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Commercial video games as a resource for mental health: A systematic literature review

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ABSTRACT

Game-based interventions have been gradually and successfully implemented in the mental health domain given the games' ability to positively affect a variety of mental health conditions. To this aim, scholars have recently discovered the usefulness of Commercial Off-the-Shelf (COTS) video games, due to their increasing popularity, availability, and cost effectiveness. Nevertheless, key aspects of this line of research have not emerged yet, since a comprehensive overview of how commercial video games impact on different mental disorders is still missing. In this article, we present a systematic literature review of recent research that focuses on the usage of commercial video games in mental health. We analyze 39 papers and map the relevant themes that are recurrent in the last ten years of research, offering a detailed understanding of the methodological approaches that were used, the results obtained, the main disorders addressed, and the video game genres exploited. On the basis of these findings, we highlight open issues in current work and point out a variety of research opportunities that could be tackled in future years, like the need of conducting more field and longitudinal studies, the necessity of developing the design knowledge, and the possibility of connecting research with clinical practice.

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1. INTRODUCTION

The fundamental role of play in human life has been studied since decades in a variety of disciplines, spanning from anthropology to psychology (e.g., Huizinga, 1938; Berne, 1964; Fink, 1960).

Developmental psychologists, for instance, emphasized the positive function of play in the development of children's social cognition and mastery of emotions (e.g., Erikson, 1977; Piaget, 1962; Vygotsky, 1978), as well as in the child's imaginative life (Winnicott, 1971). However, the specific games that people play certainly make a difference, as they produce diverse effects on players, engaging them in different activities (Caillois, 2001). It is therefore not surprising that the advent of video games, which are games based on digital technologies, changed the way we look at the activity of playing, widening and rehashing the debate on its potential "beneficial impacts".

When video games first gained popularity, skepticism prevailed in line with criticisms that are often directed towards novel media and technologies (Ceranoglu, 2010a): this is shown by the vast amount of research on the supposed negative effects of video games (e.g., Griffiths, 2008; Anderson & Bushman, 2001). Later, however, other research perspectives appeared, based on the assumption that video games share similarities with "traditional games", and may thus provide comparable benefits (Granic et al., 2014). For instance, psychotherapy has a long history of using games in therapy sessions (Griffiths et al., 2017): video games have been then proposed as a tool for supporting the rapport between the patient and the therapist, being considered beneficial to the whole therapeutic process (Ceranoglu, 2010a; Clarke & Schoech, 1994; Gardner, 1991; Spence, 1988). In this vein, video games have been seen as an effective means for supporting individuals' health both in the physical and mental health domains.

In particular, playing video games has been discovered to positively affect a variety of mental disorders, whereby game-based interventions may have comparable or even greater effects than non-game-based programs (Staiano and Flynn, 2014). To this aim, different forms of video games have been experimented, such as exergames (e.g., Anderson-Hanley et al., 2011; Rosenberg et al., 2010; Smits-Engelsman et al., 2015), location-based games (e.g., Rowntree & Fenney, 2019), brain-training games (e.g., Hutchinson et al., 2016; Kable et al., 2017; Nouchi et al., 2013), and electronic games for psychotherapy (EGP) (e.g., Horne-Moyer et al., 2014). This research resulted in valid alternatives for treating, for instance, schizophrenia (Suenderhauf et al., 2016), anxiety (Pessoa et al., 2014), and Parkinson disease (Perrochon et al., 2019).

Nevertheless, video game-based interventions are not always a preferable alternative to traditional programs, due to, for example, high costs and design difficulties (Horne-Moyer et al., 2014). A promising opportunity for remedying shortcomings of developing ad hoc video games lies in Commercial Off-The-Shelf (COTS) video games (also known as commercial video games): these games had two and a half billion players across the world in 2019 (Statista, 2020), are already integrated into people's everyday practices, are primarily designed for entertainment purposes, can be easily found in the market, are often updated, and are available at a relatively low cost (Ackerman et al., 2010; McKinney, 1999; Blanchette, 2005; Steadman et al., 2014).

Given these advantages, research has explored opportunities to employ commercial video games in mental health interventions, as several literature reviews show (e.g., Granic et al., 2014; Strahler Rivero et al., 2015; Li and Foo, 2016; Hall et al., 2012; Byrne and Kim, 2019; Pessoa et al., 2014). These reviews, however, suffer from several limitations, as they, e.g., conflated commercial video games and games with a serious purpose in their analysis (Horney-Moyer et al., 2014), merged physical and mental conditions (Griffiths et al., 2017), were circumscribed to a certain disorder or game genre (Strahler Rivero et al., 2015; Pessoa et al., 2014), or addressed neurological matters, leaving apart video games' psychological effects (Perrochon et al., 2019; Suenderhauf et al., 2016).

Until now, no previous work gave a comprehensive overview of the specific role that commercial video games play in mental health research, describing their impact on different mental conditions at

the psychological level. To fill this research gap, in this article we present a systematic literature review that analyzes how commercial video games have been used in mental health interventions across multiple populations with diverse mental disorders. To this aim, we focus on the last ten years or research because video game technologies and designs, as well as players' preferences and habits, move at a fast pace. While early attempts of using video games in clinical settings have encountered a variety of obstacles, mainly due to the hesitation of both therapists and patients in their adoption (Ceranoglu, 2010b), the completion of the so-called "casual revolution" in the early 2010s (Juul, 2010), made them far more popular, and thus acceptable. In those years, video games moved beyond the bounded space in which they were confined, and new video gaming practices were introduced. The spreading of video games on smartphones and social network sites (Bankov, 2019) and the employment of novel game-based design techniques in non-game contexts (Deterding et al., 2011) dramatically changed the traditional video game "audience": for instance, *Zinga's Farmville* reached more than 80 million players in 2010, appealing segments of the population that were traditionally reluctant to video game playing (Chiang, 2010). Moreover, the rise of cloud gaming and streaming platforms like Twitch from 2010 onwards (Slotnik, 2017) introduced video games in the popular culture, even creating new professional figures, like professional streamers (Johnson & Woodcock, 2017). Finally, active video games involving full-body experiences became more popular when Microsoft Kinect and PlayStation Move were released in 2010. These platforms were an answer to Nintendo Wii, which was launched in 2006 and first enabled body-based interaction in the commercial video game domain (Schreiber et al., 2009).

In sum, by narrowing the analysis to the last ten years we aim to capture research that takes full advantage of the recent transformations of the video game landscape, when the general population started integrating video games more preeminently and naturally into their daily lives, likely making their usage more acceptable even in the context of mental health. This is important, as one of the main strong points of using commercial video games is their popularity: if people already play them spontaneously, they may better comply with the intervention (Ceranoglu, 2010a). In so doing, we

attempt to give an answer to the following research question: How have commercial video games been employed in the mental health domain and what kinds of psychological impacts do they have?

2. RELATED WORKS

Research on video games for the mental health domain is not recent. Video games specifically designed for this serious purpose (also known as “serious games”) have been developed to target young adults’ mental health since the 1980s. In 1985, Honig and Eikelboom presented a system containing an array of games and exercises having therapeutic and diagnostic value for both physical and mental conditions, such as dyslexia: however, they did not test the application with a clinical sample. Ten years later, Clarke and Schoech (1994) designed a computer game to help adolescents learn impulse control: the game was used for 4 weeks with positive outcomes, whereby the clients also became more cooperative and enthusiastic about the treatment. In 2000, Goldsworthy and Goldsworthy (2000) presented STAR, an interactive multimedia program targeted to adolescents with Attention Deficit Hyperactivity Disorder (ADHD): the computer game was meant to support social problem-solving skills and to be integrated into classroom activities. Sharry et al. (2003) designed a biofeedback game to treat anxiety problems in children: as a matter of fact, the game was used as an incentive to learn relaxation techniques. More recently, research on serious games for mental health rose in popularity, so that they have been acknowledged as the “gold standard” in game-based interventions (Fleming et al., 2017; Lau et al., 2017).

Similarly, the usage of commercial video games in the mental health context can be traced back to the 1980s. In 1982, Mickel (1982) briefly explained how these games could represent an innovative way for restoring and measuring mental functions in seriously injured patients. One of the first documented and positive usage of commercial video games in mental health is represented by Gaylord-Ross et al. (1984), who conducted two experiments to favor initiation and social interactions between autistic and non-autistic youths. The training involved the video game Pacman and other leisure objects (a Walkman, a pack of gum) that autistic youths were instructed to employ in order to

approach a peer and engage in an interaction. In 1991, Gardner (1991) described how different games (e.g., *Super Mario Bros*, *Legend of Zelda*) had been used in four cases of child therapy in order to, for example, widen the children's repertoire of problem-solving strategies, or support the release and control of their aggressive emotions. A further attempt was made by Kokish (1994), who used the role-playing game *Ultima* for conducting play therapy with children. At the beginning of 2000s, Lawrence et al. (2002) selected both a target and an adventure game (*Point Blank*, *Crash Bandicoot*) to test the cognitive performance of a group of boys with ADHD, finding more promising results with the target game. Robillard et al. (2003), instead, found that virtual environments derived from video games like *Half-Life* and *Unreal Tournament* could be used as a therapeutic environment for exposing phobic individuals to phobogenic stimuli. Basak et al. (2008) used a real-time strategy game in a laboratory setting (*Rise of Nations: Gold Edition*) to enhance the cognitive functions of a group of older adults, finding that the game had benefits on their executive control functions.

