VIRTUALNA STVARNOST KAO TERAPIJA MUCANJA

VIRTUAL REALITY AS A THERAPY FOR STUTTERING

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Sažetak: *Iako je virtualna stvarnost pojam koji se najčešće veže uz zabavu, ona je sve prisutnija u granama medicine, psihologije, ali i logopedije. U području psihologije virtualna se stvarnost pokazala kao uspješan tretman za različite vrste strahova i anksioznost. Nadalje istraživanja iz područja psihologije upućuju na veću učinkovitost terapije virtualnom stvarnošću u odnosu na klasične tretmane. S obzirom na to da su anksioznost i strah od govornih situacija izražene komponente mucanja, počela se ispitivati i primjena virtualne stvarnosti u terapiji mucanja. Ovaj rad donosi pregled nekoliko dosadašnjih istraživanja iz ovog područja. Prva su istraživanja bila usmjerena na povezivanje virtualnih i stvarnih uvjeta, a dobivene statistički značajne pozitivne korelacije između njih upućuju na to da virtualna stvarnost može biti korisna za procjenu i terapiju mucanja. Zaključak ostalih dosadašnjih istraživanja jest da virtualna stvarnost utječe na smanjenje anksioznosti i poboljšanje tečnosti govora. U Hrvatskoj do sada nije bilo istraživanja koja povezuju virtualnu stvarnost i mucanje.*

Ključne riječi: *mucanje, terapija mucanja, virtualna stvarnost*

1. UVOD

Posljednjih godina svjedoci smo sve većeg utjecaja računala i informacijskih znanosti na razvoj društva. Virtualna je stvarnost izranjajuća tehnologija koja se spominje u mnogim istraživanjima, a tijekom posljednjeg desetljeća razvijeni su brojni virtualni sustavi i platforme. Danas virtualna stvarnost plijeni pozornost kako u istraživanjima tako i u primjeni. Koristi se u različitim područjima uključujući rehabilitaciju, elektronički inženjering, psihologiju, kompjuterske znano-

Abstract: *Although virtual reality is most commonly associated with fun and games, it is used more frequently in medicine, psychology, and speech and language pathology. In psychology, virtual reality is recognized as a useful treatment or anxiety and different types of fears. Furthermore, research shows that virtual reality is more efficient in treating psychological disorders than classical treatment. Knowing that anxiety and fear of speaking are prominent components of stuttering, researchers started exploring virtual reality as a treatment for stuttering. This review summarises many of the findings from these endeavours. In the beginning, researchers were focused on finding statistically significant positive correlations between real life and virtual reality so that virtual reality could be used as a base for assessment and treatment for stuttering. Later, all the research arrived at a similar conclusion: therapy based on virtual reality reduces anxiety and improves speech fluency. There is currently no ongoing research related to this subject in Croatia.*

Keywords: *virtual reality, stuttering, stuttering therapy*

1. INTRODUCTION

In recent years, we have witnessed the growing influence of computers and information science on the development of society. Virtual reality technology is an emerging technology, and many virtual reality systems and platforms have been developed during the past decade. At present, virtual reality technology has garnered increased attention in both research and applied settings. Virtual reality is used in rehabilitative therapy, electronic engineering, psychology, computer science, education, and entertainment. Although virtual reality is a term most often associated with

sti, edukaciju i zabavu (Nafjan, Alghamdi, Almudhi, 2021). Iako se još uvijek virtualna stvarnost prvenstveno povezuje sa zabavom i igricama, evidentno je da se u svijetu sve više koristi u raznim granama, pa tako i u medicini, psihologiji i logopediji. Burdea i Coiffet (2003) navode da tehnologija virtualne stvarnosti izaziva interes entuzijasta i onih kojima je to hobi, ali istovremeno predstavlja moćan znanstveni alat. Brundage, Graap, Gibbons, Ferrer i Brooks (2006) opisuju virtualnu stvarnost kao ljudsku kompjutersku interakciju u kojoj su korisnici ujedno i aktivni sudionici u kompjutorski generiranom trodimenzionalnom svijetu. Razlikuje se od tipičnog računala jer stvara osjećaj prisutnosti u virtualnom okruženju koristeći i slušalice i naočale s praćenjem pokreta (Brundage i sur., 2006).

Virtualna se stvarnost prvi put počela koristiti u kliničke svrhe ranih devedesetih godina. Prve studije bile su usmjerene na dizajniranje virtualnih stimulacija za specifične strahove (primjerice strah od visine, pauka i javnog govora) i za procjenu kognitivnih sposobnosti (Rizzo, Koenig i Talbot, 2019). Virtualna stvarnost predstavlja prividan okoliš simuliran pomoću računala unutar kojega je korisniku omogućen privid boravka, kretanja i opažanja. Virtualno se okruženje ostvaruje na zaslonu računala ili posebnim uređajima (npr. naočale). Doživljaj se upotpunjuje zvukovima (uz pomoć slušalica ili zvučnika) i vibracijama, a iskušavaju se i mogućnosti pobuđivanja taktilnih i osjetila mirisa (https://www.enciklopedija.hr/natuknica.aspx?ID=64795). Rowland, Casey, Ganapathy, Cassimatis i Clough (2021) u svojem radu opisuju virtualnu stvarnost kao kompjuterski generiranu trodimenzionalnu tehnologiju koja omogućuje perceptivno i interaktivno iskustvo stvarnog okruženja putem senzoričkih stimulacija. U posljednjem desetljeću, a uslijed napretka u programiranju, grafici, poboljšanju brzine procesiranja, internetskoj povezanosti i veće potražnje za virtualnom stvarnošću, virtualna je stvarnost postala jedinstvena i nezamjenjiva tehnologija (Rizzo i sur., 2019). Unatoč ranijim predviđanjima da će tehnologija virtualnog okruženja revolucionarizirati skrb mentalnog zdravlja i brojnim istraživanjima koja sve više dokazuju benefite

entertainment and games, it is getting used more commonly world- wide in various branches, including medicine, psychology as well as speech and language therapy. Burdea and Coiffet (2003) state that "virtual reality technology encompasses the interests of enthusiasts and those for whom it is a hobby but at the same time presents a powerful scientific tool". Brundage, Graap, Gibbons, Ferrer and Brooks (2006) describe virtual reality as a human computer interaction in which users are also active participants in a computer-generated three-dimensional world. It differs from a typical computer program because it creates a sense of presence in a virtual environment by using both headphones and glasses with motion tracking (Brundage et al., 2006). The idea of using virtual reality for clinical purposes was first recognized in the early-to-mid 1990s, with initial efforts aimed at imitating exposure therapy for specific phobias (e.g., fear of heights, flying, spiders, and public speaking) through virtual reality simulations and for cognitive assessment/rehabilitation (Rizzo et al., 2019).

