Prevalence of virtual reality (VR) games found through mental health categories on STEAM: a first look at VR on commercial platforms as tools for therapy

Almira Osmanovic Thunström, Iris Sarajlic Vukovic, Lilas Ali, Tomas Larson and Steinn Steingrimsson

Objective: The aim of this study was to take a first look at the prevalence and overview of content of commercially available games. The games were found using search words related to psychiatric diagnosis or care.

Methods: We performed a search for keywords related to symptoms, diagnosis, and treatment strategies of mental health problems. The search was performed November 2020 on STEAM. A scheme was created for elimination and inclusion of games, eliminating those games which were irrelevant to mental health or had triggering elements such as violence, excessive movement which could trigger nausea, horror and pornographic imagery.

Results: In total, 735 hits were found, 565 unique games. After the games were reviewed for content via trailers, descriptions and screenshots, 32%, i.e. 182 games passed the inclusion criteria. Majority of the games which were excluded were either not connected to mental health, contained violence, adult content or were in other ways irrelevant or inappropriate.

Conclusions: Commercial platforms are only at the beginning of the development towards therapeutic content. Currently the quality and usability for therapeutic use is scarce but holds great potential.
over 70 million active users it is one of the most actively used platforms for gaming.

An increasing part of the commercial platforms for digital games are serious games, edutainment, e-learning games as well as games aimed at self-help and psychiatry. These games are defined as games with a purpose other than mere entertainment [14]. A growing category on commercial gaming platforms is gamification of self-help and well-being in terms of, e.g. meditation, phobias, and life coaching. Many games try to enhance efficacy of a treatment strategy by offering a gamification aspect to the game or experience [15]. Case studies and clinical trials with ‘difficult to treat’ patients have shown that VR has been useful in increasing efficacy for adhering to treatments [13], however some studies lack follow-ups and replications. The systems and games which are employed by researchers vary greatly. While some researchers use commercially available VR games others adhere to games and software created by and for a specific research lab. STEAM is a frequently used, cross cultural platform which allows great accessibility to games for both laymen and researchers.

Aim

This original study aims to explore the prevalence of games tagged with keywords related to mental health. The aim is also to explore how many games found through chosen keywords can be included according to a specific inclusion criterion based on trigger elimination, as well as explore the initial impressions of the included games.

Method

Search strategy

A list of keywords was constructed containing psychiatric diagnosis and commonly used treatment terms. The keywords chosen were ‘Psychology’, ‘Psychiatry’, ‘Therapy’, ‘PTSD’, ‘Post traumatic stress disorder’, ‘ADHD’, ‘Attention deficiency/hyperactivity disorder’, ‘Psychosis’, ‘Addiction’, ‘Depression’, ‘Anxiety’, ‘Anorexia’, ‘Bulimia’, ‘Eating Disorder’, ‘Trauma’, ‘Suicide’, ‘Personality Disorder’, ‘Mindfulness’, ‘Meditation’, ‘Phobia’, ‘CBT’, ‘Cognitive Behavioral Therapy’ ‘Hallucination’, ‘Schizophrenia’, ‘Burnout’, ‘Paranoid’, ‘Sexual abuse’, ‘LSD’, ‘Alcoholism’, ‘Body Dysmorphic Disorder’, ‘Body Image’, ‘OCO’, ‘Obsessive compulsive disorder’, ‘Hoarding’, ‘Self harm’, ‘Borderline Personality Disorder’, ‘Bipolar Disorder’, ‘Relaxation’ ‘Hoarding’ and ‘Stress’.

Similar search word strategies on STEAM have previously been reported to explore mental health themes in video games [16].

The search was performed without any restrictions and again with restrictions provided by STEAM during the month of November 2020. STEAM settings allow for searches to filter mature and violent content. Users can choose to exclude games that are intended for mature audiences. These games may have content or themes not appropriate for all audiences such as graphic violence, frequent nudity, sexual content, and other mature topics. Additional keywords were added in the settings to filter games with keywords ‘Porn’ ‘Sexual content’, ‘Violence’ and ‘Horror’. As our purpose is to provide an overview of content to a wide spectrum of patients in psychiatry, we aimed to avoid things which could be considered particularly triggering of negative emotions, e.g. violence and sexual exploitation. Although there is sparse and inconsistent evidence for violent imagery, pornography and aggression causing negative emotions and worsened mental health, we erred on the side of caution, siding with common sense in terms of triggering stimuli [17,18].

Inclusion and exclusion criteria for content

The search was restricted to ‘VR Only’ Games, 360 video/360 graphic experiences and Demos and excluded Streams, Recorded Videos, Software and other content as well as ‘VR Supported’ games. 360-degree videos are video recordings where a view in every direction is recorded at the same time (360 degrees). In a virtual reality display the 360-video can be experiences though immersion and explored though head movement. 360 graphic experiences are computer generated videos or virtual reality environments that most often have very little interaction during the immersion, example of such is 360-degree cartoon movies.

The decision to exclude ‘VR Supported’ games was based on the focus of this study being solely on ‘VR Only’ content and technology that properly supports VR content.

The search was not restricted to any specific virtual reality hardware or user language. The purpose of the search was to explore which type of games can be found using search words aimed at psychiatric disorders, treatment strategies or therapy methods.