However, despite a few works exploring the positive impacts of commercial video game usage, early research on mental health was dominated by the investigation of their adverse effects (Wilkinson et al., 2008). As a matter of fact, only at the end of the 2000s scholars focused more prominently on their potential psychological benefits (Ceranoglu, 2010a). As these benefits started being unveiled, researchers from different disciplines, like psychology, neuroscience, and medicine, explored more thoroughly the effective use of COTS games in mental health interventions. We found 25 reviews related to the topic of video games and mental health published in the last ten years: 12 are systematic while 13 are non-systematic. Still, none of them provides a comprehensive picture of the specific role that commercial video games play in mental health research.

In fact, non-systematic reviews investigated the benefits of video games broadly (e.g., Steadman et al., 2014). However, they share relevant limitations with reference to our research question, which go beyond the non-systematic nature of their analysis. In particular:

i) They conflated in the same analysis commercial video games and exergames (Charikleia et al., 2011) or serious games (Craven & Groom, 2016; Griffiths et al., 2017; Horney-Moyer et al., 2014; Rodríguez Jiménez et al., 2015; Jones et al., 2015; Kato, 2010), which all have different designs and

purposes. Commercial video games are primarily designed to entertain the player, while serious games are specifically developed to support “serious goals” (Alvarez and Djaouti, 2011). Likewise, exergames are addressed to increase the player’s physical activity (Best, 2012). Kato et al. (2010), for example, examined together commercially available and tailor-made games (i.e., serious games) used for education and training with patients, medical students and doctors.

ii) They paid attention to the effects of video games on the general well-being of a healthy population, without tackling specific conditions (Charikleia et al., 2011; Jones et al., 2014; Granic et al., 2014); or addressed certain age groups like children and adolescents, analyzing together healthy and non-healthy individuals (Steadman et al., 2013). Granic et al. (2014), for instance, synthesize the positive impacts of video games on four domains, that is cognitive, motivational, emotional and social, also highlighting research that points to the detrimental aspects of video game playing. However, they did not explore the effects that video games may have on precise mental disorders.

iii) They merged physical and mental conditions (Griffiths et al., 2017; Kato, 2010), clouding the specific impacts that video games may have on mental health. Griffiths et al. (2017), for example, examined together different physical and mental areas, like video games and physiotherapy, pain management, cognitive rehabilitation, and anxiety disorders; as well as video games in health care, in the elderly care, and in psychotherapeutic settings.

iv) They considered only the training function of video games, while leaving apart their therapeutic effects (Rodríguez Jiménez et al., 2015). The studies examined by Rodríguez Jiménez et al. (2015) precisely focus on game-based trainings that have the goal to improve cognitive skills, like attention and decision-making.

v) Finally, they addressed the psychotherapeutic setting (Franco, 2016a; Ceranoglu, 2010a), leaving apart the effects that video games may have outside the therapy sessions. Franco (2016a), for instance, provided a brief overview of the literature concerning the use of video games in a psychotherapeutic context, discussing how they may support the rapport between the therapist and the client.

By contrast, systematic literature reviews were circumscribed to specific disorders (e.g., ADHD in Strahler Rivero et al., 2015; depression in Li and Foo, 2016; disorders affecting older adults in Hall et al., 2012; neurological disorders in Perrochon et al., 2019; schizophrenia in Suenderhauf et al., 2016) or specific video game genres (e.g., Byrne and Kim, 2019; Pessoa et al., 2014). These efforts provide a narrow, although detailed, picture of the usage of commercial video games in mental health.

Moreover, these works also share limitations similar to those identified in the non-systematic reviews:

i) They addressed the study of a specific game genre, such as online games (Sublette et al., 2017) or exergames (Pessoa et al., 2014; Stanmore et al., 2014; Li & Foo, 2016; Tripette et al., 2016; Byrne and Kim, 2019; Perrochon et al., 2019), or did not distinguish between serious games and commercial video games (Hall et al., 2012; Perrochon et al., 2019; Staiano & Flynn, 2014; Strahler Rivero et al., 2015). Staiano & Flynn (2014), for example, conflated the analysis of commercially available and custom-designed active video games, mainly tackling “physical” issues like improving muscle strength, mobility or postural control.

ii) They merged the investigation of physical and mental outcomes (Hall et al., 2012; Tripette et al., 2016). Hall et al. (2012), for instance, presented an overview of research on digital games played by older adults identifying the health outcomes associated with game play: nonetheless, they did not examine the specific impacts of video games on mental health.

iii) They focused on the effects of gaming technologies on healthy populations (Pallavicini et al., 2018; Sublette et al., 2017; Stanmore et al., 2017), without tackling video games’ effects on people with mental health conditions. For example, Pallavicini et al. (2018) presented research about the impact of video game training on healthy adults’ cognitive and emotional skills.

iv) Finally, they addressed the neurological level, leaving apart video games’ psychological effects (Perrochon et al., 2019; Suenderhauf et al., 2016). As an example, Perrochon et al. (2019) provided a systematic review of rehabilitation interventions based on exercise games, which were addressed to individuals with neurological disorders (e.g., stroke, multiple sclerosis and Parkinson’s disease): however, psychological symptoms of these conditions were not taken into account.

In sum, there is no previous review that systematically analyzed research on commercial video games and mental health focusing on the impacts that this technology may have on specific mental health conditions at the psychological level. In the following, we attempt to fill this gap.

3. METHOD

To analyze research on COTS video games in mental health, we used the Grounded Theory Literature Review (Wolfswinkel et al., 2013) method, which is rooted in grounded theory, an approach developed in social sciences for examining empirical data (Glaser & Strauss, 2017). This method adopts an inductive, rather than a hypothetical-deductive stance, which implies that the content of the reviewed articles is examined as if it were empirical material in order to develop concepts and identify relevant themes. The method follows four different stages: i) Define: selecting the inclusion/exclusion criteria, identifying the appropriate data sources, and defining the specific query to be searched; ii) Search: collecting the papers searched through all the identified sources; iii) Select: defining the final sample by checking the papers against the identified criteria; iv) Analyze: analyzing the selected papers through open, axial, and selective coding techniques. A further stage relates to the recounting and discussion of the papers analyzed.

3.1 Selection criteria

To be included in this systematic review, an article should be a scholarly and peer-reviewed article and had to meet four inclusion criteria.

1) The articles had to address a psychological or psychiatric disorder/condition. We used the fifth edition of the DSM (Diagnostic and Statistical Manual of Mental Disorders) as a basis to determine the boundaries among the health conditions classified in literature.

2) The articles had to tackle commercial video games.

3) The articles had to present a study with human participants. As for the papers with a quantitative, experimental design, they had to use commercial video games at least in one experimental condition as an independent variable. This entails that papers presenting experiments in which video games are exclusively employed in the control condition were excluded. This criterion ensured that the experiment revolved around the specific effects that video games may have on individuals' mental health.

4) The articles had to explore at least one psychological aspect impacted by video game play.

5) The articles had to be published between 2010 and 2020. We assumed that the 2010-2020 video game landscape significantly differs from that of the previous years in terms of players' habits and preferences, video games available on the market, and video game practices (Vervoort, 2019). In fact, in the last ten years, video games spread on smartphones and social network sites, appealing to the general population much more than before (Bankov, 2019), new ways of playing appeared on cloud gaming and streaming platforms (Slotnik, 2017; Johnson and Woodcock, 2017), as well as new forms of gameplay involving full-body experiences became more popular, thanks to the release of Microsoft Kinect and PlayStation Move.

We also assumed that over the last ten years both clinicians and researchers have become more aware of video games' potential benefits and less hesitant to incorporate video games in mental health interventions. In fact, the increasing popularity of commercial video games lessened their concerns about the general public's negative attitudes towards them, as well as about the barriers in access to this technology because of a lack of familiarity, which undermined their use in therapy until the end of the 2000s (Ceranoglu, 2010a).

6) The articles had to be peer-reviewed, scholarly articles published in international journals or in international conference main proceedings and be written in English.

As a consequence of these criteria, we excluded articles presenting studies on video games not commercially available but ad hoc developed. Studies exclusively investigating neurological aspects e.g., through neuroimaging techniques, were not included as well. Moreover, we excluded articles

using “serious games” (both commercial and ad hoc developed), which are games designed for a serious purpose, like training or treatment. Serious game category includes “exergames” (Laato et al., 2019), which have the primary goal of increasing the player’s physical activity for a serious aim (e.g., fitness) (Williams and Slak-Valek, 2019). Research employing these kinds of games (e.g., Rosegrant, 2012; Li et al., 2018; Rosenberg et al., 2010; Fenney and Lee, 2010; Weybright et al., 2010; Anderson-Hanley et al., 2011; Benzing and Schmidt, 2017; Smits-Engelsman et al., 2015; Hammond et al., 2014; Cutter et al., 2014) is addressed to primarily increase the individual’s physical activity and, through that, impact on her mental health. Although interesting, studies employing serious games (exergames included) tackle different issues with respect to research using commercial video games: therefore, they were excluded. By contrast, certain active video games, which are games controlled by the player’s body and are not designed for serious purposes but to provide a fun and enjoyable full-body gaming experience (e.g., Dance Dance Revolution) have been included in the corpus.