Virtual reality is an environment simulated by a computer in which the user is given the illusion of presence, moving and perceiving. Such an environment is realised on a computer screen or by special devices (e.g., glasses), and the experience is complemented by sounds (with the help of headphones or speakers) and vibrations; the possibilities of stimulating tactile and olfactory senses are being tested (https://www.enciklopedija.hr/natuknica.aspx?ID=64795). Rowland, Casey, Ganapathy, Cassimatis and Clough (2021) define virtual reality as a computer generated three- dimensional technology that delivers sensory stimuli to generate a perceptual and interactive experience of a realistic and immersive environment. The past decade has seen unprecedented industrial developments and advancements in the technological specifications of virtual reality. Improvements in computing power, graphics, advanced processing speed, and greater internet connectivity has resulted in increased access and consumer demand for virtual reality (Rizzo et al, 2019). However, despite earlier predictions that virtual reality would revolutionise mental health

terapije virtualne stvarnosti, mnoge intervencije virtualnom stvarnošću još nisu dosegnule svoj puni potencijal niti se virtualna stvarnost koristi kao uobičajena terapija u kliničkom okruženju (Rowland i sur, 2021).

2. VIRTUALNA STVARNOST U PODRUČJU PSIHOLOGIJE I LOGOPEDIJE

Već postoje mnogi znanstveni članci o upotrebi virtualne stvarnosti u terapiji poremećaja iz područja psihologije, a najviše su vezani uz anksiozni poremećaj i specifične strahove, ali i posttraumatski poremećaj. Virtualna je stvarnost tehnologija koja se koristi za terapije poremećaja iz područja psihologije i mnoga istraživanja upućuju na to da terapija virtualnom stvarnošću može biti učinkovita u prevladavanju anksioznih poremećaja (Gershon, Anderson, Graap, Zimand, Hodges i Rothbaum, 2002). Klasične terapije anksioznog poremećaja uključuju izlaganje pacijenta stvarnom podražaju koji izaziva anksioznost zbog čega pacijenti imaju jaku averziju prema ovom obliku terapije. Osim izlažućih terapija za liječenje anksioznog poremećaja postoje terapije koje se oslanjaju na sistematsku desenzitizaciju. Sistematska desenzitizacija temelji se na zamišljanju situacija koje izazivaju anksioznost s ciljem smanjivanja anksioznosti u svakodnevnom životu. Međutim sistematska desenzitizacija vrlo je često neučinkovita jer pacijent teško može zamisliti zadanu situaciju i povezati je sa stvarnim životom. Terapija virtualnom stvarnošću predstavlja „zlatnu sredinu“ između takvih dviju terapija jer se izvodi u privatnosti terapeutske sobe, pacijent ima kontrolu nad situacijom, izbjegava se javno sramoćenje pacijenta i ne narušava se njegovo povjerenje, a pacijent ipak virtualnu stvarnost doživljava dovoljno intenzivno da se može usporediti sa stvarnim životom (North M., North S. i Coble, 1998). U psihologiji se eksperimenti s virtualnom stvarnošću provode još od ranih devedesetih godina i dosad se virtualna stvarnost pokazala učinkovitom u smanjivanju anksioznosti, ali i za liječenje straha od letenja, straha od visina, straha od specifičnih situacija, straha od javnog govora (North M. i sur., 1998). Rezultate

care and research increasingly demonstrating the therapeutic benefits of virtual reality, many virtual reality interventions have yet to reach their full potential and still rarely translate from research to application in clinical settings (Rowland et al., 2021).

2. VIRTUAL REALITY IN THE FIELD OF PSYCHOLOGY AND SPEECH AND LANGUAGE PATHOLOGY

There are already many scientific articles on the use of virtual reality to treat disorders in the domain of psychology mostly related to anxiety disorder and specific fears but also to post-traumatic disorder. Virtual reality is a relatively new technology to be applied in the field of clinical psychology, but many studies indicate and suggest that virtual reality therapy may be effective in overcoming anxiety disorders (Gershon et al. 2002). Exposure therapies, such as those related to behavioural therapy, include exposing the patient to a real stimulus that causes anxiety and to which a patient has a strong aversion. Furthermore, therapies that rely on systematic desensitisation are often ineffective because the patient can hardly imagine a given situation. Virtual reality therapy represents the “golden mean” between two such therapies because it is performed in the privacy of the therapy room, the patient has control over the situation, public embarrassment of the patient is avoided, their trust is not violated, and yet the patient experiences virtual reality intensely enough to be compared to real life (North, North and Coble, 1998). In psychology, such experiments have been conducted since the early 1990s and, so far, virtual reality has proven effective in reducing anxiety and for treating fear of flying, fear of heights, fear of specific situations, and fear of public speaking (North et al., 1998). The results of research related to flying anxiety show significant effectiveness of virtual reality therapy (VRET - Virtual Exposure Therapy) in relation to classical interventions, and better results were seen within a certain time period from virtual reality therapy compared to that of exposure therapies (Cardos, David & David, 2017).Page and Coxon (2016) cite four independent meta-analyses in their pa-

ti istraživanja terapije straha od letenja pokazuju značajno veću učinkovitost terapije virtualnom stvarnošću u odnosu na klasične intervencije te bolje rezultate terapije naspram izlažućih terapija u određenom vremenskom razdoblju (Cardos, David O. i David D., 2017). Page i Coxon (2016) u svom radu navode četiri neovisne meta analize koje imaju isti zaključak – terapije virtualnom stvarnošću dovode do slabljenja simptoma povezanih s anksioznošću.