The scheme was constructed by 2 specialists in psychiatry, one clinical psychologist, a nurse specialist in psychiatry and a cognitive neuroscientist. The main purpose of the scheme was to minimize stimuli that could elicit triggers which could worsen symptoms, well-being or specific mental health conditions such as gambling, flashbacks, and more. We excluded games with violent or frightening imagery, pornographic imagery, games which contained shooting or stabbing with items that can be considered as weaponry, games which contained gambling or alcohol use as well as games which employed excessive use of movement which may cause nausea e.g. roller-coasters or swinging from buildings. A game or experience was included based on the game’s own description, video, and images on STEAM.

Further insight into exclusion criteria can be seen in Figure 1. If the game video/trailer, description, or promo images contained any of these aspects (if YES on any parameter) the game was excluded.

Results

A total of 735 hits were found using the search words listed without applying any filters, and 628 hits were found with
filters (Figure 2). Table 1 shows the prevalence of overall hits per search word that generated hits. Search word such as ‘ADD, Anorexia, Bulimia, Eating disorder, Personality disorders, Schizophrenia, Sexual abuse, Body dysmorphic disorder, OCD, Obsessive compulsive disorder, Borderline personality disorder and Bipolar disorder’ did not generate any hits. Upon manual review 565 unique games and/or experiences remained and were manually reviewed. 182 games made the inclusion criteria (Table 2).

While the automated exclusion system was effective in rooting out horror and sexual content, it was less efficient at identifying violence which was mainly excluded manually. Games which were excluded contained violence, adult themes, nudity and gambling inappropriate for use as they may trigger or worsen some mental health problems (e.g. PTSD or gambling addiction) and excessive movement. An example of one such game is Blind (Tiny Bull Studio, 2018). The game is based on echolocation in a dark mansion, where the subject meets dangers in form of deranged protagonists and puzzles. The themes of madness and hopelessness emerge, but there is a heavy focus on the action and horror. The aim and purpose of the game is to cause distress for the player. It was thus excluded.

Most common factor for excluding games which have passed the STEAM filter was grounded in their misplacement in connection to the search word they were found under. One such example is Virtual Escape: The Play Room (Default Interactive, 2016). The game features horror imagery and high leaves of stress. It was found under the search word trauma. The theme trauma is relevant in connection to the context of the game but is not feasible as a tool for treating trauma or trauma exposure therapy due to its other worldly and horror imagery as well as competitive aspects.
**Depression and CBT**

Very few search results appeared for VR-Only gaming content for the search word depression. At the point of search only four hits appeared, and only two were eligible for further review one of those being *Lullaby of Colours* (Developer Company: Andrew C Wang, 2019) (Figure 3). CBT is a commonly recommended as a treatment strategy for depression which meta-analyses have shown to be effective in most populations [19]. But, when CBT (both abbreviation and full terminology) was typed in the search field only *WiseMind* (REALITEER Corp, 2016) appeared. *WiseMind* did not offer any tools for mapping thoughts or behaviors but was rather a relaxation and distraction tool. The user was instructed to balance stones on a table in a relaxing environment. All above mentioned games were included as they fulfilled the general inclusion criteria.

**Psychology, therapy, phobia and psychiatry**

Search words such as psychology, phobia, psychiatry, and therapy generated a variety of games. The term phobia identified games such as *Fear Simulator* (Ibsoft Studio, 2019), and *Arachnophobia* (IgnisVR, 2016), but it also identified games with no themes of phobia. One such example is the game *Purgatory Fell* (Insanely Virtual, 2018). The game is described as a psychological thriller set in 1955, exploring the declining mind of a man who cannot sleep. It was excluded due, among other things, horror imagery.

A large variety of type of games was found under the search words therapy and psychology. Very few were relevant upon review. Games which were excluded had content unrelated to their keywords, for example *Crazy Flies* (Chongqing Yan Wan network technology Co. Ltd, 2016). The gameplay is focused on eliminating flies from a kitchen and

### Figure 2. Summary of inclusion process.

| Identification | Search result identified without restrictions (n = 735) |
|----------------|------------------------------------------------------|
|                | Search result identified with restrictions (n = 628) |
|                | Records after duplicates removed (n = 565)           |
|                | Games screened (n = 565)                             |
|                | Games removed due to excessive movement, violence and/or adult content (n = 383) |
|                | Games included for further review (n = 182)          |
had no other connections to psychology other than the word ‘crazy’ in the title. It was thus eliminated. In contrast, a series of games made by Staples VR called VRemedies was by far the most accurately tagged and the ones with the most feasible design for use in clinical practice. The game series consists of several different games/experiences which focus on reducing anxiety and educating younger patients who are to undergo medical imaging or surgery. This game was included as it follows our inclusion criteria.

**Hallucinogens and LSD**

Hallucination or Hallucinogens generated few but irrelevant results. Games were mainly geared towards the horror genre thus no games were included. In contrast, LSD generated three relevant results. There was a large variation of the content provided. The games mainly focused on the visual hallucinations which are associated with psychedelics. Some games which thematically fell under this category appeared under Mindfulness instead, such as Ayahuasca (Atlas V, 2020) (Figure 4). The game is a psychedelic experience in VR, which tries to emulate the cerebral and emotional experience of participating in a traditional Ayahuasca ceremony. The game was included as the purpose of the experience was to simulate a spiritual journey and not to elicit horror imagery.