3.2 Search strategy

The articles included in this review were collected in August 2020. We used the Association for Computing Machinery Digital Library (ACM DL), EBSCO APA PsycINFO and Scopus as sources for searching relevant articles. We selected these repositories in order to potentially capture any article addressing relevant topics in video games and mental health: the ACM DL collects computer science papers, PsycINFO collects psychological papers, and Scopus is a more generalist repository offering a wider perspective across different disciplines. In line with other systematic literature reviews conducted in human-computer interaction and cyber psychology research fields (Clark et al., 2019; ter Stal et al., 2020; Kuss et al., 2021), Google Scholar was not selected as a repository, because it includes a variety of documents that were not relevant to our research aims, like doctoral dissertations, theses, technical reports, white papers, and preprints, without providing the researcher with the possibility of excluding them during the search.

The search was conducted by using the terms and connectors reported in Table 1.

Table 1. Review search terms. Quotation marks are meant to wrap open compound words into one phrase, while asterisks denote truncation to account for alternative spellings.

("video game*" OR "computer game*" OR "digital game*" OR "electronic game*") AND (psychotherapy OR treatment* OR mental health OR disorder* OR well-being OR psychopatholog*)

The first part of the query relates to the notion of video game including its synonyms. Quotation marks were needed to wrap open compound words, in order to avoid the retrieval of papers addressing research on only a part of the word (e.g., on videos as resulting by taking separately the terms composing the word 'video game'). The second part refers, instead, to mental health topics: the list of search terms was composed after several iterations and refinement by all the authors, in line with other systematic reviews (e.g., ter Stal et al., 2020). In sum, the search retrieved articles mentioning at least one word of the first part of the query and one word of the second part of the query.

In Scopus we limited the search to the title, abstract and keywords, to journals and conference proceedings as sources, to articles and conference papers as documents, and to English as language. In PsycINFO we excluded books and dissertations and limited the search to English language. The search was conducted on the papers published from January 2010 to August 2020. The queries retrieved a total of 5857 articles (980 results in the ACM DL, 2180 in PsycINFO, and 2697 in Scopus). We then exported the results in a table to make the records uniform and removed the duplicates, so the first version of the corpus counted 3573 papers.

3.3 Article selection

The first author firstly screened the title and the abstract of the papers included in the initial tentative corpus against the eligibility criteria. In this phase, 3298 papers were excluded. There are several reasons for this diminution: many studies employed serious games or non-commercial video games; others did not investigate any psychological variable.

Then, the full texts of the papers that were preliminary considered eligible (275) were independently screened by the first and the second authors to determine inclusion: if discrepancies in their decisions arose, they discussed the articles in order to take a final decision by common accord.

At this stage, the corpus included 36 papers. Finally, backward snowballing was employed to screen the references in the included articles. The final corpus counts 39 articles.

3.4 Data analysis

Data analysis was inductively oriented. First, both the authors analyzed the corpus to identify relevant themes. They independently read and labeled each paper with one or more open codes, which were then discussed. In the axial coding phase, they independently grouped the codes into more abstract conceptual categories and then discussed the resulting categorizations together. Finally, the relevant themes were defined and discussed jointly. These resulting themes are: 1) study characteristics and research methodologies, 2) mental disorders and video game usage, 3) video game features, and 4) synthesis of the results.

4. RESULTS

In the following sections, we report on the results emerging from the analysis of the 39 papers included in our corpus. The first section provides an overview of the characteristics of the studies, namely their goals, setting and how the video games have been used during the research, as well as the methodologies that have been adopted. The second section focuses on the specific disorder(s) addressed in the articles. Then, the third section pays attention to the genres of the video games

employed. Finally, the last section describes the findings of the papers in terms of their successfulness in achieving the intended research goal. All the video games mentioned in these sections are commercial video games. Table 1 in the Appendix further provides an overview of the included studies.

4.1 Study characteristics and research methodologies

4.1.1 Study characteristics

The articles included in the corpus can be grouped into four different categories with reference to their characteristics, i.e., their goals, setting, adopted approach, and how they integrated the video game(s) into the study.

A first group of 9 papers (Colder Carras et al., 2018; Cutler et al., 2016; Elliott et al., 2015; Etter et al., 2017; Finke et al., 2018; Gallup and Serianni, 2017; Kaufman and Zhang, 2015; Rowntree and Fenney, 2019; Sundberg, 2018) investigates why and how people play with video games in their everyday life, with the aim to discover both their potential benefits and drawbacks for mental health. Here, participants are commonly asked to report on their everyday experience of gaming: the majority of these studies, in fact, aims to capture the individuals' subjective accounts and perceptions about their mental condition and how the gaming activity had an impact on it. Particular attention is given to the meanings that participants ascribe to video games and to the act of playing itself. For instance, Colder Carras et al. (2018) asked veterans diagnosed with PTSD to describe their own views on and personal experiences with video games and how these related to their mental health problems. Likewise, Cutler et al. (2016) delivered 26 technology sessions to a group of people with dementia inviting them to describe their subjective experience, with the aim to capture the participants' view on the positive and negative aspects of playing with video games.

A second group of 25 papers (Brühl et al., 2019; Butler et al., 2020; Cancer et al., 2020; Chung et al., 2015; Dickinson and Place, 2016; Fenney and Lee, 2010; Fish et al., 2014, 2018; Franceschini and Bertoni, 2019; Franceschini et al., 2013; Franceschini et al., 2017; Groenewoud et al., 2017; Heasman

and Gillespie, 2019; Hicks et al., 2019; Holmes et al., 2010; Iyadurai et al., 2018; James et al., 2015; Kessler et al., 2018; Kessler et al., 2020; Kühn et al., 2018; Łuniewska et al., 2018; MacCormack and Freeman, 2019; Russoniello et al., 2013; Segev et al., 2017; Weybright et al., 2010), instead, adopts a controlled approach, studying the specific effects of video games on psychological variables considered relevant for people's mental health. Here, researchers are mainly interested in assessing a particular game-based treatment, often comparing it to other, non-game based, interventions. Most of these studies invite participants to perform one or more video game sessions in a laboratory-like setting, carefully defining which video game is used and how it is played, as well as the frequency and the duration of playing. For instance, Cancer et al. (2020) compared two training programs for dyslexia, one of which was based on the usage of action video games: participants were split in two groups and exposed to the different programs. Both interventions, administered for 13 hours over 9 days (two 45 min training sessions per day), took place in a quiet room.

A small part of these studies assesses the impact of video games in more "natural" or "informal" contexts with the supervision of a researcher, like at school (e.g., Dickinson and Place, 2016), at the participants' home (e.g., Chung et al., 2015), or at a residential facility (Weybright et al., 2010). The opportunity to play in a more familiar environment is crucial for those individuals who do not tolerate unfamiliar places or cannot move outside their home. For example, Weybright et al. (2010) involved two older adults living in an assisted living facility in an intervention implying playing with an interactive video game for 16 weeks: the study occurred in the day room of the facility and an instructor was always present during the playing sessions.

Only four of the studies belonging to this group conducted a "field trial" where participants were delivered a game-based intervention in their everyday life without any supervision from a researcher. Fish et al. (2014, 2018) and Russoniello et al. (2013) paired lab sessions with playing activity at the participants' home, giving them precise instructions about the duration of play and the number of play sessions, e.g., "30-45 minutes, four times per week, for a total of 16-sessions" (Fish et al., 2018, p. 6). Kühn et al. (2018), instead, gave participants access to an action video game, which could be played at participants' home as long as they wanted for a period of six weeks.

Finally, the fourth group consists of 5 studies (Ceranoglu, 2010b; Franco, 2016b; Gerhardt and Smith, 2020; Guhde, 2017; Rosegrant, 2012) involving clients who underwent therapy with one of the authors of the research. Here, the game is played in the study of the therapist or at the clients' home. The distinctive characteristic of this kind of research lies in the intertwining of the psychotherapeutic intervention with the game sessions, whereby clients are often invited to recount their gaming experiences and reflect on them. These gaming sessions and the eventual subsequent clients' reflections are then used as a resource for the psychotherapy. In other words, in these studies the video game is considered a useful tool to both improve the client's self-understanding and treat her psychological disorder. In this respect, Rosegrant (2012) emphasizes the positive impact of playing on the whole therapeutic experience, even when the game is not "interpreted": the therapist let the patient completely free of playing as she liked, while the gaming activity allowed expressivity and brought a variety of themes into the therapeutic process, which could be subsequently used as an input for the exploration of personal meanings.

4.1.2 Employed methodologies

In the corpus, 18 papers used quantitative methods, 10 papers employed qualitative methods, and 11 papers used mixed methods.

4.1.2.1 Quantitative methods

The majority of the papers (13) employing quantitative methods present experiments with a between-subjects design (Butler et al., 2020; Cancer et al., 2020; Dickinson and Place, 2016; Fish et al., 2014, 2018; Franceschini and Bertoni, 2019; Franceschini et al., 2013, 2017; Holmes et al., 2010; Kühn et al., 2018; Łuniewska et al., 2018; Russoniello et al., 2013; Segev et al., 2017). For instance, Holmes et al. (2010) conducted two between-subjects experiments to investigate the beneficial effects of Tetris on Post-Traumatic Stress Disorder (PTSD). In Experiment 1, 60 participants watched a "traumatic film" followed by a 30 min structured interval. They were then divided into three groups where they

had to play with *Tetris*, play with *Pub Quiz*, or sit quietly. In Experiment 2, 75 participants were exposed to the “traumatic film” and then left the laboratory for 4 hours, before returning to the laboratory and being assigned to the same experimental conditions of Experiment 1.