Tradicionalno logopedi se bave poremećajima komunikacije, jezika i govora u kontroliranim, kliničkim uvjetima gdje su ograničene mogućnosti za generalizaciju naučenih ponašanja u svakodnevnici. Najčešće korištena metoda za generalizaciju naučenih ponašanja iz kliničkog u vanjskom okruženju jest igra uloga. Ipak, igra uloga nije dovoljna jer je komunikacija multidimenzionalna i na nju utječu brojni okolinski čimbenici (npr. okruženje, komunikacijske sposobnosti i komunikacijski partner) i osobni čimbenici (anksioznost, motivacija, edukacija, kultura itd.) koje je teško simulirati unutar kliničkog okruženja. Upravo zato u području logopedije postoji velika potreba za razvojem kliničkog alata koji će omogućiti pacijentima da uče i vježbaju komunikacijske vještine u realističnom, individualiziranom, ali ipak sigurnom okruženju. Dosadašnja su istraživanja učinkovitosti korištenja virtualnog okruženja u području logopedije pokazala da se tehnologija virtualne stvarnosti primjenjivala uspješno za psihološke i motoričke vještine kod osoba nakon moždanog udara, kod djece s cerebralnom paralizom i osobama s Parkinsonovom bolešću (Vaezipour, Aldridge, Koenig, Theodoros i Russell, 2021). Nadalje postoje istraživanja koja upućuju na učinkovitost komunikacijskih intervencija putem virtualne platforme za osobe s afazijom zahvaljujući kapacitetu virtualne stvarnosti da simulira svakodnevne aktivnosti (Vaezipour i sur., 2021). Peng, Yin i Chao (2021) u svom radu daju pregled četiri neovisne studije o učinkovitosti korištenja tehnologije virtualne stvarnosti kod osoba nakon moždanog udara i zaključuju da virtualna stvarnost može biti korisna, najviše za poboljšanje motoričkih funkcija, manje za poboljšanje psiholoških i kognitivnih sposobnosti, ali da je svakako

per that have the same conclusion: virtual reality therapies lead to a reduction in anxiety-related symptoms.

Traditionally, speech and language pathologists have delivered therapy to address communication deficits within controlled clinical environments where there are limited opportunities for real-world practice. Due to those limitations, clinicians often rely on tools such as role play to assist with assessment and generalisation of communication skills learned within the clinic to external environments. However, role play is not enough to engage clients more directly and authentically in a real-world-like experience because communication is multidimensional influenced by many environmental factors (e.g., setting, skills and attitudes of communication partner), and personal factors (e.g., anxiety, fatigue, motivation, education, culture) that are difficult to simulate authentically within the clinic. Therefore, there is a vital need for the development of clinical tools that enable individuals to learn and practise their communication skills in realistic, personally relevant, yet, safe environments. Increasing evidence has emerged from a wide range of health fields supporting the use of virtual reality in rehabilitation contexts. Virtual reality has been applied successfully as a therapeutic modality to train physical and motor skills following stroke, in children with cerebral palsy, and individuals with Parkinson's disease (Vaezipour, Aldridge, Koenig, Theodoros and Russel, 2021). Furthermore, there is evidence suggesting that communication interventions for people with aphasia can be delivered successfully using a virtual reality platform. It has been proposed that virtual reality technology in the rehabilitation of patients with aphasia has the potential to provide treatment efficacy given its capacity to simulate activities of daily living (Vaezipour et al., 2021). Peng, Yin and Chao (2021) conducted a meta- analysis to determine the efficacy of virtual reality in restoring motor function in patients after stroke. A great improvement in motor function was noted in the virtual reality group, but improvements in mental and cognitive function were insignificant when compared to preintervention values. However, more studies are still

potrebno još istraživanja o učinkovitosti korištenja virtualne stvarnosti kao oblika terapije.

Generalno su istraživanja o virtualnoj stvarnosti u području logopedije još uvijek u začetku, ali imaju pozitivan učinak na generalizaciju funkcionalnih komunikacijskih vještina iz virtualnog u stvarnom okruženju (Vaezipour i sur., 2021). S obzirom na to da u Hrvatskoj ne postoje istraživanja o primjeni virtualne stvarnosti u terapiji mucanja, pretraživanjem elektroničkih baza, relevantne literature i časopisa iz područja poremećaja tečnosti govora, logopedije i inženjerske tehnologije, nastojali smo dati prikaz novijih istraživanja iz ovog područja. Budući da je kod osoba koje mucaju često prisutna i socijalna anksioznost, ne čudi nas što je većina tih istraživanja usmjerena na ispitivanje uspješnosti primjene virtualne stvarnosti u terapiji socijalne anksioznosti kod odraslih osoba koje mucaju.

3. MUCANJE I TERAPIJE MUCANJA

Mucanje je razvojni govorni poremećaj karakteriziran nevoljnim prekidima tečne produkcije govora (Chard i Zalk, 2022). Govor je temeljni mehanizam na kojem se temelji svakodnevna interakcija s drugima, oko kojeg se zasnivaju, razvijaju i održavaju socijalni odnosi, a iščekivanje socijalne štete koja može pratiti mucanje može ometati socijalno funkcioniranje i u takvim se okolnostima javlja socijalna anksioznost (Messenger, Onslow, Packman i Menzies, 2004). Anksioznost je jedna od najčešćih promatranih psiholoških pojava kod osoba koje mucaju (Iverach i Rapee, 2014), a razlog tome upravo je u važnosti govora za svakodnevno funkcioniranje (Messenger i sur., 2004).

S obzirom na uspješnost koju terapija virtualnom stvarnošću ima u psihologiji, ali i na izraženu psihološku komponentu mucanja kod osoba koje mucaju (anksioznost, strah od govornih situacija), logično je zapitati se može li terapija virtualnom stvarnošću imati uspjeha i u području mucanja. Mucanje se definira kao multidimenzionalni poremećaj tečnosti govora koji utječe na mnoge aspekte života osobe koja muca (Yaruss, 2010). Osobni izvještaji, biografije i empirijska

warranted to determine the effectiveness of these interventions in retaining the cognitive function and physical performance of such patients.

Whilst research into the use of virtual reality within the field of communication disability is in its infancy, early studies utilising virtual reality have demonstrated positive effects on the generalisation of functional communication skills from the virtual environment to the real world (Vaezipour, 2021).

Given that there is no research in Croatia on virtual reality treatment for stuttering, we collated this review paper from information provided by electronic databases, relevant literature and journals in the field of speech disorders, speech therapy and engineering technology. Considering that people who stutter often have social anxiety disorder, most research is directed at efficiency of virtual reality in rehabilitating people who stutter with social anxiety.

3. STUTTERING AND STUTTERING THERAPIES

Stuttering is a developmental speech disorder characterised by the involuntary disruption to the fluent production of speech (Chard and Zalk, 2022). Speech is the fundamental mechanism on which everyday interaction with people is based (Messenger et al., 2004). Social relations are established, developed and maintained thanks to the ability of speech. Anticipation of social damage can disrupt social functioning, and, in these circumstances, social anxiety occurs. Anxiety is one of the most commonly observed physiological phenomena in people who stutter (Iverach and Rapee, 2014).