**Mindfulness and meditation, overlapping field and games**

Mindfulness and meditation generated highest frequency of hits. Out of initial search results 20% of the games that were found via the search term mindfulness passed the inclusion criteria while 68% of the games under the search term meditation were included (Table 1). Very few of the experiences were traditional mindfulness programs, instead games focused more on virtual relaxing environments, creative environments for painting, playing simpler ball games or space and nature exploration. Searching for meditation, several relevant games and demos appeared; however, it too contained a broad spectrum of experiences which could be classified in many different fields. For example, the experience Dances with butterflies (Jonathan Robson, 2019) was not a meditation app, but provided an environment and sounds which could be used during a meditation. Where Thoughts Go (Thought Co., 2018) was not at all a meditation experience but rather fell under the category of group therapy, it was none the less found under the search word meditation. Some games did however solely focus on helping individuals train and perform different type of meditation e.g. Guided Meditation VR (Cubical Ninjas, 2016).

| Search words           | Nr of hits without filter | Nr of hits with filter | Relevant hits after manual review | % Relevant of original unfiltered search |
|------------------------|----------------------------|------------------------|-----------------------------------|----------------------------------------|
| ADD                    | 0                          | 0                      | 0                                 | 0%                                     |
| Addiction              | 52                         | 51                     | 4                                 | 8%                                     |
| ADHD                   | 1                          | 0                      | 0                                 | 0%                                     |
| Alcoholism             | 14                         | 12                     | 0                                 | 0%                                     |
| Anorexia               | 0                          | 0                      | 0                                 | 0%                                     |
| Anxiety                | 12                         | 7                      | 0                                 | 0%                                     |
| Borderline             | 0                          | 0                      | 0                                 | 0%                                     |
| Body dysmorphic disorder | 0                       | 0                      | 0                                 | 0%                                     |
| Body image             | 11                         | 9                      | 1                                 | 9%                                     |
| Bulimia                | 0                          | 0                      | 0                                 | 0%                                     |
| CBT                    | 0                          | 0                      | 1                                 | 0%                                     |
| Depression             | 6                          | 5                      | 4                                 | 67%                                    |
| Eating disorders       | 0                          | 0                      | 0                                 | 0%                                     |
| Hallucination          | 4                          | 2                      | 0                                 | 0%                                     |
| Hoarding               | 8                          | 5                      | 0                                 | 0%                                     |
| Hoarding               | 0                          | 0                      | 0                                 | 0%                                     |
| LSD                    | 3                          | 3                      | 3                                 | 100%                                   |
| Meditation             | 66                         | 62                     | 45                                | 68%                                    |
| Mindfulness            | 221                        | 174                    | 45                                | 20%                                    |
| OCD                    | 0                          | 0                      | 0                                 | 0%                                     |
| Paranoid               | 3                          | 3                      | 0                                 | 0%                                     |
| Personality disorders  | 0                          | 0                      | 0                                 | 0%                                     |
| Phobia                 | 7                          | 5                      | 3                                 | 43%                                    |
| Psychiatric            | 3                          | 3                      | 0                                 | 0%                                     |
| Psychology             | 25                         | 21                     | 5                                 | 20%                                    |
| Psychosis              | 1                          | 0                      | 0                                 | 0%                                     |
| PTSD                   | 2                          | 2                      | 0                                 | 0%                                     |
| Relaxation             | 196                        | 186                    | 114                               | 58%                                    |
| Schizophrenia          | 1                          | 1                      | 0                                 | 0%                                     |
| Self harm              | 1                          | 1                      | 0                                 | 0%                                     |
| Sexual abuse           | 0                          | 0                      | 0                                 | 0%                                     |
| Stress                 | 57                         | 47                     | 17                                | 30%                                    |
| Suicide                | 17                         | 12                     | 0                                 | 0%                                     |
| Therapy                | 19                         | 17                     | 16                                | 84%                                    |
| Trauma                 | 5                          | 3                      | 0                                 | 0%                                     |
| Total                  | 735                        | 628                    |                                   |                                        |

ADD: Attention difficulty disorder; ADHD: Attention difficulty hyperactive disorder; CBT: Cognitive behavioral therapy; LSD: Lysergic acid diethylamide; OCD: obsessive compulsive disorder; PTSD: Post traumatic stress disorder.
Table 2. Games which passed the inclusion criteria.