One study uses a single-subject design (Chung et al., 2015). The authors hypothesize that active video gaming may increase pro-social behavior and decrease aggression in children with Autism Spectrum Disorder (ASD) more than sedentary video gaming. Then, they recruited three dyads, composed of an ASD child and a sibling, and employed the following procedure: four control sessions, in which the dyads played the sedentary video games; six intervention sessions, when the dyads played together the active video games; two control sessions, when the dyads played the sedentary video games.

By and large, this kind of research employs a variety of instruments to measure the target variables. Questionnaires, scales and inventories are commonly delivered to measure variables like social functioning (e.g., Dickinson and Place, 2016), depressive disorder symptomatology (e.g., Russoniello et al., 2013), the levels of “state anxiety” and “trait anxiety” (e.g., Fish et al., 2014; Fish et al., 2018), traumatic experiences lived or witnessed (Holmes et al., 2010), or the participants’ level of aggressiveness (e.g., Segev et al., 2017). Ad hoc self-completion questionnaires are also employed to gather demographic information and playing habits (e.g., Sundberg, 2018). Often, specific tasks are provided to assess certain skills, as reading abilities in children with dyslexia (e.g., Cancer et al., 2020; Franceschini et al., 2013), or participants’ cognitive functionality (Kühn et al., 2018). Observations, also by means of videotaping, are conducted to study specific behaviors, like pro-social behavior (Chung et al., 2015). Finally, the video game itself is used as an assessment tool through the collection of game logs and game scores. For instance, Segev et al. (2017) collected virtual behaviors in the video games played by the participants (e.g., the number of kills, the number of missions attempted, the numbers of cars stolen) and linked them to their mental condition.

The remaining four studies (Etter et al., 2017; Kaufman and Zhang, 2015; Rowntree and Fenney, 2019; Sundberg, 2018) employ surveys to explore the impact of playing on mental health. For example, Rowntree and Fenney (2019) used a cross-sectional survey to ask outpatients attending an

Irish general adult mental health service about their gaming activity and the perceived impact it had on their mental health.

4.1.2.2 Qualitative methods

Qualitative research included in our corpus can be described as follows: five papers present single-case studies recruiting the researcher/therapist's patients (Ceranoglu, 2010b; Franco, 2016b; Gerhardt and Smith, 2020; Guhde, 2017; Rosegrant, 2012); one paper reports on a multiple case study (Elliott et al., 2015); one paper employs multiple qualitative techniques based on the principles of Participatory Action Research (Hicks et al., 2019); four papers recount findings collected through qualitative interviews (Colder Carras et al., 2018; Elliott et al., 2015; Finke et al., 2018), whereby one of them uses a phenomenological approach (Gallup and Serianni, 2017).

As for the single-case studies, the participants mostly played alone and then recounted their experience to the therapist or were observed during play in the therapist's room. In this kind of research, the patients' mental health condition is often extensively described, and the intervention is framed within a psychoanalytic (Guhde, 2017; Rosegrant, 2012) or psychodynamic framework (Ceranoglu, 2010b), or grounded in narrative therapy (Franco, 2016b) or Cognitive-Behavioral Therapy (Gerhardt and Smith, 2020).

The principles of Participatory Action Research, which is an approach to research in communities emphasizing participation and action (Reason and Bradbury, 2008), were employed to engage a group of older adults with dementia in local health care initiatives (Hicks et al., 2019). The participants were invited to form a group, choose a name for it, provide feedback on each game session they played, and take photographs to illustrate the experience lived during the study. The authors used focus groups, open interviews, and extensive reflective field notes to collect data from the participants during the research process.

Among the four studies that used semi-structured interviews, Gallup and Serianni (2017) adopted a phenomenological approach, which focuses the data analysis less on the researchers' interpretations and more on the description of the participants' experiences. On top of the interviews, the authors conducted observational sessions and analyzed a series of documents (e.g., forums, blogs).

4.1.2.3 Mixed methods

The eleven papers employing mixed methods in our corpus followed different research designs: four studies present experiments with a between-subjects design (Brühl et al., 2019; Iyadurai et al., 2018; James et al., 2015; Kessler et al., 2020), one study presents an experiment with a within-subjects design (Kessler et al., 2018), two studies conduct experiments with a single-subject design (Fenney and Lee, 2010; Weybright et al., 2010) while the remaining four studies carry out observation (Groenewoud et al., 2017; Heasman and Gillespie, 2019; MacCormack and Freeman, 2019) or ethnography paired with questionnaires and focus groups (Cutler et al., 2016).

Here, quantitative data were obtained through questionnaires, inventories, or scales (e.g., Kessler et al., 2020; Iyadurai et al., 2018), as well as gaming log data and scores (e.g., Fenney and Lee, 2010; James et al., 2015). As for the qualitative data, they were collected using diaries (e.g., Kessler et al., 2018), ethnographic field notes (Cutler et al., 2016), or interviews (e.g., Groenewoud et al., 2017). Heasman and Gillespie (2019), instead, analyzed conversations among the study participants both quantitatively and qualitatively, in order to detect any expression of "intersubjectivity", i.e., a process that enables the individuals' reciprocal understanding and communication.

Among the techniques employed to collect data, it is worth to mention the intrusion diary, a method for recording intrusive memories of traumatic experiences, which is used by those studies aiming to prevent and treat PTSD symptomatology (e.g., James et al., 2015; Kessler et al., 2020). Participants commonly played in a laboratory setting and then kept a diary during the subsequent days to collect qualitative data on intrusive memories, whereas quantitative data were gathered through scales and questionnaires. For example, Iyadurai et al. (2018) first examined medical records to assess the

participants' traumatic event. Then, they invited participants to fill an intrusion diary and administered scales to measure post-trauma distress, anxiety, depression and dissociative symptoms, as well as questionnaires to understand the participants' experience of the study.

To summarize, the corpus is quite heterogenous in terms of the study characteristics and methodologies employed: both quantitative, qualitative and mixed methods studies are represented in the corpus, with a prevalence of quantitative studies.

4.2 Mental disorders and video game usage

In this section we point out how video games have been used with reference to specific mental disorders, identifying the potential positive impacts that they may provide on certain symptomatology. This would allow to better understand why they can be a valid alternative to traditional treatments. To this aim, we will describe, on the one hand, the main characteristics of the disorder and, on the other hand, how video game playing may ameliorate the patients' condition.

The majority of papers included in our corpus aim to improve the condition of specific target populations suffering from disorders that can be identified according to DSM-5 categories. An exception is represented by six studies that either recruited a heterogeneous sample in terms of disorders (Segev et al., 2017), or involved patients whose psychological condition is not described (Rowntree and Fenney, 2019), is described according to non-quantitative and non-categorical criteria (Rosegrant, 2012; Guhde, 2017) or it cannot be circumscribed to a single disorder (Ceranoglu, 2010b; Gerhardt and Smith, 2020).

This said, we group the remaining papers in four main categories, with reference to the specific disorder they aim to treat. The largest group is represented by studies addressing the area of neuro-developmental disorders, which counts 12 papers. A group of 10 papers tackles, instead, the domain of Post-Traumatic Stress Disorder, whereas 6 papers focus on mood disorders. Finally, neurocognitive disorders are addressed by 5 studies.

4.2.1 Neurodevelopmental disorders

As for the neurodevelopmental disorder area, most studies focus on ASD (7 papers), while Developmental Dyslexia (DD) is tackled by 5 papers. These disorders are grouped together in the DSM 5 (American Psychiatric Association, 2013), since they are both characterized by early manifestation during the child's development: the developmental deficits may then produce impairments of personal, academic, social, or occupational functioning. In most cases, video games are used to improve the person's cognitive and social aspects affected by the disorder.

As for the cognitive aspects, these are addressed mainly in DD research. Cancer et al. (2020) emphasize that DD might be caused by a deficit of phonological processing, namely a difficulty in the processing of speech sounds, while Łuniewska et al. (2018) also stress the role of attentional dysfunction, which hinders the rapid and efficient processing of visual stimuli that are needed to fluently read. Franceschini et al. (2013, 2017) tested video game capacity to orientate attention and train attentional skills of people with DD: during game play, players were constantly stimulated by the game and received feedback on their performance, which could produce learning and ameliorate spatial attention. Another rationale for using video games in DD consists in directly and precisely measuring the patient's level of attentional ability by means of game scores (Franceschini & Bertoni, 2019).

As for the social aspects, research mainly revolves around ASD (Chung et al., 2015; Dickinson and Place, 2016; Finke et al., 2018; Heasman and Gillespie, 2019; Gallup and Serianni, 2017; MacCormack and Freeman, 2019; Sundberg, 2018): albeit ASD may occur in very different forms, individuals with ASD share deficits especially in communication and social skills, with a tendency to withdrawal from social relationships (Baron-Cohen, 2017). In this sense, researchers used video games to support social skill acquisition (e.g., Chung et al., 2015; Finke et al., 2018), or to improve both the quantity and quality of ASD individuals' relationships (Sundberg, 2018), which are generally

poor (e.g., Bauminger & Kasari, 2000; Kasari et al., 2012): this often entails negative experiences, such as feelings of loneliness and social isolation (Locke et al., 2010; Orsmond et al., 2013).

