virtual environments, where individuals see themselves as their avatar which in turn shapes their behavior.

4.1.7 Forced Allocentric Viewpoints

The word allocentric refers to having one's interest and attention centered on other persons — compare egocentric.This technique includes empathy training, implicit self-beliefs and other beliefs can passively and actively be changed which can help with interpersonal skills. The most direct and compelling benefit that immersion offers to the cognitive interpretation of the world is a reduction in conceptual load because of the simplifying directness of perception of the virtual world. In most interaction with simulations, pictures, photographs, and line drawing representations, a human observer automatically constructs a virtual self, a viewpoint that enters the space of the drawing as if a human observer were there.

4.1.8 Allocentric Lock Theory

In some disorders third person/ allocentric view (internalization of observer's perspective/ self-objectification) is not updated by egocentric view/perceptual data. Top-down predictions are disconnected from bottom-up perceptions. VR body swapping illusions may be update negative stored representations of the body[1]. Body-swapping illusions may be useful in body image disorders (Eds, body image, psychosomatic Sx's)- Multisensory conflicts modulate body representations- the brain abhors discrepancies, when mismatches occur internal models update. Adopting an alternative viewpoint as when one views a picture and enters the space of the picture, seems relatively straightforward, but it may involve some very difficult cognitive processes and transformations. One indication of the difficulty of the task comes from the results of Psotka Lewis' (1994). Experiments on the effects of field of view (FOV) on distance judgments. In the initial part of this experiment students judged their distance from the viewing monitor by placing a mark on an overhead view of the room in which they sat. The resulting scatter plot of judged distances as a function of real distance from the monitor is somewhat non-linear and shows very large dispersion for such a simple task. This large variability is a good indication of just how difficult the task of creating an allocentric view of one's situation is.

4.2 Virtual Reality

There are many potential high-payoff areas for research and development of VR technology for education and training. VR needs to be developed as an integral part of the educational and training process, implemented alongside other traditional and non-traditional tools. It can be used for exploration and for training practical skills, technical skills, operations, maintenance and academic concerns. Teachers and trainers need to be exposed to VR in multiple ways so that they can begin preparing themselves and their institutions for future changes. Integrated scenarios for an assortment of environments and educational areas need to be developed to give educators and trainers a better view of the strengths and weaknesses of these environments; and to give evaluators a means for documenting effectiveness and formative evaluations. Digital libraries need to be constructed that take advantage of VR interfaces. Much more research is needed on the variables that control immersion and on the benefits and drawbacks of immersion so that cost-effective design compromises can be made. Finally, more extensive long term effects, both social and psychological, of these environments need to be documented and analyzed.

4.2.1 PTSD

Among the many approaches that have been used to treat PTSD, exposure therapy appears to have the best-documented therapeutic efficacy. Phobias are a category of anxiety disorders that involve intense fear occurring in the presence of or in anticipation of a specific object or situation. Posttraumatic stress disorder (PTSD) involves strong physiologic and psychological responses to cues associated with the traumatic event. A hallmark of these disorders is avoidance behavior. Such treatment typically involves the graded and repeated imaginal reliving of the traumatic event within the therapeutic setting and is believed to provide a low-threat context in which the patient can begin to therapeutically process trauma-relevant emotions as well as decondition the learning cycle of the disorder via a habituation/extinction process. While the efficacy of imaginal exposure has been established in multiple studies with diverse trauma populations, many patients are unwilling or unable to effectively visualize the traumatic event. To address this problem, researchers have recently turned to the use of virtual reality (VR) to deliver exposure therapy by immersing patients in simulations of trauma-relevant environments that allow for precise control of stimulus conditions [50].