| Game title                        | Year of release | Found under keywords                                      |
|-----------------------------------|-----------------|-----------------------------------------------------------|
| A Lullaby of Colors VR            | 2019            | Depression, meditation, relaxation                        |
| A Walk in the Woods               | 2020            | Stress                                                    |
| A Writer and His Daughter         | 2017            | Mindfulness                                               |
| ABC Paint                         | 2018            | Mindfulness                                               |
| Adventure Climb VR                | 2019            | Mindfulness                                               |
| Anyland                           | 2016            | Addiction, mindfulness                                    |
| Apollo 17 – Moonbuggy VR          | 2019            | Mindfulness                                               |
| Arachnophobia                     | 2016            | Phobia                                                    |
| Ashes of the Ark                  | 2018            | Relaxation                                                |
| Ayahuasca                         | 2020            | Meditation                                                |
| Ballavita                         | 2020            | Depression                                                |
| Basketball Court VR               | 2017            | Relaxation                                                |
| Batter Up! VR                     | 2017            | Relaxation                                                |
| Beach Ball Valley                 | 2020            | Mindfulness, relaxation                                   |
| Beast Pets                        | 2019            | Relaxation                                                |
| Beat Blocks VR                    | 2018            | Addiction                                                 |
| Beyond the Horizon                | 2017            | Meditation, relaxation                                    |
| Big Breezy Boat – Relaxing Sailing| 2018            | Relaxation                                                |
| Binaural Odyssey                  | 2020            | Meditation, relaxation                                    |
| Bitslap                           | 2016            | Mindfulness                                               |
| Blobby Tennis                     | 2017            | Relaxation                                                |
| Blortasia                         | 2017            | Mindfulness, meditation, relaxation                       |
| bloxyz                            | 2016            | Relaxation                                                |
| Bowling at the Lake               | 2016            | Relaxation                                                |
| Bowlslinger                        | 2016            | Relaxation                                                |
| Boxplosion                        | 2018            | Relaxation                                                |
| Breathe Peace World               | 2019            | Mindfulness, meditation, relaxation                       |
| Bridge Trek                       | 2018            | Therapy                                                   |
| Builder VR                        | 2019            | Mindfulness                                               |
| CAPCOM GO! Apollo VR Planetarium  | 2019            | Relaxation                                                |
| Carpe Lucem – Seize The Light Demo| 2016            | Mindfulness, relaxation                                    |
| Catch & Release                   | 2018            | Meditation, relaxation                                    |
| Clean VR                          | 2019            | Relaxation                                                |
| Code51: Mecha Arena               | 2018            | Relaxation                                                |
| Conscious Existence – A Journey Within | 2019 | Mindfulness, meditation, relaxation |
| Country Road VR                   | 2020            | Mindfulness, relaxation                                    |
| Cove Point Fun Center VR          | 2017            | Relaxation                                                |
| Crazy Machines VR                 | 2018            | Mindfulness, relaxation                                    |
| Cubism                            | 2020            | Mindfulness                                               |
| Cut Cut Buffet                    | 2017            | Relaxation                                                |
| Dances with Butterflies VR        | 2019            | Mindfulness, meditation, relaxation                       |
| Deep Diving VR                    | 2019            | Relaxation                                                |
| Destination: Pluto the VR Experience| 2017      | Mindfulness                                               |
| Die Fantastischen VR – Fantaventura| 2020        | LSD, relaxation                                           |
| Dimensional Intersection          | 2016            | Meditation                                                |
| Dive with Sylvia VR               | 2019            | Relaxation                                                |

(continued)
| Game title                                | Year of release | Found under keywords                                      |
|-------------------------------------------|-----------------|-----------------------------------------------------------|
| DMT: Dynamic Music Tesseract              | 2018            | Relaxation                                                |
| Dodo Adventures                           | 2020            | Meditation                                                |
| DOJAGI: The Korean Pottery                | 2018            | Relaxation                                                |
| DownStream: VR Whitewater Kayaking        | 2019            | Relaxation                                                |
| DREAMFLIGHT VR                            | 2015            | Relaxation                                                |
| DreamTank                                 | 2017            | Meditation, relaxation                                    |
| Drops: Rhythm Garden                      | 2018            | Mindfulness, meditation, relaxation                       |
| Echoes in White                           | 2018            | Meditation, relaxation                                    |
| EGE DistancePlanet NonXXX                 | 2017            | Relaxation                                                |
| Elevator VR                               | 2017            | Meditation                                                |
| EmbodyMe Beta                             | 2017            | Body Image                                                |
| Fair Islands VR                           | 2016            | Relaxation                                                |
| Fear Simulator                            | 2019            | PSYCHOLOGY, mindfulness, phobia                           |
| Fishing Adventure VR                      | 2020            | Relaxation                                                |