The papers included in the corpus pinpoint relevant reasons for using commercial video games for social purposes in the ASD domain, also highlighting several limitations. Firstly, they are various, affordable, fun, and interactive, so they encourage people to play (Dickinson and Place, 2016). The importance of engagement for self-motivation is stressed by both Chung et al. (2015) and MacCormack and Freeman (2019): as people with autism have narrow patterns of interests (South et al., 2005), their subjective preferences need to be taken into account within an intervention and commercial video games offer a variety of options that may satisfy their specific tastes.

Secondly, the virtual worlds of digital games give people with ASD the opportunity to gradually experience themselves in a protected and structured environment: on the one hand, video games dismiss uncontrolled variables, which are common in daily life and may engender anxiety in people with ASD (Gallup and Serianni, 2017); on the other hand, they offer the opportunity to interact in a space that has clear rules and shared goals (MacCormack and Freeman, 2019). Such a scaffold is fundamental for learning: for example, in video games, individuals with ASD can face challenges similar to those that they encounter in real life, but in more manageable and rewarding ways. Moreover, virtual environments give them the opportunity to experiment novel situations and identities (Gallup and Serianni, 2017; Finke et al., 2018).

Thirdly, video games give individuals with ASD the possibility to engage with an activity that may make them feel competent: this may motivate them to connect with others by competing (Dickinson and Place, 2016) or showing their expertise (MacCormack and Freeman, 2019). When players with ASD have the chance to use their competences to solve complex problems, establishing new relationships is easier for them (Gallup and Serianni, 2017; MacCormack and Freeman, 2019). Heasman and Gillespie (2019), for instance, observed autistic-to-autistic interactions occurring during video game play. Here, video games offer a social setting where people with ASD are “naturally” required to enact social behaviors useful to achieve the in-game goals.

4.2.2 Mood disorders

The group of papers addressing mood disorders consists of studies that focus on depression (Franco, 2016b; Kaufman and Zhang, 2015; Kühn et al., 2018; Russoniello et al., 2013), even with co-morbid anxiety disorders (Fish et al., 2014; Fish et al., 2018). On the one side, depression may be accompanied by affective (e.g., sinking mood, loss of interest, low self-esteem) and cognitive symptoms (e.g., poor concentration, diminished ability to think, or indecisiveness) (American Psychiatric Association, 2013); on the other side, anxiety clusters around a common set of symptoms, namely negative mood, loss of control, unnecessary worry, avoidance of specific environments/situations, and chronic stress (American Psychiatric Association, 2013).

Video games provide a valid alternative (or addition) to regular medical therapy of mood disorders, without the negative side effects of pharmacological interventions and with a better cost-effectiveness ratio (Fish et al., 2014, 2018; Kühn et al., 2018; Russoniello et al., 2013). Moreover, some research (Fish et al., 2018; Kühn et al., 2018) points out that interventions with video games are perceived by patients living with mild depression as non-invasive, with no associated stigma, and that video games can be self-administered by the patient alongside medical therapy (e.g., with Selective Serotonin Reuptake Inhibitors (SSRI) in Fish et al., 2014, 2018). In this context, the concept of “flow”, as theorized by Csikszentmihalyi (1975), is particularly relevant: video games allow patients to enter into a flow state, making them experience feelings of intrinsic reward, focused attention, timelessness and extreme focus on the activity (Fish et al., 2014; Fish et al., 2018). According to these studies, experiencing this hyper-focused state is linked to positive mental outcomes improving mood and reducing the symptoms of anxiety and depression.

It is worth to notice that one paper focuses on depression among elderly people (Kaufman and Zhang, 2015). The cost-related benefits of video games are here particularly important, as the global geriatric population is expected to grow in the next years, demanding new and convenient solutions for facing

age-related problems (U.S. Department of Health and Human Services, 2009): video games may offer an economical and scalable method for supporting older adults suffering from depression, anxiety, and experiencing a sense of loneliness, by ameliorating their well-being, sense of inclusion and social connection. For example, Kaufman and Zhang (2015) investigated the social-emotional benefits of Massively Multiplayer Online Role-Playing Games (MMORPGs) on older adults, as in these games elderly can play together, no matter where they are physically located: this is considered an important advantage, as social engagement is a fundamental component of healthy aging.

4.2.3 Neurocognitive disorders

According to the DSM-5 the hallmark of neurocognitive disorders consists in the impairment of cognitive functions (e.g., attention, language, memory, learning, and thought), resulting from decline from a previous level of performance (American Psychiatric Association, 2013). The five papers addressing these kinds of disorders focus on dementia (Groenewoud et al., 2017; Hicks et al., 2019; Cutler et al., 2016; Fenney and Lee, 2010), which is the customary term for a series of degenerative neurocognitive conditions that mainly affect older adults, negatively interfering with their mental, physical and emotional well-being, or on Mild Cognitive Impairment (MCI) (Weybright et al., 2010), which indicates earlier degradation of cognitive functioning.

By and large, this research mostly aims to preserve patients' quality of life (QoL), taking the Healthy Ageing Agenda (The Swedish National Institute of Public Health Research, 2007) as a reference point: video games are employed to favor the patients' sense of connection, self-expression, and self-esteem, as well as to support their lifelong learning, or provide them with cognitive stimulation. More specifically, research emphasizes several reasons why commercial video game-based interventions might be effective for treating dementia and MCI. First, video game-based therapeutic activities can match patients' personal interests. The participants observed by Groenewoud et al. (2017) were allowed to choose, among a selection of 13 titles, the game to play, which ensured a positive experience during the treatment. In this way, patients had the opportunity to decide how to spend their time, rather than feeling constrained to participate in standardized group activities (Groenewoud et al.,

2017). Similar insights can be found in Fenney and Lee (2010) and Hicks et al. (2019). Second, digital gaming technologies may create a space where patients do not always have the pressure to perform: most video games are designed to be rewarding, which contributes to empower patients' self-esteem against negative, stereotypical perceptions of their abilities and, ultimately, to improve their overall perceived QoL (Cutler et al., 2016). Finally, video games may produce a significant increase in older adults' "task attention" and "positive affect", giving them the opportunity to participate in an engaging, stimulating, and self-directed activity (Weybright et al., 2010).

4.2.4 Post-Traumatic Stress Disorder

Post-Traumatic Stress Disorder is a condition characterized by psychological distress that follows a stressful or traumatic event: the symptomatology presents intrusive, recurrent distressing memories of the event and avoidance of stimuli associated with it, as well as persistent negative alterations in mood and cognitions (American Psychiatric Association, 2013). The 10 papers addressing PTSD can be divided into three groups: four studies employ video games in a laboratory setting using the "Trauma Film Paradigm" (Horowitz, 1969), which reproduces a shocking experience by exposing participants to a trauma film; the second group of papers, instead, studies the impact of video games on patients with diagnosed PTSD who had a real-life trauma, especially veterans; finally, one study explores how video game playing is associated with PTSD symptoms.

As for the first group (Brühl et al., 2019; Holmes et al., 2010; James et al., 2015; Kessler et al., 2020), research shares the common objective of preventing the development of PTSD negative symptoms (Brühl et al., 2019). Here, trauma is conceived as a memory issue, where timing is critical: the intervention should be addressed in the early post-trauma period to reduce later undesired and intrusive memories occurring in the form of flashbacks, which may cause significant distress and impairment (Holmes et al., 2010). Video games act as a competing cognitive task that can disrupt not only the initial consolidation, but also the reconsolidation of trauma images (Brühl et al., 2019).

The second group of five papers (Butler et al., 2020; Colder Carras et al., 2018; Elliott et al., 2015; Iyadurai et al., 2018; Kessler et al., 2018), instead, focus on the role of video games in mitigating patients' ongoing distress. These studies stress the limits of the current trauma-focused psychotherapies (e.g., narrative exposure therapy, cognitive processing therapy, which involve exposure to the traumatic experience), which might be uncomfortable for the patients, who have to recall the traumatic memories (Colder Carras et al., 2018; Elliott et al., 2015). Conversely, digital games may provide individuals with the opportunity to heal from distressing emotions, by offering pleasurable experiences that can help them manage negative moods and stressful emotional states (Colder Carras et al., 2018). Players can benefit from a "flow" state, where their attention is focused on the game and intrusive thoughts can be kept under control, decentering, i.e., psychological distancing from symptoms and stressors, and reframing perspectives (Colder Carras et al., 2018). Moreover, video games may provide players with a sensation of control (Colder Carras et al., 2018; Elliott et al., 2015), which is usually compromised in PTSD, as several stimuli can trigger undesired memories (American Psychiatric Association, 2013). They also stimulate the patients' working memory, planning and spatial cognition (Elliott et al., 2015), which may be negatively altered in individuals with PTSD, who often suffer from trauma-related amnesia and concentration difficulties (American Psychiatric Association, 2013). Equally important, video games may favor the development of in-game relationships providing intimate forms of social interactions (Colder Carras et al., 2018; Elliott et al., 2015): this is worth to notice, as social avoidance is one of the criteria to diagnose PTSD (American Psychiatric Association, 2013).