Given the success of virtual reality therapy in psychology and the distinct psychological component of stuttering in people who stutter (anxiety, fear of speaking situations), a logical question raised is whether virtual reality therapy can be successful in the treatment of stuttering. Stuttering is defined as a multidimensional speech fluency disorder that affects many aspects of a stuttering person's life (Yaruss, 2010). Personal reports, biographies, and empirical research confirm that the person who stutters feels shame, anxiety,

istraživanja potvrđuju da osoba koja muca osjeća sram, anksioznost, teškoće u komunikaciji pa čak i osjećaj nezadovoljstva životom zbog mucanja (Yaruss, 2010). Mnoga istraživanja pokazuju da je mucanje povezano s većom razinom socijalne anksioznosti u odnosu na tečne govornike (Iverach i Rapee, 2014). Prema Dijagnostičkom i statističkom priručniku (DSM-V, 2013) socijalna anksioznost okarakterizirana je kao „izražen, ili intenzivan strah ili tjeskoba od društvenih situacija u kojima pojedinca mogu pomno provjeravati drugi". Za neke osobe koji mucaju to će se manifestirati kao subklinička socijalna anksioznost (ili sramežljivost) koja je povezana s kliničkom dijagnozom socijalnog anksioznog poremećaja, ali se smatra različitom od nje (Dalrymple i Zimmerman, 2013). Međutim osobe koje mucaju izložene su većem riziku od razvoja socijalnog anksioznog poremećaja u usporedbi s osobama koje tečno govore. Procjenjuje se da približno 46% osoba koje mucaju zadovoljava dijagnostičke kriterije za socijalni anksiozni poremećaj, za razliku od 4% onih koji tečno govore (Blumgart , Tran , Craig, 2010).

Uz socijalni anksiozni poremećaj često se vezuju strah od negativne evaluacije, očekivanje negativne društvene reakcije, negativne spoznaje, predrasude, izbjegavanje i sigurnosna ponašanja (Iverach i Rapee, 2014). Sve je više dokaza da takva obilježja poremećaja socijalne anksioznosti mogu igrati ključnu ulogu kod mucanja (Iverach i Rapee, 2014). Na primjer osobe koje mucaju znaju na koji način izbjeći socijalno „prijeteće" situacije, kako bi smanjile tjeskobu i sram (Iverach i Rapee, 2014). Istraživanja koja su vezana uz strah od negativne evaluacije, predrasude i sigurnosna ponašanja mogu pomoći razumijevanju veze socijalne anksioznosti i mucanja.

Yaruss (2010) navodi da postoje brojne definicije mucanja, ali i brojni terapijski pristupi upravo zbog kompleksnosti samog poremećaja. Guitar (2014) opisuje mucanje kao poremećaj definiran osnovnim ponašanjima, sekundarnim ponašanjima te osjećajima i stavovima koji prate mucanje. Dakle riječ je o složenom poremećaju koji se manifestira u brojnim aspektima života osoba koje mucaju i upravo je zato teško naći jedinstvenu

communication difficulties, and even feelings of dissatisfaction with life due to stuttering (Yaruss, 2010). A large body of evidence links stuttering to heightened levels of social anxiety (Iverach and Rapee, 2014). According to DSM-V (2013) social anxiety is characterised as "a marked, or intense, fear or anxiety of social situations in which the individual may be scrutinised by others". For some people who stutter, that will manifest as subclinical social anxiety which is similar to but differs from clinical diagnosis of social anxiety disorder (Dalrymple, Zimmerman, 2013). However, persons who stutter are also at greater risk of developing social anxiety disorder compared to fluent speakers. Approximately 46% of people who stutter are estimated to meet diagnostic criteria for social anxiety disorder as opposed to 4% of fluent speakers (Blumgart, Tran and Craig, 2010).

Fear of negative evaluation, expecting negative social reaction, negative perception, prejudices, avoiding social situations and security behaviours are often related to social anxiety disorder. There is more and more evidence that these behaviours play a crucial role in stuttering (Iverach and Rapee, 2014). For example, people who stutter know how to avoid socially threatening situations to reduce anxiety and shame. Research related to fear of negative evaluation, prejudice, and security behaviours can help explain the relationship between social anxiety and stuttering.

Yaruss (2010) states that there are numerous definitions of stuttering, but precisely because of the complexity of the disorder itself, also numerous therapeutic approaches. Guitar (2014) describes stuttering as a disorder defined by basic behaviours, secondary behaviours, and feelings and attitudes that accompany stuttering. Thus, it is a complex disorder that manifests itself in many aspects of the lives of people who stutter and that is why it is difficult to find a unique therapy. Plus these stuttering characteristics differ from each other. For starters, they vary according to the age of people who stutter, so there are therapies for preschoolers, schoolchildren and adults. Therapies most commonly used in adulthood are psychologically oriented therapies. With the right approach to emotional reactions associated with stuttering,

terapiju te se one međusobno razlikuju. Za početak razlikuju se prema dobi osoba koje mucaju, pa tako postoje terapije za predškolsku dob, školsku dob i odraslu dob. Terapije koje se najčešće koriste u odrasloj dobi psihološki su orijentirane terapije. Uz ispravan pristup emocionalnim reakcijama povezanim s mucanjem često se koriste tehnike oblikovanja tečnosti i tehnike modifikacije mucanja kao metode pomoći pri prevladavanju mucanja u svakodnevnim situacijama. Većina terapija koristi metode za oblikovanje tečnosti – spor govor s razvlačenjem vokala, opušteno disanje, mekan početak vokala, riječi, konsonanata i višesložnih riječi. Vrlo često korištene terapije jesu kognitivno-bihevioralne terapije usmjerene na smanjivanje anksioznosti i socijalnog izbjegavanja povezanog s mucanjem. Općenito govoreći, kognitivno-bihevioralne terapije mucanja mogu se podijeliti u tri grupe ovisno o korištenoj tehnici:

- terapije koje se odvijaju u stvarnom životu (izlažuće terapije) – osoba koja muca izlaže se stvarnim životnim situacijama u kojima inače muca. To su primjerice situacija naručivanja hrane u restoranu, razgovor na telefon pa čak i razgovor s prijateljima ili rodbinom, dakle bilo koja situacija u kojoj dolazi do mucanja. U takvim metodama važno je da se osoba postupno uvodi u stvarne situacije i izlaže im se jer inače može doći do lošeg ishoda zbog kojega će se osjećati još gore nego na početku terapije.
- imaginarne terapije – odnose se na postupke u kojima osoba koja muca zamišlja situacije u kojima muca, a terapeut ju vodi kroz zamišljenu situaciju te vodi računa o emocionalnom stanju pacijenta. To je nešto sigurnija terapija jer osoba u bilo kojem trenutku može otvoriti oči i prekinuti terapiju.
- introceptivne terapije – osoba koja muca izlaže se emocionalnim i fizičkim osjetima koje proživljava u izazovnim situacijama. Neke od metoda korištenih u ovoj terapiji jesu: disanje, tjelesna vježba, vrtnja u krug i drmanje. Cilj je smanjiti utjecaj emocija i tjelesnih doživljaja u situacijama mucanja (Walkom, 2016).