| Fractal Gallery VR                        | 2019            | Meditation, relaxation                                    |
| Fujii                                     | 2019            | Meditation, relaxation                                    |
| Funball Games VR                          | 2017            | Mindfulness                                               |
| Function                                  | 2020            | Therapy, meditation                                       |
| Funfair                                   | 2016            | Relaxation                                                |
| Galactic Gallery                          | 2017            | LSD                                                       |
| GATEBALL                                  | 2020            | Depression                                                |
| GIPHY World VR                            | 2018            | Relaxation                                                |
| Go For a Walk                             | 2020            | Addiction                                                 |
| Golf On the Moon (VR)                     |                 |                                                           |
| Graffiti Bombing                          | 2020            | Mindfulness                                               |
| Groove Catcher Demo                       | 2020            | Meditation                                                |
| Guided Meditation VR                      | 2016            | Mindfulness, meditation, relaxation                       |
| Hoop Shot VR                              | 2017            | Relaxation                                                |
| INK                                       | 2020            | Depression                                                |
| Instacalm VR                              | 2019            | Mindfulness, relaxation, therapy                          |
| International Space Station Tour VR       | 2018            | Mindfulness                                               |
| Island Explorer VR                        | 2020            | Relaxation                                                |
| Jam Session VR                            | 2017            | Relaxation, therapy                                       |
| Jam Studio VR - Education & Health Care Edition | 2018    | Therapy                                                   |
| Jigsaw 360                                | 2018            | Relaxation, meditation                                    |
| Kakwitene VR                              | 2019            | Relaxation                                                |
| KENDAMVR – Virtual Reality Kendama        | 2017            | Relaxation                                                |
| Kinose                                    | 2018            | Meditation                                                |
| L U N E                                   | 2016            | Meditation                                                |
| Let's Create! Pottery VR                  | 2019            | Mindfulness, relaxation                                    |
| Light and Dance VR – Music, Action, Relaxation | 2017   | Mindfulness, relaxation                                    |
| Marimba VR                                | 2017            | Relaxation                                                |
| Maze of Gaea (Real Maze VR Simulation)    | 2018            | Relaxation                                                |
| Meditation Journey VR Zen Garden          | 2020            | Anxiety, mindfulness, meditation, relaxation              |
| Meditation VR                             | 2020            | Meditation                                                |
| Mind Labyrinth VR Dreams                  | 2018            | Mindfulness, meditation, relaxation                       |
| MinigolfPark VR                           | 2019            | Relaxation                                                |
| Mio Garden                                | 2018            | Meditation, relaxation                                    |
| My Home VR                                | 2019            | Relaxation                                                |
| My Lil' Donut                             | 2016            | Relaxation                                                |
| Namaste Virtual Yoga Retreat              | 2018            | Relaxation                                                |
| Naturallandscape - Three Gorges (自然景观系列-长江三峡) | 2018 | Relaxation                                                |
| Nature Treks VR                           | 2017            | Meditation, relaxation                                    |
| NetStars – VR Goalie Trainer              | 2018            | Stress                                                    |
| Obstruction: VR                           | 2018            | Mindfulness, relaxation                                    |
| Off The Chains Disc Golf                 | 2020            | Relaxation                                                |
| OrbusVR: Reborn                           | 2019            | Relaxation                                                |
| Particulate                               | 2019            | Relaxation                                                |
| Perfect                                   | 2016            | Meditation, relaxation                                    |
| Personal Disco VR                         | 2017            | PSYCHOLOGY                                                |
| Planetarium VR                            | 2020            | Relaxation                                                |
| PLAYNE VR                                 | 2020            | Mindfulness, meditation                                    |
| Playthings: VR Music Vacation             | 2016            | Stress                                                    |
| PolyDome                                  | 2016            | Relaxation                                                |
| Power Solitaire VR                        | 2017            | Relaxation                                                |
| Prana                                     | 2020            | Meditation                                                |
| Psyia                                     | 2019            | Meditation, relaxation                                    |
| PT+                                      | 2020            | Therapy                                                   |
| Puppy Chef Academy Demo                   | 2018            | Stress                                                    |
| Puzzle Island VR                          | 2020            | Relaxation                                                |
| RadianVR                                  | 2018            | Relaxation                                                |
| Recreational Dreaming                     | 2018            | LSD                                                       |
| Relax Walk VR                             | 2017            | Relaxation                                                |
| Relaxing VR Games: Mahjong                | 2017            | Relaxation                                                |