4.2.2 Autism

Autism is a mental disorder which has received attention in several unrelated studies using virtual reality. One of the first attempts was to diagnose children with special needs at Tokyo University using a sandbox playing technique. Although operating the computer controls proved to be too difficult for the individuals with autism in the Tokyo study, research at the University of Nottingham, UK, is successful in using VR as a learning aid for children with a variety of disorders including autism. Both centers used flat screen com-

puter systems with virtual scenes. Another study which concentrated on using VR as a learning aid with an immersive headset system is described in detail in this chapter. Perhaps because of the seriousness of the disorder and the lack of effective treatments, autism has received more study than attention deficit disorders, although both would appear to benefit from many of the same technology features.Some genetic mutations seem to be inherited, while others occur spontaneously working with environmental factors. Researchers are currently exploring whether factors such as viral infections, medications or complications during pregnancy, or air pollutants play a role in triggering autism spectrum disorder.Autism spectrum disorders are characterized by core deficits with regard to three domains, i.e. social interaction, communication and repetitive or stereotypical behavior. It is crucial to develop intervention strategies helping individuals with autism, their caregivers, and educators in daily life. For this purpose, virtual reality (VR), i.e. a simulation of the real world based on computer graphics, can be useful as it allows instructors and therapists to offer a safe, repeatable and diversifiable environment during learning. This mini review examines studies that have investigated the use of VR in autism [51].

4.2.3 Depression

Depression is a common mental disorder with a large treatment gap. Low-intensity, automated virtual reality (VR) interventions (not requiring a therapist) is a scalable and promising solution now that VR is an accessible and mature, consumer technology. Yet unlike with phobias, there have been few attempts at translating evidence-based cognitive behavioral therapeutic (CBT) techniques for depression into the VR modality. In this paper, people discuss how specific CBT techniques can be made into VR experiences, including psychoeducation, behavioral activation, cognitive restructuring, and social skills training [57]. Another consumer technology with potential to act as a delivery format for CBT for depression is Virtual Reality (VR), technology that allows the user to feel immersed in virtual, computer-generated world. There were no significant differences between VR-based and other active interventions. VR interventions outperformed control conditions for anxiety and depression but did not improve treatment drop-out. High heterogeneity, potential publication bias, predominant use of wait list controls, and high or uncertain risk of bias of most trials question the reliability of these effects [52].

5 Research Gaps and Challenges

Application of immersive Virtual Reality (VR) system has been proven to be practical and effective in offering the sense of presence and engagement for users to explore inside a virtual environment (VE) creation. However, numerous user experience problems still occur within the application design and development phase. An attempt to categorized the issues from presented studies by the researchers within the scope of papers between years of 2007 to 2017[62] . There is no empirical evaluation conducted in this reviewing process but the aim is to bridge the gap between user experience and application system through understand-

ing and learning from the challenges in the system itself. This can promote a more highly acceptance level of this complex technology among the users. This paper also proposes the future research directions and predicts the development trends of VR system [58]. Furthermore, the system itself can bridge the limitation of users to access and interact in virtual places without concern of distance, time or danger [59]. According to [60], at this state of time, VR is at its reliable phase and its usage is receiving global recognition due to its inimitable design features. In addition, there is a vast number of VR system found applied to several field of studies [61]. From the next section, possible research gaps and challenges are discussed.

5.1 Cybersickness

Cybersickness is a form of motion sickness that occurs as a result of exposure to immersive extended Reality (XR) environments, such as virtual reality (VR) and augmented reality (AR) applications. Immersive technologies, such as virtual and augmented reality, initially failed to live up to expectations, but have improved greatly, with many new head-worn displays and associated applications being released over the past few years. VR is well-known to cause nausea, mostly as it's related to motion sickness and the speed of the objects moving in the game you're playing. A few studies have looked at a another condition known as "cybersickness" or "sim sickness" that is caused by being overwhelmingly immersed by a simulated reality. Unfortunately, 'cybersickness' remains as a common user problem that must be overcome if mass adoption is to be realized [53].

5.2 Visual disturbances/ visual fatigue

Visual disturbance is a experience of a short spell of flashing or shimmering of light into the sight. The symptoms normally last around twenty minutes before your sight returns to normal. Usually, there is no headache during the visual disturbance. A visual disturbance should not be confused with a retinal or ocular migraine where there is a partial or total loss of vision in one eye, normally with a headache.Visual disturbance is a common condition among people who are affected by migraines, although they can affect anyone.Visual disturbances tend to be more common in women and people aged under 40 or over 60 and people with a personal or family history of migraines. Using VR for a long time sometimes create visual disturbance and though VR is taking the advantage for the mental disorder treatments but still researchers are working on this field. When using VR, a user's brain is forced to process visual stimuli in a different way than normal. This can cause eye strain, which is simply a case of the eye muscles becoming fatigued. Eye strain will not cause long-term problems, but it is a sign that the eyes and brain need a break from the activity.Eye strain and pain are common issues when using VR headsets. When people use VR, they strain their eyes to focus on the image they see, but what they are actually doing is focusing their eyes on a pixelated screen[62].