The last paper (Etter et al., 2017), instead, examines the relationship between playing and posttraumatic stress disorder (PTSD) symptoms among current and former members of the military. The study suggests that individuals with PTSD play already with shooter games, but these are not predictive of PTSD symptoms, so that research and clinical work can explore therapeutic uses of these low-cost, broadly accessible games.

To summarize, video games have been employed to address different mental health conditions and for a variety of objectives: to improve the individual's self-understanding of a specific disorder, treat its

symptoms, ameliorate skills that are compromised by the disorder, or impact on those psychological variables that are relevant to the disorder.

4.3 Video game features

In this section, we shed light on the relationship between specific kinds of games and the ways they have been used in research, in order to provide an understanding of how specific video game features may be suitable to prevent or treat certain mental conditions. By focusing on the game characteristics, this section complements the previous one, which addressed the disorders' peculiarities.

In our corpus, a major part of the studies (N=17) employed video games running on consoles, such as Nintendo Wii (e.g., Cancer et al., 2020), Nintendo DS (e.g., Iyadurai et al., 2018), PlayStation 3 (Franceschini & Bertoni, 2019) and Xbox 360 (Heasman & Gillespie, 2019). Three studies used games running on smartphones or tablets (Groenewoud et al., 2017; Kessler et al., 2018; MacCormack & Freeman, 2019). Finally, in one case (Gerhardt & Smith, 2020) participants played on a Personal Computer (PC). As for the remaining articles, the gaming platform was not specified.

Video games, however, not only employ different technologies, but also tackle different “imaginaries”. If we adopt a “narratological” approach, video games can be precisely described according to a main theme or subject: a subject can be attributed to games offering content or experiences similar to those contained within traditional narrative forms such as books or film (Woods, 2004), while other games, like *Tetris*, lack a narrative element (Tavinor, 2008). As for the games employed within the reviewed studies, they mostly lack an identifiable subject, while their narrative aspects are scarcely taken into account during the definition of the interventions. This said, the combat theme is certainly relevant for research addressing PTSD in veterans (Colder Carras et al., 2018; Elliott et al., 2015), as this research line explores positive and negative effects of games that can recall veterans' past combat experiences. Likewise, the fantasy theme, which characterizes games like *Elder Scrolls: Morrowind* and *World of Warcraft*, may either support the client's work on her identity, by providing characters with which she can identify (Guhde, 2017; Rosegrant, 2012), or undermine

her possibilities of creating her own narratives, as these games usually provide already well-defined stories (Franco, 2016b). Other subjects that appear in the studies included in our corpus are the crime (e.g., Segev et al., 2017), sports (e.g., Fenney & Lee, 2010), and science fiction (e.g., Ceranoglu, 2010b; Chung et al., 2015) themes: these, however, do not appear to be intentionally exploited by the interventions reported in the reviewed articles.

Video games also widely vary in terms of features and experiences that they are able to elicit, which may affect how they are integrated into a therapeutic protocol, as well as the outcome of the intervention. An order in such a complex landscape may be given by the notion of “game genre”: the term refers to “groups of games, differentiated based on one or more game characteristics” (Heintz and Law, 2015). However, classifying video games is problematic (Aarseth, 2004; Arsenault, 2009; Apperley, 2006; Clarke et al., 2017), because the concept of genre itself proved to be imprecise when applied to video games. Attempts to build video game classifications in the scholarly domain often failed to map the language used by the game industry or the players (Clarke et al., 2017), so that there does not exist a universally recognized list of game genres. In the following, we will use the genre labels mentioned within the articles of the corpus. Alternatively, when the articles miss to specify the game genres tackled, we will refer to the game industry standards, as the aim of this review is to map research on commercial video games. Three papers did not specify either the video games played by the participants or their genre (Finke et al., 2018; Rowntree and Fenney, 2019; Sundberg, 2018), while other studies addressed a wide range of video game genres (Cutler et al., 2016; Hicks et al., 2019; Heasman and Gillespie, 2019; Colder Carras et al., 2018).

We can group the video games addressed in our corpus into 8 genres in order to explore their distinctive features: active video games, action video games, action-adventure video games, casual video games (CVGs), puzzle games, First Person Shooter (FPS) games, Role-Playing Games (RPGs) and the sub-genre of Massively Multiplayer Online Role-Playing Games (MMORPGs), and sandbox video games.

4.3.1 Active video games

Active video games refer to a relatively novel video game genre, which extends the gaming experience to the entire body: by combining game play with physical activity, active video games provide a fun experience based on body movements (e.g., Benzing and Schmidt, 2017). In the corpus, this genre is used in various ways by 4 papers to improve the social functioning of children with ASD (Chung et al., 2015; Dickinson and Place, 2016), or the mental health of older adults (Fenney and Lee, 2010; Weybright et al., 2010).

Active video games are mostly designed to allow group gameplay, enabling people to meet together and participate in a common activity: this may also improve cognitive functioning, which is usually low when social engagement is poor (Weybright et al., 2010). For instance, Dickinson and Place (2016) highlight that *Mario & Sonic at the Olympic Games*, which allows simultaneous playing for up to four players, creates optimal conditions to study social interactions among ASD children. Forming a cohesive group is also important when the goal is to foster a “positive and independent therapeutic environment” (Fenney and Lee, 2010, p. 311), within which the patients can play without any further support.

4.3.2 Action video games

Action video games emphasize physical challenges, including hand–eye coordination and reaction time, and are used within 6 studies (Cancer et al., 2020; Franceschini and Bertoni, 2019; Franceschini et al., 2013, 2017; Kühn et al., 2018; Łuniewska et al., 2018). In these games, players may also have to face puzzle-solving and exploration challenges (Adams, 2006). Action video games appear to yield substantial positive influence on cognition (McCord et al., 2020) due to their neuropsychological properties (Bediou et al., 2018): i) the non-linear, fast pace (which stimulates a quick motor response in the player); ii) the perceptual burden (which positively affects working memory and planning abilities); iii) the continuous and rapid focus switching and iv) the presence of distractors with irrelevant information to be suppressed (which elicits visual attention and task switching). In this

perspective, Kühn et al. (2018) employed an action video game to reduce depression symptoms, which may cause downfall in attention, memory, and rumination. They encouraged participants with depression to play *Boson X*, a fast-paced game in which the player navigates a running avatar through a tunnel. The game increased the players' ability to suppress rumination via improvements in executive function.

Action video games also appear to ameliorate the discrimination of visual stimuli and the cross-sensory attentional shifting ability from visual to auditory stimuli in children with DD (Franceschini and Bertoni, 2019; Franceschini et al., 2013, 2017), thanks to their “speed, high sensory-motor load, and presentation of multiple, peripheral and temporal attention” (Franceschini et al., 2017, p. 2). However, this positive impact is not confirmed by all the studies included in the corpus (Łuniewska et al., 2019).

4.3.3 Action-adventure video games

Compared with action video games, action-adventure video games offer a more complex gameplay, combining core elements from action and adventure video games (Morris and Rollings, 2000). They engage both reflexes and problem-solving abilities to solve puzzles (Luban, 2002) but can also require the player to impersonate a character (Adams, 2006). These games, as *GTA IV*, may present an open-world environment, in which players have a high degree of freedom and their actions heavily influence the gameplay (Segev et al., 2017).

Three papers in the corpus used action-adventure video games (Ceranoglu, 2010b; Chung et al., 2015; Segev et al., 2017). These games widely vary and are used within different kinds of interventions and for different disorders, being especially suitable for becoming an “assessment tool”. Ceranoglu (2010b), for instance, describes a therapeutic experience with a 13-year-old child who played *Lego Star Wars II*, a Lego-themed action-adventure video game in which players can choose among 68 Lego characters and customize them. Avatar customization may impact on players' identification (Turkay and Kinzer, 2017), which, in turn, may influence players both cognitively and behaviorally

(Sah et al., 2017). In this study, the therapist observed the child's behavior within the game and helped him connect his game attitude with the attitude he had towards the accomplishment of learning tasks at school: for example, his low self-esteem was reflected in his initial wandering across the game levels without completing any goals (Ceranoglu, 2010b). By reflecting upon the experiences recounted by the patient, the therapist could better assess his "cognitive skills, affect, and impulse regulation" (p. 235).

In the same vein, Segev et al. (2017) examined the relationships between the specific disorders affecting a group of male adolescents and their playing patterns within an "unstructured" action-adventure video game (*GTA IV*) and a structured racing game (*Need For Speed*). They hypothesized that different adolescents would play video games differently, in a manner that would reflect their particular psychopathologies. Players' in-game behaviors were observed and then translated into quantifiable parameters mirroring several characteristics typical of specific disorders (e.g., impulsiveness, lack of energy, dysthymia). While there was no difference among the individuals' usage patterns of the structured racing game, there was a high variability among the individuals' usage patterns of the non-structured action-adventure game. The findings suggest that virtual behavior in unstructured action-adventures may mirror the players' disorders: the freedom of action offered by *GTA IV* allows players to enact different ways of playing, which may unveil their mental health and psychological traits.