(continued)
Discussion

In comparison to traditional PC games without head mounted display, virtual reality content is still growing and finding its audience on commercial platforms such as STEAM. The aim of this study was to explore the prevalence of virtual reality experiences and games found under keywords related to mental health. Although many of the search words could be found, a large portion could not. Commercial platforms are still primarily for entertainment, thus more clinical terms and educational games in VR may not be primarily found here but are developed and distributed by developers that sell them directly to psychiatric departments. STEAM is also not a hub of 360 video content, which may be more popular in health care due to its availability via Youtube.

| Game title | Year of release | Found under keywords                                                                 |
|------------|----------------|--------------------------------------------------------------------------------------|
| Ricerca VR | 2016           | Meditation                                                                           |
| River Relaxation | 2019 | Relaxation                                                                            |
| Rocking Legend | 2020 | Relaxation                                                                           |
| Screensavers VR | 2019 | Mindfulness, relaxation                                                               |
| Sea of memories | 2018 | Mindfulness, relaxation                                                               |
| Self-knowledge VR | 2019 | PSYCHOLOGY                                                                          |
| SereNest | 2019           | Meditation                                                                           |
| Sheaf – Together EP | 2019 | Relaxation                                                                        |
| Shinrin-yoku: Forest Meditation and Relaxation | 2018 | Therapy, meditation, relaxation                                                      |
| Skill Master VR – Learn Meditation | 2016 | Anxiety, mindfulness, meditation, relaxation                                         |
| Soulace | 2021           | Relaxation                                                                           |
| SOUNDART | 2020           | Mindfulness                                                                           |
| Soundscape VR | 2017 | Mindfulness                                                                           |
| SpaBerry VR Experience | 2018 | Therapy                                                                               |
| Space Dream | 2018           | Meditation                                                                           |
| Space Slurpies | 2021 | Relaxation                                                                           |
| Stars | 2016           | Relaxation                                                                           |
| Stonehenge VR SANDBOX | 2017 | Mindfulness                                                                           |
| Tails | 2016           | Relaxation                                                                           |
| Teleporter: World of Gamers (Alpha) | 2020 | Mindfulness                                                                           |
| Thal: Dreamtime is Now | 2020 | Mindfulness                                                                           |
| The Grand Canyon VR Experience | 2017 | Meditation, relaxation                                                               |
| The Night Cafe: A VR Tribute to Vincent Van Gogh | 2016 | Relaxation, relaxation                                                               |
| The Stars Between Us | 2020 | Meditation, relaxation                                                               |
| The Virtual Reality Museum of Immersive Experiences | 2019 | Anxiety                                                                            |
| THE VR CANYON | 2020 | Relaxation                                                                           |
| theBlu | 2016           | Meditation                                                                           |
| Therapy Sheep VR | 2020 | Therapy, mindfulness, meditation                                                     |
| These Lands | 2019           | Mindfulness                                                                           |
| Throwing Stone | 2020 | Phobia                                                                               |
| Time Transit VR | 2019 | Relaxation                                                                           |
| Top Floor | 2016           | Relaxation                                                                           |
| Tsuro - The Game of The Path – VR Edition | 2019 | Relaxation                                                                         |
| Turing Tumble VR | 2018 | Addiction                                                                            |
| Turing Tumble VR | 2018 | Mindfulness                                                                           |
| Vetrix | 2020           | Relaxation                                                                           |
| ViKubb | 2020           | Relaxation                                                                           |
| Virtual telescope | 2018 | Relaxation                                                                       |
| Virtual Vacations | 2020    | Relaxation                                                                         |
| Virtual Reality | 2018 | Therapy                                                                             |
| VirtualIron - Immersive YOGA practice | 2019 | Meditation                                                                           |
| Visionarium | 2019           | Meditation                                                                           |
| Vistascapes VR | 2016 | Meditation, relaxation                                                               |
| VR Aquarium | 2017           | Relaxation                                                                           |
| VR Aquarium - 雅 - | 2017 | Relaxation                                                                         |
| VR Fitness Gym (Cycling, Marathon, Football, etc) | 2020 | Therapy, mindfulness, meditation                                               |
| VR Regatta – The Sailing Game | 2018 | Meditation, relaxation                                                               |
| VR Retreat | 2017           | Meditation, relaxation                                                               |
| VR SUPER SPORTS | 2017 | Stress                                                                              |
| VR Table Sports | 2017   | Relaxation                                                                          |
| VRmedies – CT Procedure Experience | 2018 | Therapy                                                                            |
| VRmedies – MRI Procedure Experience | 2018 | Therapy                                                                            |
| VRmedies – Radiotherapy Procedure Experience | 2018 | Therapy                                                                            |
| VRmedies – Theatre Procedure Experience | 2018 | Therapy                                                                            |
| WellTown | 2019           | Meditation                                                                           |
| Whale Island | 2018         | Relaxation                                                                           |
| Where Thoughts Go | 2018 | Meditation, relaxation                                                               |
| Whispers from Within: Moving On | 2020 | Psychology                                                                        |
| WiseMindVR Only | 2017 | CBT                                                                                 |
| You Can Pet the Dog VR | 2020 | Relaxation                                                                           |
| Zen Universe | 2020 | Relaxation                                                                           |
| Zoo World VR | 2020           | Mindfulness, relaxation                                                               |
| 心镜 VR/Mind VR Exploration | 2020 | Mindfulness                                                                      |
While content was scarce, 32% of the games passed the inclusion criteria. Already at this stage, we could identify games of interest for exploring further and potentially adopting as a therapeutic tool. With a growing demand for clinical use of VR as well as vetted self-care apps, this bodes well for the future.

We used the most common search words related to psychiatry and therapy which have previously been used by other authors when exploring mental health categories in video games [16,20]. We applied a strict criterion and any level of “action” which may cause agitation, excitement or nausea was excluded. More games would have been able to be included if these criteria had not been applied. Games which were set to come out later in 2020 were also excluded from further review for practical reasons (i.e. no demos or trailers available) but would have extended the frequency of eligible games.

Several games appeared under the search words addiction and alcoholism, for example Taphouse VR (Catland, 2018), Drunk or Dead (41 Lab, 2017), Steve’s Pub – Soda on Tap (giccare, 2018), Saloon VR (Cap’N Studios, 2019), Hobo Living VR (BefuddleBug, 2020) etc. The games portrayed a more comedic or stereotypical view of being inebriated and were thus excluded. In accordance to Ferrari et al. [16] we also found negative representation and stereotyping of psychiatric patients. Especially in terms of addiction demonstrated in the above-mentioned games.

Depression, which affects approximately 10%–30% of individuals during a lifetime [21] did not generate many search hits. In summary, none of the games in this category seem to be specifically aimed at alleviating depression through a specific therapeutic strategy. They did however have the potential to offer relaxation for individuals suffering from depression [22–24]. Stress, meditation, and mindfulness overlapped greatly as many games appeared in all three search words. It may be due to developers of those games tagging the games with both the trigger feeling and the treatment strategy.

Majority of the games which were featured in those categories focused on yoga, exposure to nature or creativity (painting, creating music, playing music). Several studies support the use of simulated natural environments to decrease stress and lower anxiety levels [22,23]. Games such as ACB Paint and Drops: Rhythm Garden (Planeta, 2018) are examples of tools which could be used in therapy. Although it is not an evidence-based therapy; art-therapy has shown promising results in decreasing symptoms of depression and anxiety [24–27]. In a study by Castillo-Pérez et al. (2010) music therapy was significantly more effective at reducing depression and anxiety symptoms than other therapy methodology used in the study [24]. There was an educational and clinical versions of the game Jam Studio called Jam Studio VR – Education and Health Care edition (Beamz Interactive Inc, 2017), which is directly applicable in clinical practice and for music therapy. Games such as Drops: Rhythm Garden could be applicable in music therapy as well; particularly remotely as digital tools are becoming more and more important for increasing accessibility to care. Both games also address important financial aspects which provide instruments and soundproof environments which otherwise would be impossible to implement in an inpatient psychiatric facility.