fluency shaping techniques and stuttering modification techniques are often used as methods to help overcome stuttering in everyday situations. Most therapies use fluency shaping methods- slow speech with stretched vowels, relaxed breathing, soft onset of vowels, words, consonants and polysyllabic words. Very commonly used therapies are cognitive-behavioural therapies. Those therapies are based on reducing anxiety and avoiding social interactions associated with stuttering. Generally speaking, cognitive-behavioural therapies for stuttering can be divided into three groups, depending on the technique used:

- Therapies that take place in real life (exposure therapies) – with this type of therapy, a person who stutters is exposed to real life situations in which the person normally stutters. This can be, for example, the situation of ordering food at a restaurant, travelling, talking on the phone, even talking to a friend or a family member- generally any situation in which a person will stutter. Within such methods, it is important that the person is easily introduced and exposed to real situations because otherwise it can lead to a bad outcome that will make them feel even worse.
- Imaginary therapies - these therapies refer to procedures in which a person who stutters imagines situations when they normally stutter, and the therapist guides them through that situation and takes care of the patient's emotional state. It is a slightly safer therapy because the person can open their eyes at any moment and stop the therapy.
- Interoceptive therapies - a person who stutters is exposed to emotional and physical sensations they experience in challenging situations. Some of the methods used within this therapy include: breathing, physical exercise, spinning around and shaking. The goal is to reduce the impact of emotions and physical sensations in situations that induce stuttering (Walkom, 2016).

Kao što je već ranije navedeno, kognitivno-bihevioralne terapije imaju svoje nedostatke jer se osobe boje iskusiti stvarnu situaciju u kojoj mucaju ili imaju poteškoće u zamišljanju situacija i prizivanju ostalih osjećaja koji se javljaju dok mucaju. Prema Brundage i sur. (2006) svim terapijama mucanja najveći je problem prijeći barijeru između kliničkog okruženja i stvarnog okruženja i upravo ta generalizacija naučenih ponašanja utječe na uspješnost i učinkovitost klasičnih terapija mucanja. S druge strane terapija virtualnom stvarnošću predstavlja sigurnu zonu za pacijente, a opet omogućuje stvaran prikaz situacije i pobuđuje sve emocije i osjete koje osoba proživljava u stvarnom životu. Kombinacija i implementacija navedenih kognitivno-bihevioralnih terapija u virtualnoj stvarnosti otvaraju brojne mogućnosti za dobrobit osoba koje mucaju.

4. MUCANJE I TERAPIJA VIRTUALNOM STVARNOŠĆU

Uzimajući u obzir do sada navedene karakteristike i mogućnosti virtualne stvarnosti, načina na koji se koristi u terapiji za anksioznost i strahove, obilježja mucanja i njegove povezanosti sa socijalnom anksioznošću, otvara se mogućnost za novu terapiju za mucanje. Terapija virtualnom stvarnošću navodi se kao jedna od najučinkovitijih i najsigurnijih izlažućih terapija, a povezivanje takve terapije s osobama koje mucaju predstavlja jedinstvenu ideju (Walkom G., 2016). Dosadašnjih istraživanja nema mnogo i sva su provedena kod odraslih osoba, uzorci su maleni, ali idu u prilog smanjenju anksioznosti i povećanju tečnosti govora kod osoba koje mucaju. Okruženje u virtualnoj stvarnosti kompjuterski je generiran 3D-svijet koji omogućava korisniku da iskusi situacije slične onima u stvarnome životu (Brundage i Hancock, 2015). Kako bi se virtualna stvarnost uopće mogla razmatrati kao potencijalna terapija za osobe koje mucaju trebalo je najprije odrediti u kojoj mjeri koreliraju afektivne, bihevioralne, kognitivne mjere u virtualnoj stvarnosti s istima u stvarnome životu. Dakle postavilo se pitanje hoće li osobe koje mucaju uopće mucati u virtualnom okruženju?

As mentioned earlier, exposure therapies have their disadvantages because people are afraid to experience the actual situation in which they stutter or they have difficulty imagining situations and evoking other feelings that occur while stuttering. According to Brundage et al. (2006), the biggest problem with all stuttering therapies is crossing over the barrier between the clinical environment and the real environment, and it is precisely this generalisation of learned behaviours that influences the success of classical stuttering therapies. On the other hand, virtual reality therapy is a safe zone for patients, and yet it allows a realistic display of the situation and arouses all the emotions and sensations that a person experiences in real life. The combination and implementation of exposure therapies into virtual reality opens up numerous opportunities for the wellbeing of people who stutter.

4. STUTTERING AND VIRTUAL REALITY THERAPY

Taking into account the above-mentioned characteristics and possibilities of virtual reality, the way virtual reality is used in therapy for anxiety and fears, the features of stuttering and its connection with social anxiety, virtual reality as a new therapy for stuttering is possible. Virtual reality therapy is cited as one of the most effective and safest exposure therapies, and linking such therapy with people who stutter is a unique idea (Walkom, 2016). So far, research is limited, all participants (in all research) are adults, and the samples are small, but the findings favour reduction of anxiety and increased fluency of speech in people who stutter. A virtual reality environment is a computer-generated three-dimensional world, which allows the user to experience situations similar to those in real life (Brundage, Hancock, 2015). In order for virtual reality to be considered a potential therapy for people who stutter, it was first necessary to determine the extent to which affective, behavioural, cognitive measures in virtual reality correlated with those in real life. So, the question was, will people who normally stutter, stutter in a virtual environment?