4.3.4 Casual video games

Four papers focus on CVGs (Fish et al., 2014; Fish et al., 2018; Russoniello et al., 2013; Groenewoud et al., 2017), which are games usually played on smartphones and tablets. Russoniello et al. (2013) point out that these games have the following characteristics: i) they are quick to access, fun and easy to learn; ii) they do not require any previous expertise, or iii) regular time commitments; and iv) they are based on familiar game concepts, so that players can recall their past game experiences.

Fish et al. (2018) believe that CVGs “*inherently possess the requisites for individuals to experience flow: challenge, transparent rules and goals, and the ability to increase difficulty and skills applied*” (p. 3), so that they are indicated to treat anxiety and depression-related symptoms. Furthermore, CVGs are designed to give immediate rewards and feedbacks (e.g., “awesome!”, “great job!”) and this may support the individual in building confidence and sense of efficacy, which are normally lacking in people with dementia and concurrent depression (Groenewoud et al., 2017). Groenewoud et al. (2017), for example, stress that CVGs satisfy three important psychological needs of people living with dementia: they allow them to spend time (*occupation*), they create a sense of connection (*attachment*) that comes from the interactions with the game Artificial Intelligences, and they enable the remembering of memories from their own past, e.g., by recalling past episodes when they used to play solitaires (*identity*).

4.3.5 Puzzle games

Puzzle games emphasize problem solving, focusing on logical, cognitive, coordination, or perceptual challenges (Adams, 2006). In the corpus, they are represented by *Tetris*, which is used in 7 papers, all addressing PTSD (Brühl et al., 2019; Butler et al., 2020; Holmes et al., 2010; Iyadurai et al., 2018; James et al., 2015; Kessler et al., 2018, 2020).

What are the characteristics of Tetris that make it so suitable for PTSD? Tetris is a “*highly visuospatial game that involves the rotation and fitting together of visually presented blocks that differ in shape and color*” (Lau-Zhu et al., 2017, p. 438). Playing Tetris consists in doing a series of visuospatial tasks that require a sustained cognitive effort and is consistent with the emphasis that these PTSD studies place on trauma memories, which can be re-experienced by the patient after the traumatic event: playing Tetris during the consolidation of a trauma memory may interfere with the latter’s consolidation, thus reducing the frequency of later intrusive images (Brühl et al., 2019). Moreover, the visuospatial features of Tetris make the game an optimal complement to the eye movement desensitization and reprocessing (EMDR) therapy, which can be used as an alternative of

the trauma-focused cognitive behavior therapy and incorporate a visuosensory attentional component (Butler et al., 2020).

4.3.6 First Person Shooter games

FPS games, as well as their variant called Military FPS (MFPS), are used to address PTSD among members of the military in 2 articles (Elliott et al., 2015; Etter et al., 2017). They depict a gaming environment that is often modeled on real-life warzones and experienced from a first-person point of view: players interact within this world as soldiers having the objective of killing enemies. This kind of game presents similarities to technologies being used in virtual-reality exposure therapy (VRET), which consists in fostering immersion in trauma-related memories (Hoffman, 2004; Rizzo et al., 2011) with the aim to desensitize individuals to frightening stimuli.

Could simulated experiences in FPS gradually desensitize the individual, similarly to VRET? Do the realistic representations of combat experiences in these games exacerbate or, on the contrary, ameliorate PTSD symptoms (Etter et al., 2017)? Elliot et al. (2015) suggest that being immersed in a simulation that is similar to real life past experiences might help people who struggle with recalling traumatic episodes, producing a diminished affective response. The gradual decrease of PTSD patients' avoidant responses and paralyzing fear is here attributed to FPS' ability to make traumatic realities feel more game-like in retrospect, by evoking memories of experiences similar to those depicted in the game "protected environment": camaraderie, skill sharpening, and pure enjoyment stemming from playing further work towards this aim. Nonetheless, FPS might also have detrimental effects on individuals' health, namely an increased risk of isolation and triggering of unwanted memories (Elliott et al., 2015).

4.3.7 Role-Playing games

In RPGs, players take the role of imaginary characters and impersonate their stories (Franco, 2016b). Five papers present studies using RPGs (Franco, 2016b) or its “social” variant represented by MMORPGs (Gallup and Serianni, 2017; Guhde, 2017; Kaufman and Zhang, 2015; Rosegrant, 2012).

RPGs and MMORPGs share several relevant features: i) they both require the player to create a character and shape it in a way that will slightly change her interaction with the environment and the game experience (Franco, 2016b; Rapp, 2018); ii) they have an open-ended narrative structure, which means that there is not an ultimate end to reach, but players can keep completing the game tasks, which may point to a variety of secondary stories, and evolve their characters indefinitely (Rapp, 2017). In addition to these characteristics, MMORPGs engage the player in a wide number of social dynamics, so that they are considered “*both games and communities*” (Ducheneaut et al., 2007, p. 413). WoW, for instance, depicts a rich, open and dynamic universe, called Azeroth, where players can socially interact at various levels, starting from dyadic interactions to complex virtual organizations (Rapp, 2018, 2020).

Three papers in the corpus highlight that these features are especially appropriate for psychotherapeutic sessions (Franco, 2016b; Rosegrant, 2012; Guhde, 2017). Franco (2016b), for instance, stresses the importance of participating in the stories afforded by the game, as it happens to players in the RPG *The Elder Scroll: Morrowind*. Within the framework of narrative therapy (White and Epston, 1990), a “story” is a dominant plot that people use to organize their experiences and weave them together. Still, stories are not comprehensive of every experience, as some of them are concealed or forgotten: then, the objective of narrative therapists is to identify the patient’s main narrative and to help her in exploring different stories, which can unravel neglected aspects of the self (Fleming, 2003). Playing with an RPG can thus “*enable clients to externalize their problems and re-author their experiences*” (Franco, 2016b, p. 1). The therapist used the RPG as an “assignment” by asking the patient to create a character that is similar to her: this activity enabled her to reflect on the narratives she created about her life and to find similarities between the virtual and the real world.

Two papers (Kaufman and Zhang, 2015; Gallup and Serianni, 2017), instead, investigate the quality of the relationships built within WoW and the impact that they had on the participants. Kaufman and

Zhang (2015), for example, explored the social-emotional health of older adults playing WoW, who may suffer from lack of social support and loneliness. It turned out that WoW's specific features, such as the offering of quests and raids, i.e., in-game tasks that require cooperation among players to be completed, encourage players to group with others, facilitate the construction of social groups ("guilds"), and, in some cases, provide in-game friends who "*are seen as important as real-life friends*" (Kaufman and Zhang, 2015, p. 528).

4.3.8 Sandbox video games

Sandbox video games enable the player to express a high degree of creativity and often do not propose any definite goals or victory conditions, leaving her completely free to do what she wants (Adams, 2000), to explore or to create (Kuhn, 2018). In the corpus, 2 papers (Gerhardt and Smith, 2020; MacCormack and Freeman, 2019) employed two versions of the same sandbox game, Minecraft. MacCormack and Freeman (2019) used Minecraft Pocket Edition (Minecraft PE), which allows the player to build the game world's landscape, in order to support ASD children's social interactions. Minecraft game space is a "playground" (Schneier and Taylor, 2018) where players do not have a predetermined set of objectives to reach but are left free to explore and create the game world at their own will (Ellison and Drew, 2019). ASD children could play the game both in the standard unstructured way and in a structured modality set by the researchers: results showed that the structured condition was the most appropriate to facilitate interaction among ASD children, given their need of clear and predictable rules, due to difficulties in dealing with violations of their expectations (Van de Cruys et al., 2014). Therefore, MacCormack and Freeman (2019) show that certain games may be suitable for certain conditions only if played in certain ways, as an excess of freedom may not be beneficial to individuals who need structured interaction to participate in social activities.

To summarize, a major part of the reviewed articles appears to take into account the specific characteristics of video games, selecting the video game genre that is presumably most appropriate for

addressing a specific disorder. A correct coupling between video game genres and mental conditions is crucial for the successfulness of the intervention but, as MacCormack and Freeman (2019) show, the setting in which the players play the game is important too. Despite the nature of the game, researchers may act upon the intervention setting, manipulating how the game is played in order to fit with the patients' needs.

4.4 Synthesis of the results

This section analyzes the selected papers with reference to their reported outcomes. We first describe the (full, partial, or null) positive effects produced by video games on mental health, reported in the quantitative, qualitative, and mixed-methods studies included in the corpus. Then, we point out the negative impacts of playing highlighted by those few papers that considered the potential side effects of video game usage in the context of mental health.

4.4.1 Quantitative findings

Among the 18 quantitative studies included in the corpus, 10 articles claimed that commercial video games had positive effects on the target variables, whilst 8 papers only partially confirmed their initial research hypotheses by reporting some effects.

4.4.1.1 Positive effects

Three papers claimed that video games were effective on mood disorders (Fish et al., 2014; Kaufman and Zang, 2015; Russoniello et al., 2013). They could mitigate some of the depressive symptoms, which involve changes in affect, cognition, and neurovegetative functions (American Psychiatric Association, 2013). Russoniello et al. (2013), for instance, reported that playing CVGs significantly reduced symptoms of clinical depression. They also showed that these positive effects were

maintained after 1 month from the end of the intervention in patients with both mild and severe depression.