Yoga and meditation retreats appeared as a common theme in mindfulness and meditation. Yoga and meditation practices in VR have shown to be great tools for lowering of anxiety, promoting physiotherapy, and decreasing pain [28,29]. Although neither yoga nor meditation are evidence-based practices in psychiatry yet, as add on treatments they can offer value. This might particularly be valuable for psychiatric units which do not have resources to provide yoga instructors.

Games listed in phobia and CBT were generally designed for the purpose, however upon looking at the promotion of the material we can see that there are design flaws. In Fear
Simulator facing spider phobia, images show that you are put on a bed and exposed to hundreds and thousands of spiders which grow. It resembled more a horror scenario than a real CBT session for Arachnophobia, we would however need to explore the game further to draw any conclusion about its feasibility. We did debate to what extent it should be excluded, but we decided to include it as the promotional videos on STEAM did not indicate horror or violence. In general, this genre (phobia and exposure therapy) seems to have poor quality on commercial platforms such as STEAM in terms of therapeutic potential, for now. The best treatments can be found on clinically certified platforms. Although there are quite many VR games and experiences which can be purchased from VR vendors, these games are currently not found in STEAM through the search words we chose.

We chose to incorporate the word hallucinogens and LSD as these substances have found new traction in research as therapeutic strategies for treatment of a variety of psychiatric diagnoses [30,31] and digital LSD and hallucinogens have equally gained traction with developers who want to recreate altered states of consciousness through VR. Although there is little research performed on digital LSD (also known as cyberdelics) or virtual hallucinogens there is a growing field of interest and research into this topic [32]. The three hits which were found in this study for LSD all focused on visual hallucinations and fractal art. Die Fantastischen VR – Fantaventura (Radar Media, 2020) was a mixture of surrealism and art, centered on one band of artists. The most relevant hit Ayahuasca did not appear under this keyword, which may indicate that many games of interest for exploration in psychiatry, might be mislabeled or not tagged at all. This may lead to an underestimation of the potential of the usability of STEAM to find clinically relevant tools. The games found in this search may not be the best representation of a psychedelic experience but do contain some representations of altered states of consciousness. It is hard to establish to what extent these experiences are representative of experiencing a truly psychedelic feeling as to our knowledge no comparative studies have been performed on real and digital LSD.

As the substances are frequently explored in recovery of mental health problems [33], digital alternatives might grow in popularity as well due to their accessibility. In conclusion, STEAM does provide tools for cyberdelics, to what extent these are clinically valid or useful, is a subject for further investigation.

All of the games which have been included would have to be carefully vetted through a gameplay by several independent psychiatric specialists in order to determine their feasibility as therapeutic tools in treatment of psychiatric disorders. Another issue that should be brought to life is regulatory aspects of using games which have not been vetted or registered as health care technology. According to policy and regulations such as the European medical device regulatory law (MDR 745/2017), all medical software should be registered and vetted before use on patients. The same applies for (for example) the American Food and Drug Administration (FDA). None of these games which are included in our list are CE marked, FDA approved or registered as medical technology. A broader discussion needs to be had about the future and current role of commercially available games and how to ensure they can safely be used in clinical settings in accordance to current regulations.

Limitations

Search was performed in November of 2020; thus we might have missed games which were posted after the search month and in December. It is however unlikely as most games set to release during the winter and spring season were already pre-registered. Several of the game hits were yet not available for purchase but could be pre-ordered. We did not include STEAM’s own scores and prices such as previous studied have done [16]. We also excluded prices as most games were available for special prices during the SARS-CoV-2 crisis. We noted that many games lacked reviews, thus those were not included in this study. We applied strict criteria for which type of games were to be included. Story driven games, shooters and action games were excluded. This was performed to exclude any potential violent imagery. However, we might have missed the therapeutic aspects of some of such games. Shooter games, although controversial, have in documented instances shown to be of use for increasing well-being, mental health and decreasing stress [34], and studies show that there is no correlation between increased violence and crime prone behavior for those who play shooter games [35]. By excluding these games, we have created a narrower spectrum of available games. The same can be said of sexual content. We came across sexual games in search term mindfulness, for some individuals, games with sexual contact may benefit well-being and alleviate loneliness. As with any intervention, the benefits must outweigh the harm and the risk, even if small, the risk for triggering worsened mental health exists and thus violent and pornographic stimuli should be avoided until further research is made.

Furthermore, games might be missed by lack of search words. We did not do a specific search for all personality disorders; with the narrow or lacking results of the ones we did search for we suspect that it would not have yielded better results. We also might miss games who were not one or more of these keywords but provide therapeutic content. In a study by Cuijpers, Karyotaki, de Wit, Ebert & et al. (2020) a wide variety of therapies were shown to be of equal importance to that of CBT for treating depressive symptoms and depression [36]. In this study we didn’t include search words for e.g. Acceptance and commitment therapy (ACT) which was shown to be an effective therapy according to the systematic review and meta-analysis by Cuijpers et al. (2020). The study could have benefitted from exploring a broader range of therapeutic strategies. We only performed this search on STEAM and not on e.g. the Oculus platform or on Viveport, two equally important VR content platforms. STEAM was chosen based on having the widest audience. Most games which are available on other platforms, can be
purchasable via STEAM as well. In a future study we hope to explore those platforms as well especially as they are a growing part of the commercial market.