Brundage i Hancock (2015) u svom su istraživanju željeli ispitati može li virtualna stvarnost pobuditi afektivne, bihevioralne i kognitivne aspekte mucanja koji su slični onima u stvarnom životu kako bi evaluirali potencijal virtualne stvarnosti za korištenje u procjeni i terapiji mucanja. Uzorak je činilo deset osoba koje mucaju čija je jakost mucanja bila izmjerena Instrumentom za ispitivanje jakosti mucanja (Instrument za ispitivanje jakosti mucanja – SSI-3, Riley, 1994). Osim toga korišten je i upitnik kojim se ispituju stavovi o komunikaciji (*Modified Erickson Scale of Communication*, Andrew i Cutler, 1974). Svi su sudionici naveli mucanje kao jedini poremećaj. Zadatak je bio održati javni govor i to dva puta – jednom pred stvarnom publikom, a zatim (dva dana poslije) pred virtualnom publikom. Pred virtualnom publikom osobe koje mucaju bile su testirane dva puta – jednom je virtualna publika bila zainteresirana za ono što osoba koja muca govori (podržavajuće okruženje), a drugi je put okruženje bilo izazovno, u smislu da je virtualna publika bila nezainteresirana i to je pokazivala. Osobe koje mucaju prije svakog su testiranja ispunile standardizirane testove razumijevanja (*Personal Report of Communication Apprehension-24*, McCroskey, 1997) i samopouzdanja (*Personal Report of Confidence as a Speaker*, Paul, 1966) za mjerenje kognitivnog i afektivnog stanja, a učestalost mucanja mjerena je prilikom svakog javnog govora – stvarnog i virtualnog. Poslije virtualnih javnih govora svaki je ispitanik dobio upitnik u kojem je opisivao svoje virtualno iskustvo. Dobiveni rezultati njihova istraživanja pokazuju pozitivne, statistički značajne korelacije između stvarnih i virtualnih uvjeta što nam ukazuje na to da sigurni i kontrolirani uvjeti koje omogućuje virtualna stvarnost mogu biti korisni za procjenu i terapiju mucanja. Dakle afektivna, kognitivna i bihevioralna iskustva koja su karakteristična za mucanje mogu se predvidjeti iz virtualnih iskustava. Upitnik kojim su ispitanici ocjenjivali svoje virtualno iskustvo također je pokazao da su iskustva u virtualnom okruženju slična onima u realnom svijetu.

Istraživanje Brundage i sur. (2006) pokazuje mogućnost manipulacije učestalošću mucanja koristeći virtualnu stvarnost, točnije virtualno okru-

In their study, Brundage and Hancock (2015) sought to examine whether virtual reality could evoke affective, behavioural, and cognitive aspects of stuttering similar to those in real life to evaluate the potential of virtual reality for use in stuttering assessment and therapy. The sample consisted of ten stuttering individuals whose stuttering strength was measured by the Stuttering Severity Instrument for Children and Adults (SSI-3; Riley, 1994). In addition, a questionnaire was used to examine attitudes toward communication (*Modified Erickson Scale of Communication*, Andrew and Cutler, 1974). All participants stated stuttering as the only disorder. The task was to give a public speech twice - once in front of an actual audience and then- two days later- in front of a virtual audience. Examinees (people who stutter) were also tested twice in front of the virtual audience- the first time virtual audience was interested in what the stutterer was saying (supportive environment) and the second time the environment was challenging, in the sense that the virtual audience showed disinterest. The examinees completed standardized tests of apprehension (*Personal Report of Communication Apprehension-24*, McCroskey, 1997) and self-confidence (*Personal Report of Confidence as a Speaker*, Paul 1966) to measure cognitive and affective state before each test, and the frequency of stuttering was measured during each public speech (real and virtual) (Instrument SSI-3). After the virtual public speeches, each examinee was given a questionnaire describing their virtual experience. The results of this research showed positive, statistically significant correlations between real and virtual conditions, which indicates that the safe and controlled conditions provided by virtual reality can be useful for the assessment and treatment of stuttering. Thus, the affective, cognitive, and behavioural experiences that are characteristic of stuttering can be imitated by virtual experiences. A questionnaire by which examinees rated their virtual experience also showed that experiences in a virtual environment are similar to those in the real world.

The study by Brundage et al. (2006) presents the possibility of manipulating the frequency of stuttering using virtual reality, more precisely the

ženje u kojem se simulira intervju za posao (što je izazovna situacija za osobe koje mucaju). Sudjelovalo je 20 osoba koje mucaju, a težina njihova mucanja (mjerena Instrumentom za ispitivanje jakosti mucanja – SSI-3) varirala je od vrlo blagog do teškog mucanja.

Prvo okruženje bilo je izazovno – intervju se odvijao u većem uredu, vodio ga je virtualni direktor, a u samom intervjuu ispitanici su bili prekidani, manje se uspostavljao kontakt očima i (virtualni) direktor govorio je bržim tempom. Ispitanike je prije tog intervjua virtualna tajnica obavijestila da je direktor vrlo zauzet. Pri ulasku u sobu direktor ih je prvo informirao da nema puno vremena, da moraju brzo govoriti i da očekuje važan telefonski poziv. Autori rada kontrolirali su i vrijeme provedeno u virtualnoj čekaonici prije početka samog intervjua. Svi navedeni uvjeti namjerno su stvoreni kako bi se ispitanicima stvorio što veći pritisak. Drugi intervju, koji je bio podržavajući, odvijao se u manjem (virtualnom) uredu, vodila ga je osoba iz ljudskih resursa koja nije upadala u riječ, održavala je kontakt očima, govorila je sporijim tempom te je započela intervju informirajući ispitanika da je i ona sama osoba koja muca. Odmah nakon svakog intervjua ispitanici su ispunjavali upitnik (*Personal Questionnaire* – u daljnjem tekstu PQ) kojim ispitanici ocjenjuju realnost virtualnog okruženja. Također se mjerio ukupan broj mucajućih slogova i postotak tih slogova u odnosu na ukupan broj izgovorenih slogova. Nadalje uspoređivao se i broj ukupno izgovorenih slogova na izazovnom i podržavajućem intervjuu. Rezultati su pokazali da korelacija između težine mucanja i rezultata PQ-a nije statistički značajna. Ipak, iz kvalitativne analize usmenih komentara ispitanika o virtualnom iskustvu vidljivo je da svi ispitanici izvještavaju o osjećajima sličnim kao u stvarnim situacijama. Nadalje osobe koje mucaju (u daljnjem tekstu OKM) prije virtualnih intervjua bile su ispitane Instrumentom za ispitivanje jakosti mucanja (SSI-3). Na tom „intervjuu“ također su im se brojali mucajući i ukupno izgovoreni slogovi, a rezultati su kasnije uspoređivani s rezultatima u virtualnom okruženju te se pokazalo da je učestalost mucanja slična tijekom intervjua u virtualnom i stvarnom okruženju. Usporedbom

virtual environment of a simulated job interview (which is a challenging situation for people who stutter). Twenty people who stutter participated, and the severity of their stuttering (measured by the Stuttering Severity Instrument; SSI-3) ranged from very mild stuttering to severe stuttering.