5.3 Postural Instability

A significant gap remains in the ability to effectively characterize postural instability in individuals with Parkinson's disease. Postural instability refers to imbalance and loss of righting reflexes. Its emergence in a patient with Parkinson disease is an important milestone, because it is poorly amenable to treatment and a common source of disability in late disease. Clinical evaluation of postural declines is largely subjective, whereas objective bio mechanical approaches are expensive and time consuming, thus limiting clinical adoption. Recent advances in mobile devices present an opportunity to address the gap in the quantification of postural stability [55].Visual motion in the VR stimuli initially produced marked postural instability, but repeated sessions with VR reduce this instability. The increased postural instability is likely to be the result of an ambiguity between visual information and body movement.[63]. Provocative visual motion can be produced without physical motion for research purposes by virtual reality (VR). VR involves real-time simulation and interactions between sensory, motor and cognitive channels. When the user moves their head, the VR device determines the new direction of gaze and recreates the visual scene from the user's new point of view in 3D space. Hence, VR can be set up to be strongly immersive, in that the environment appears real and three-dimensional, to induce reliable ego-motion. This is particularly useful experimentally as VR can induce motor responses to an unexpected veridical virtual input. In fact, VR simulations of riding a roller coaster can produce such a strong illusion of movement that it causes motion sickness.

5.4 Lucid Dreaming

After Facebook's acquisition of Oculus VR and its Oculus Rift headset, Mark Zuckerberg (2014) praised the gadget in grandiose terms. "People who try it say it's different from anything they've ever experienced in their lives," he remarked, adding that it "opens up the possibility of completely new kinds of experiences." While similarly inflated rhetoric surrounded products such as iPhone, promotional discourse often frames VR devices as near-magical talismans poised to unleash previously unknown dimensions of human imagination [56]. Such cost and design limitations will likely become obsolete in the coming years. A lucid dream is a type of dream where the dreamer becomes aware that they are dreaming. During a lucid dream, the dreamer may gain some amount of control over the dream characters, narrative, and environment; however, this is not actually necessary for a dream to be described as lucid.In a new study, sleep researchers found an unexpected connection between virtual reality, specifically the ill-effects of too much time spent in VR and lucid dreaming, suggesting virtual reality may be able to train the brain to dream in a totally different way [64]. In some ways, the study poses more questions about lucid dreaming than it answers. Ultimately, the researchers say their mixed results may be to do with how rare the lucid-dream experience is, even if you are actively trying to induce this dream state.But researchers working on virtual-reality group, the researchers find a connection between an unpleasant side-effect of virtual reality and lucid dreams. Characterized by nausea and feelings of dissociation, "VR sickness," as it is known, may be playing a role in how the technology stimulates lucid dreaming.

5.5 Sensory- Motor Symptoms

It decreases the feeling in any area of the body, difficult for breathing and shallowing issue may raise. The main barrier is the cost and design limitations, and they will likely become obsolete in the coming years.Sensory and motor development is the gradual process by which a child gains use and coordination of the large muscles of the legs, trunk, and arms, and the smaller muscles of the hands. A baby begins to experience new awareness through sight, touch, taste, smell, and hearing.A continuous use of VR may create problems with the sensor-motor and this research is working under process. The treatment for Sensory Processing Disorders (SPD) commonly involves providing patients with controlled sensory stimuli [64].Sensory processing disorders (SPD) (aka sensory integration dysfunction) refer to conditions that are generated when a person's brain is not able to integrate or organize (part of) the flow of sensory impulses so as to provide the individual with good, accurate information about herself/himself or the world around her/him [65], and can affect one or more senses at the same time [66], [67]. The consequences of such disorders can be rather serious as they affect the way an individual perceives the environment around her/him and the way in which she/he interacts with it and with other people [68].