Our study design was like that of Ferrari et al. (2019) and Shapiro et al. (20) yet also vastly different as we focus on the prevalence and therapeutics of Virtual Reality content rather than mental health representation of gaming characters in PC games.

We further narrowed our study by not including streams, videos, or other content. In a future study, broader criteria might be applied.

One of our largest limitations is the subjectivity of perception of content. As it is our subjective perception of the material that decides its inclusion or exclusion, human error is inevitable. It would thus be good for future studies of this kind to elicit a machine learning algorithm which can be trained to include and exclude material based on image and content recognition more systematically.

Future directions

As this field grows exponentially bigger due to availability and accessibility of hardware, we need to have a framework for validating and ensuring the quality of games which are geared towards clinical or self-help use. Perhaps in the future, and with repeated studies, the psychiatric community can help to vet such games and more games can be registered and certified as medical technology. Engaging users from the public and psychiatric patients in the evaluation of the usability would be optimal for a more comprehensive evaluation of both overall therapeutic effects of the 182 identified games, as well as the quantitative measure of usability and clinical feasibility of the games. Further investigations and clinical evaluations of these tools would add value. As these games are easily acquired, they could hold great potential for expanding virtual reality as a tool in therapy in clinical settings or at home using commercial headsets. With the availability of good quality commercial games, we can increase accessibility to treatments.

Conclusion

Commercial platforms for VR content might not yet be an optimal place to find tools for all types of therapy, it does however contain plentiful of user-friendly games that can be good add-on treatments for psychiatric patients.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

All authors are supported by a salary from Sahlgrenska University Hospital or Gothenburg University which supported this research. The Unit of Knowledge Support for Mental Health, Department of Healthcare – Head Office of West Region Sweden supported this project with finances for purchase of games and equipment. We would also like to acknowledge StaplesVR, which made their software available to our researchers at no cost. Steinn Steingrimsson’s research time is financed by grants from the Swedish state under the agreement between the Swedish government and the county councils, the ALF agreement [ALFGBu-786541]. The funders had no influence over the conduct or reporting of the results.

Notes on contributors

Almira Osmanovic Thunstrom, Doctoral researcher and organisational developer at Sahlgrenska University Hospital, Sweden and Gothenburg University - Department of Neurosurgery and Physiology.

Iris Sarajić Vukovic, M.D., Adult and Child and Adolescent Psychiatrist and Psychoanalyst. Opt. Of Affective Psychiatry, Sahlgrenska University Hospital, Gothenburg, Sweden

Lilas Ali, R.N., Ph.D., is a lecturer and researcher of care science in psychiatry at the University of Gothenburg, Sweden.

Tomas Larson, Senior psychologist, Ph.D., Division of Adult Psychiatry, Sahlgrenska University Hospital and the Department of Psychiatry and Neurochemistry, University of Gothenburg, Sweden.

Steinn Steingrimsson, MD, PhD, docent and specialist in psychiatry at Sahlgrenska Academy, University of Gothenburg. Research focus is mainly on direct environmental impact on psychiatric outcomes with a specific emphasis on digital interventions.

ORCID

Tomas Larson http://orcid.org/0000-0002-7271-7604

References

[1] Riva G, Wiederhold BK. How cyberpsychology and virtual reality can help us to overcome the psychological burden of coronavirus. Cyberpsychol Behav Soc Netw. 2020;23(5):277–279.

[2] Amista NF, Kim JJ, Kim N. Trend and future of virtual reality for addiction treatment of substance use disorders: A systematic review. J Digit Contents Soc. 2017;18(8):1551–1560.

[3] Miloff A, Lindner P, Dafgard P, et al. Automated virtual reality exposure therapy for spider phobia vs. in-vivo one-session treatment: a randomized non-inferiority trial. Behav Res Ther. 2019;118:130–140.

[4] Gonçalves R, Pedrozo AL, Coutinho ESF, et al. Efficacy of virtual reality exposure therapy in the treatment of PTSD: a systematic review. PLoS One. 2012;7(12):e48469.

[5] Maples-Keller JL, Bunnell BE, Kim S-J, et al. The use of virtual reality technology in the treatment of anxiety and other psychiatric disorders. Harv Rev Psychiatry. 2017;25(3):103–113.

[6] Freeman D, Reeve S, Robinson A, et al. Virtual reality in the assessment, understanding, and treatment of mental health disorders. Psychol Med. 2017;47(14):2393–2400.

[7] Valmaggia LR, Latif L, Kempston MJ, et al. Virtual reality in the psychological treatment for mental health problems: a systematic review of recent evidence. Psychiatry Res. 2016;236:189–195.

[8] Pot-Kolder RMCA, Geraets CNW, Veling W, et al. Virtual-reality-based cognitive behavioural therapy versus waiting list control for paranoid ideation and social avoidance in patients with psychotic disorders: a single-blind randomised controlled trial. Lancet Psychiatry. 2018;5(3):217–226.

[9] Clay F, Howett D, FitzGerald J, et al. Use of immersive virtual reality in the assessment and treatment of Alzheimer’s disease: a systematic review. J Alzheimers Dis. 2020;75(1):23–43.

[10] Boedt D, McMahon E, McFaul M, et al. Using virtual reality exposure therapy to enhance treatment of anxiety disorders: Identifying areas of clinical adoption and potential obstacles. Front Psychiatry. 2019;10:773.