The first environment was challenging: the interview took place in a large office, led by a virtual director, and in the interview itself the examinees were interrupted, less eye contact was established and the (virtual) director spoke at a faster pace. Before the interview, examinees were told (by the virtual secretary) that the director was very busy, and when entering the room the director first informed them that he did not have much time, that they had to talk quickly and that he was expecting an important phone call. The authors of the paper also controlled the time spent in the virtual waiting room before the start of the interview. All the above-mentioned conditions were deliberately created in order to create as much pressure as possible for the examinees. The second interview, which was supportive, was held in a smaller office, conducted by a person from human resources who did not interrupt, maintained eye contact, spoke at a slower pace and started the interview informing the respondent that she was also a person who stutters. Immediately after each interview, the examinees completed a Personal Questionnaire (hereinafter referred to as PQ) to assess the reality of the virtual environment. The total number of stuttering syllables and the percentage of these syllables in relation to the total number of spoken syllables were also measured. Furthermore, the number of syllables spoken in a challenging versus supportive interview was compared. The results showed that the correlation between stuttering severity and PQ scores was not statistically significant. Nevertheless, a qualitative analysis of the examinees' oral comments on the virtual reality experience shows that all examinees reported feelings similar to those in real situations. Furthermore, persons who stutter were examined by the Stuttering Severity Instrument (SSI-3) prior to the virtual interview. In this "interview", total stuttering and pronounced syllables were also counted. These results were later compared with the results

postotka mucanja u podržavajućem i izazovnom intervjuu dobiveni su očekivani rezultati da su osobe mucale statistički značajno više u izazovnom intervjuu, a mjere samopouzdanja i razumijevanja (prije i nakon virtualnog okruženja) nisu značajno korelirale s jačinom mucanja (mjerene Instrumentom SSI-3). Zaključno ovo istraživanje pokazalo je da virtualna stvarnost predstavlja obećavajući alat za procjenu i terapiju mucanja.

Walkom G. (2016) u svom je istraživanju ispitao kako djeluje virtualna stvarnost kod šest osoba koje mucaju kada moraju govoriti o određenoj temi pet minuta ispred virtualne osobe (avatara). Testirala se govorna izvedba osoba koje mucaju, razina anksioznosti, tjelesna temperatura i elektrodermalna aktivnost (električne promjene na površini kože koje rastu kada kožu inerviraju signali iz mozga) u tri vremenske točke – prije, tijekom i nakon govora u dvjema seansama. Glavno je pitanje istraživanja hoće li se poboljšati govor i smanjiti anksioznost izlaganjem izazovnoj situaciji u virtualnoj stvarnosti. Rezultati istraživanja pokazali su smanjenje razine anksioznosti, poboljšanja u govoru, smanjenje tjelesne temperature kao i elektrodermalne aktivnosti između dvaju govora, odnosno dvaju mjerenja u trima vremenskim točkama.

Brundage, Brinton i Hancock (2016) u svojem su istraživanju koristili virtualnu stvarnost kako bi istražili njezinu korisnost za ispitivanje fiziološke reaktivnosti i subjektivne procjene stresa kod 10 osoba koje mucaju. Subjektivne i objektivne mjere prikupljene su tijekom govora u trajanju od četiri minute pred virtualnom publikom i pred virtualnom praznom sobom. Rezultati su pokazali da se fiziološke mjere nisu razlikovale ovisno o uvjetima, ali subjektivne mjere stresa bile su statistički značajno veće kada je bila prisutna virtualna publika u odnosu na govor pred praznom sobom. Zaključuju da virtualna stvarnost ima potencijal da bude korisna za uvježbavanje ciljeva terapije u sigurnim i kontroliranim uvjetima.

Nafjan, Alghamdi i Almudhi (2021) proveli su istraživanje s tri odrasle osobe koje mucaju, u dobi od 30 do 34 godine, a cilj je istraživanja bio procijeniti preciznost govornog analizatora u detekciji mucajućih netečnosti i procijeniti učinko-

in the virtual reality environment and they indicated that the frequency of stuttering was similar during the interviews regardless of the environment. As expected, when comparing the percentage of stuttering in a supportive interview to that in a challenging interview, individuals stuttered significantly more in the challenging interview and self-confidence and apprehension measures (before and after virtual reality environment) did not significantly correlate with stuttering intensity (as measured by SSI-3). In conclusion, this research showed that virtual reality is a promising tool for the assessment and treatment of stuttering.

Walkom G. (2016) examined how virtual reality affected six people who stutter when they have to talk about a certain topic for five minutes in front of a virtual person (avatar). Speech performance of persons who stutter, their anxiety level, body temperature, and electro dermal activity (electrical changes on the skin surface that increase when skin is innervated by signals from the brain) were tested at three time points — before, during, and after the speech- in two sessions. The main question of the research was whether speech would improve and anxiety be reduced when exposed to virtual reality. The results of the research showed a decrease in the level of anxiety, improvements in speech, a decrease in body temperature as well as electro dermal activity between the two speeches (before, during and after every speech).

In their study, Brundage, Brinton and Hancock (2016) used virtual reality to investigate its usefulness for examining physiological reactivity and subjective stress assessment in 10 stuttering individuals. Subjective and objective measures were collected during a four-minute speech in front of the virtual audience and in front of an empty virtual room. The results showed that physiological measures did not differ depending on the conditions, but subjective stress measures were significantly higher when the virtual audience was present compared to a speech in front of an empty room. They concluded that virtual reality has the potential to be useful for practising therapy goals in safe and controlled conditions.

Al-Nafjan, Alghamdi and Almudhi (2021) conducted an evaluation study with 3 persons who

vitost korištenja virtualnog okruženja kao medija za prezentiranje govornih zadataka. Eksperiment se proveo jednom, u izoliranoj sobi pod nadzorom logopeda. Glavni zadatak sudionika bio je da u virtualnom okruženju pročitaju tekst s papira pred virtualnom publikom. Nakon provedenog eksperimenta sudionici su intervjuirani kako bi dali povratnu informaciju o dojmovima virtualnog okruženja u rehabilitaciji. Rezultati istraživanja pokazali su snažne pozitivne korelacije između duljine trajanja govora sudionika i automatski detektiranih mucajućih netečnosti što ukazuje na pouzdanost govornog analizatora u zamjećivanju mucajućih netečnosti. Tijekom intervjua sudionici su pozitivno ocijenili virtualna iskustva te izvijestili o prihvatljivoj sličnosti između virtualne tehnologije i stvarnog svijeta, osim za avatare (virtualni likovi) koji imaju nižu razinu sličnosti sa stvarnim osobama. Unatoč tome virtualno je okruženje izazvalo slična iskustva i osjećaje kao i stvarno okruženje.