6 Future work

Virtual reality is already amazing, but it is far from perfect and still, there are things that people would like to see in the future. Psychiatry is a medical field that requires human touch and empathy. Woebot is one of the many apps that aim to bring AI to psychiatry. It is a smart algorithm that serves as a pocket psychologist. And while it can have a good conversation with humans and can serve as an introduction to therapy. Most people are afraid to talk about their problems and especially hesitant to seek professional help. But since Woebot can open a door for people who would not speak out, but real therapy is going to stay between two people, sitting and talking with each other. Telemedicine on the other hand is a true blessing for therapists and patients. Apps like Cloud9 aim to make mental healthcare more accessible through a platform offering intervention and prevention support by connecting patients with mental healthcare professionals. Another app called Talkspace connects users online with over 200 licensed therapists. These services are great to bring care to those who need immediate help, and those who live in rural areas with limited access to psychiatric care this app will help them to take care of their medical illnesses. Another buzzword in Silicon Valley is VR or virtual reality which is mostly used in gaming these days, but they have great possibilities in healthcare too.

VR can offer a brand-new way to treat mental health problems, such as anxiety, fears, and phobias. In VR, patients can recreate fearful situations to get over their paranoia. For example, a VR app called Arachnophobia offers self-guided exposure therapy for people having an irrational fear of spiders. What is probably the most useful gift from digital health to psychiatry is in pharmacogenomics. Pharmacogenomics is about analyzing how the genetic makeup of an individual affects their response to certain drugs. It can pro-

vide explanations as to why some people experience side-effects when taking certain antidepressants, and it can help psychiatrists to customize drug treatment to achieve better efficiency and tolerably for each patient. For the mental health treatment, smartphones could have recorded the violent outbursts, the moments of insomnia, and late light looking up the internet sites about self-harm. A therapy bot could have made some suggestions on how to improve sleep and manage anger. The therapist could have suggested therapy and drugs on Beast's pharmacogenomic information. There are some VR based treadmills available that can be helpful for stroke rehabilitation. There is a customer-ready treadmill already available in the market, called "Catwalk" which uses a low friction floor with the help of special shoes, and this treadmill costs around $700. A stroke rehabilitation patient can get feelings of movement by using a catwalk treadmill. Another one is "infinite deck" which has the additional feature of moving in any direction.

In the next 5 years, the development of commercial VR system for entertainment will probably reduce the cost. This reduction will be even more important for VR systems based on HMD that will be easily used in clinical settings. They will probably change the modality of rehabilitation of patients, especially because the results of the studies mentioned in this review support the idea that these systems are particularly effective in multitasking training. It means that cognitive and motor functions will be rehabilitated at the same time, and not more separately. It will need a multidisciplinary team of professionals formed by physical therapists, cognitive therapists, medical doctors, neuroscientists, computer scientists, and bio engineers for the development, monitoring, and adjusts of VR-based therapy performed on large groups of patients. Despite all of the possible limitations, people believed that the immersive VR programs will be the next generation of physical and cognitive therapy and will bring many benefits that could induce to decrements of the rehabilitation's costs by maintaining a high efficacy in a relatively short time.

7 Conclusion

In conclusion, all of the above study showed that (1) VR can be used also in the treatment of Generalized anxiety disorder (GAD); (2) in VR treatment, patients take advantage of a mobile device that delivers in an outpatient setting guided experiences, similar to the one experienced in VR. It also suggested, but further analysis is needed with these patients. The effectiveness of an immersive virtual relaxing environment may be improved by using physiological data to modify in real time specific features of the virtual environment. VR is a clinically appropriate treatment modality for many existing CBT techniques and the extant literature suggests that VR-unique experiences can be put to anti-depressive use. Lowintensity, consumer-targeted VR interventions built around evidence-based therapeutic techniques have great potential to decrease the depression treatment gap and make an impact on public mental health. VR can be used to induce the patient in a controlled sensory rearrangement that unconsciously modifies his or her bodily awareness (body schema). Using VR system, person's self-image projected onto the image of the visual cues (i.e., a certain Figure. or an abstract point, such as a cursor, which moves in accordance with the movement of our own hand) appearing in the video monitor, as a part of or an extension of their own hands. [6] The Proteus effect

should be expected to operate in virtual environments where users are presented with avatars, whether this is in a virtual reality laboratory or an online community.

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