5. ZAKLJUČAK

Mucanje je složen poremećaj koji se na različit način manifestira kod osoba koje mucaju i često može imati negativan utjecaj na kvalitetu života osoba koje mucaju. Postoje različiti aspekti mucanja, pa tako i različite terapije mucanja. Ipak, sve dosadašnje terapije nemaju veliku uspješnost s generalizacijom, odnosno s transferom novih, naučenih ponašanja i tehnika za modifikaciju mucanja i oblikovanje tečnosti govora iz kliničkih uvjeta u stvarni život. Terapeutima je teško, gotovo nemoguće, izvoditi klijente izvan terapijskog okruženja kako bi uvježbavali novo-naučena ponašanja ili kreirati složene socijalne interakcije u kliničkom okruženju (Brundage i sur., 2016). Nadalje takvim izlaganjem klijenta u nekontroliranim uvjetima stvarnog života narušavamo njegovo povjerenje što može imati negativan učinak na uspješnost terapije. S druge strane virtualna je stvarnost tehnologija koja omogućava klijentu da uvježbava tehnike ispred mnogo virtualnih ljudi i u mnogo različitih virtualnih okruženja i na takav način može biti korisna za desenzitizaciju klijenata na mucanje i u stvarnom životu (Nafjan i sur., 2021). Nadalje virtualno okruženje omogućuje

stutter (from 30 to 34 year of age). The study's aim was twofold: to evaluate the effectiveness of using a virtual environment as a medium for presenting speech training tasks, and to evaluate the accuracy of the speech analyser module in detecting stuttering events. The experiment was conducted in one session in an isolated room under the supervision of an expert speech and language pathologist. The participants' main task was to read an Arabic script from a paper placed on a virtual podium facing the virtual audience (as in the virtual scene). After the experiment, the participants were interviewed to provide feedback of virtual reality in rehabilitation. A strong positive correlation between the session length and the automatically detected stuttering event was found, suggesting an acceptable performance of the speech analyser in detecting stuttering events. During the post-test interviews, the participants positively rated their virtual reality experiences in different aspects. In terms of aesthetic design, the participants reported an acceptable resemblance between the virtual scene and a real-world conference room. In terms of character design, the participants reported experiencing a lower level of human resemblance in a synthetically designed character. In terms of the virtual reality experience, the participants reported that using virtual reality triggered a similar pitching experience in a virtual scene as that of a real-life situation. The participants also stated that their feelings of fear were similar to those that they felt in real-world speaking-related activities. These comments indicated significant levels of presence and immersion in the environment.

5. CONCLUSION

Stuttering is a complex disorder that manifests itself in different ways and often has a negative impact on the quality of life of people who stutter. There are different aspects of stuttering, thereby requiring different therapies for stuttering. However, all previous therapies have not been very successful with generalization, i.e., with the "transfer" of new, learned behaviours and techniques for shaping fluency from clinical conditions into real life. It is difficult, if not impossible, for therapists to take clients out to prac-

terapeutu da hijerarhijski organizira interakcije te da ih u potpunosti kontrolira čime se smanjuju negativni učinci kognitivno-bihevioralnih terapija. Terapeut kontrolira način na koji je osoba izložena i koliko je dugo izložena situaciji, reakcije sugovornika/publike itd. Pregledom svih dostupnih istraživanja vidljivo je da virtualna stvarnost utječe na smanjenje anksioznosti i povećanje tečnosti, a istraživanja iz psihologije pokazuju i veću učinkovitost ovakve terapije u odnosu na klasične terapije. Kad se govori o prednostima korištenja virtualne stvarnosti u logopedskoj terapiji, svakako treba spomenuti prenosivost, upotrebljivost i pouzdanost uređaja virtualne stvarnosti kao i prihvatljive cijene samih uređaja. Iz svega navedenog može se zaključiti da je ova tema vrijedna daljnjeg istraživanja kako bi se jednoga dana mogla oblikovati terapija koja će osobama koje mucaju omogućiti generalizaciju i transfer novih tehnika u svakodnevni život. S obzirom na to da su istraživanja pokazala uspješan učinak terapije virtualnom stvarnošću na motoričke vještine kod osoba nakon moždanog udara, kod djece s cerebralnom paralizom i kod osoba s Parkinsonovom bolešću (Vaezipour i sur., 2021), trebalo bi u budućim istraživanjima ispitati mogućnosti virtualne stvarnosti u tretiranju narušenih govorno-motoričkih komponenti mucanja. Neupitno je da će se virtualna stvarnost sve više koristiti u logopedskoj terapiji različitih jezičnih i govornih poremećaja, no potrebno je potencijalnim korisnicima ove vrste terapije naglasiti da ova vrsta terapije ne može zamijeniti logopeda i njegov izravan rad te da u terapiji ne bi trebali sudjelovati samo zato što se radi o novim tehnologijama.

tice newly learned behaviours or create complex social interactions in a clinical setting (Brundage et al., 2016). Furthermore, by exposing a client to uncontrolled, real-life conditions, we are undermining his or her confidence and this might have a negative effect on the success of the therapy. Virtual reality, on the other hand, is a technology that allows a client to practice techniques in front of many virtual people and in many different virtual environments, and thus could be useful for desensitizing clients to stuttering in real life as well (Nafjan et al, 2011). Moreover, virtual reality allows the therapist to organise interactions hierarchically and to control them completely, hence reducing the negative effects present in other exposing therapies. The therapist controls the way a person is exposed, how long they are exposed to the situation, the reactions of the other speakers / audience, and many other factors. A review of all previous research shows that virtual reality reduces anxiety and increases fluency, and research in psychology shows greater effectiveness of such therapy in comparison to classical therapies. Furthermore, virtual reality in speech and language therapy has the advantages of easy-to-use, portability and reliability. From all of the above, it can be concluded that this topic is worth researching further in order to one day shape a therapy that will allow people who stutter to generalise new techniques into everyday life. Considering results of research that showed a positive effect on motor skills of people after stroke, kids with cerebral palsy and people with Parkinson's disease (Vaezipour et. al, 2021), possibilities of virtual exposure therapy in treatment of disturbed speech-motor skills in people who stutter should be examined. It is without question that virtual reality will be used increasingly in speech and language therapy, but it should always be prominent to users that this type of therapy cannot replace speech and language pathologists and their direct clinical work.

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