As for the papers addressing neurodevelopmental disorders, three of them reported positive results. Franceschini et al. (2013, 2017) pointed out that action video games are promising for treating both attentional skills and reading abilities in DD children. These results have been confirmed by Cancer et al. (2020), who showed that an intervention with an action video game improved both reading speed and accuracy of a group of young students with DD.

Other positive effects were reported with reference to PTSD by Holmes et al. (2010) who found that playing Tetris after seeing a trauma film reduced the number of unwanted intrusions. Butler et al. (2020) reported that Tetris play yielded hippocampal increases and reductions in symptoms of PTSD. Etter et al. (2017) found that even though MFPS/FPS video game players reported higher levels of PTSD symptoms than participants who did not play with them, playing FPS/MFPS was not predictive of PTSD symptoms after accounting for personality, combat exposure, and social support variables. Finally, Segev et al. (2017) discovered that unstructured action-adventure video games were effective as an “assessment tool”.

4.4.1.2 Partial effects

The remaining 8 quantitative studies reported partial positive effects of the use of video games on mental disorders. As for mood disorders, Kühn et al. (2018) discovered that *Boson X* was effective in decreasing rumination and augmenting cognitive flexibility in people with a diagnosis of major depression or dysthymia but could not reduce depression severity. Fish et al. (2018) found a significant decrease in state anxiety scores after the one-month prescription of CVG play, while results concerning trait anxiety did not demonstrate significance.

As regards neurodevelopmental disorders, Łuniewska et al. (2018) challenged the results found by Franceschini et al. (2013, 2017), by involving a larger sample (n=54) and a control group who did not

play with any games: they compared the effectiveness of an active video game on the reading skills of individuals with DD with that of an ad hoc designed phonological non-action video game. The target skills improved after the intervention with both games, but no difference was found between the experimental groups and the control group: the authors conclude that the observed improvement in reading may be attributed either to the normal reading development related to schooling or to test practice effects. Franceschini and Bertoni (2019) reported that not all the children with DD obtained the same beneficial effects from action video game play, since phonological decoding speed and phonological short-term memory were increased only in DD children that improved their video game score.

As for ASD, Chung et al. (2015) did not find any improvement in pro-social behavior (and decreased aggression) of individuals with ASD when active video games are used in absence of other treatments. Positive effects on social functioning were instead obtained by Dickinson and Place (2016), who deployed a 9-month intervention with active video games: their positive results, however, were limited to boys, while the data about girls did not show statistical significance.

Finally, the surveys conducted by Rowntree and Fenney (2019) and Sundberg (2018) pointed to both upsides and downsides of video games as they were recounted by the patients' point of view. The former study revealed that most of the participants (63.3%) might have acceptability issues about video games, as they considered the playing activity as a waste of time: nevertheless, a consistent part of them (38.9%) also acknowledged the positive role of gaming, that is to help them develop useful skills. The latter emphasized that, albeit ASD individuals who play MMORPGs have significantly more friends than non-players, the amount of time played is crucial to this aim: individuals who played more than 5 hours per day did not gain social advantages from the game.

4.4.2 Qualitative findings

To understand the outcomes of the 10 qualitative studies, qualitative data were extracted and synthesized. We report the main findings by grouping them in three recurrent themes that capture the

role of commercial video games across different mental health interventions: 1) they act as a scaffold that sustains social interaction and the relation with the therapist; 2) they support emotion management and expression; 3) they facilitate learning and the development of skills in a safe environment.

4.4.2.1 A scaffold for social interaction and relation with the therapist

Most qualitative studies reported that video games were effective in sustaining social interaction, helping players in developing and maintaining relationships within the game or by means of the game. When the opportunity to socialize is scarce or difficult to sustain, the worlds depicted in video games turn out to be a place where socialization may favorably happen (Gallup and Serianni, 2017) resulting in a higher level of emotional well-being due to a better community involvement (Finke et al., 2018). Moreover, video game play appears to support the therapeutic relation (e.g., Ceranoglu, 2010b; Rosegrant, 2012). By using video games, the therapist may also have better opportunities to assess the patients' cognitive skills. On the one side, video games allowed for rapid screening of memory, visuospatial, motor, planning, reading, and mathematical skills (Ceranoglu, 2010b). On the other side, during video game play, the therapist could observe thought processes, temperament, impulsivity, and decision-making (Ceranoglu, 2010b). In other words, every decision taken by the player, e.g., if she uses cheat codes or restarts the game, can provide the therapist with useful information about the patient's condition.

4.4.2.2 A tool for expressing and managing emotions

Video games were effective in helping the patient express and manage her emotions when traditional methods appeared insufficient. In the case reported by Gerhardt and Smith (2020), the child overcame his traumatic experiences because he expressed his untold feelings by means of a video game's character, with which he identified. Video games provided the patient with a metaphor, a story where

thoughts, emotions and experiences could be organized and processed. Rosegrant (2012) explains that video games also alter the quality of the individuals' subjective experience of reality and these "altered realities" give people the opportunity to disclose their fears and wishes, giving the therapist access to them.

Video games also effectively supported the management of emotions, by allowing players to "escape from the world", an escape that mostly refers to psychological and mental matters. Video games disconnected players from the world, by encouraging a temporary detachment from their negative emotions (e.g., Colder Carras et al., 2018), or by creating a space where to get a second chance or even a "second life" (Rosegrant, 2012). In this perspective, virtual environments are places where people can release discomfort feelings, anxiety and fears, which are directly related to the difficulties caused by their mental condition: the struggle for establishing relationships of ASD adolescents (Gallup and Serianni, 2017), the lack of autonomy of older men suffering from dementia (Hicks et al., 2019) or the distressing emotions associated with PTSD in veterans (Colder Carras et al., 2018; Elliott et al., 2015).

4.4.2.3 A safe environment for training and learning

Participants across the qualitative studies of the corpus commonly perceived the experience of playing as beneficial since video games offered a non-threatening, familiar and comfortable space. Depending on the participant, her health condition and the goal of the study, different positive outcomes coming from this secure environment were highlighted: 1) to speak openly, relax and talk - also about the individual's mental health condition (e.g., Hicks et al., 2019); 2) to practice and, therefore, learn new skills in a non-judgmental setting, as errors and trials are part of the gameplay, which often creates a jovial and non-competitive atmosphere (e.g., Finke et al., 2018); 3) to favor the emergence of the patient's psychological problems or conflicts (e.g., Ceranoglu, 2010b; Franco, 2016b; Guhde, 2017).

Participants also recounted how the possibility of succeeding and expressing a talent in a safe environment increased their feeling of being competent, which turned to be effective even in real life

(Colder Carras et al., 2018). Albeit video games create a virtual world which is secure, controlled, and detached from reality, some players became professional gamers or streamers (Colder Carras et al., 2018), others took advantages of the skills learned in the game to “reconnect with the modern world” (Hicks et al., 2019), while others were helped in approaching living their life “in any world” (Guhde, 2017). Players could experience an “integration” of internal and external worlds by means of gaming, whereby the ability to “integrate” is a fundamental function of the human mind (Freud, 1953; Loewald, 1951; Winnicott, 1953).

4.4.3 Mixed-method findings

We group the outcomes of mixed method studies into three categories, distinguishing 8 papers which reported positive effects (Cutler et al., 2016; Fenney and Lee, 2010; Heasman and Gillespie, 2019; Iyadurai et al., 2018; Kessler et al., 2018; Kessler et al., 2020; MacCormack and Freeman, 2019), 2 papers that showed partial effects (Groenewoud et al., 2017; James et al., 2015), and one that reported no effect (Brühl et al., 2019). Differently from the quantitative papers, mixed-method studies often investigated the subjective experience of participants: therefore, results have been also analyzed with reference to this point when needed.

4.4.3.1 Positive effects

Two mixed method studies found positive effects of video games on ASD (MacCormack and Freeman, 2019; Heasman and Gillespie, 2019). MacCormack and Freeman (2019) showed that structured play helped ASD people socialize, by improving the rates of initiations, i.e., “*the number of spontaneous peer-directed utterances that were not preceded by another youth’s question or comment requiring a response*” (p. 223), and gave support to social skill development. Heasman and Gillespie (2019) showed that autistic people have the unacknowledged ability to manage interaction with their peers and that video games made this easier, by requiring them to frequently change their game social role, e.g., being the helper or the receiver, the defender or the attacker.

Three papers (Cutler et al., 2016; Fenney and Lee, 2010; Weybright et al., 2010) showed that digital gaming supported older people with neurocognitive disorders in learning, providing stimulation and encouraging their independence. For instance, Fenney and Lee (2010) affirmed that video games may not only facilitate the retention of various cognitive attributes related to the learning experience but are also considered an enjoyable and socially valuable activity by the participants. These results were extended by Cutler et al. (2016), who reported that using video games with older people with dementia had a broader impact on their health, by engaging them in “nonstereotypical activities” (p. 121) and by acting on the conception that people have about themselves and their capabilities. Moreover, participants expressed the desire to continue to learn, as well as to work on their abilities, a sign that learning was transferred outside the game sessions to daily life.

As for PTSD, three studies (Iyadurai et al., 2018; Kessler et al., 2018, 2020) presented positive effects. Both Iyadurai et al. (2018) and Kessler et al. (2020) showed that playing with Tetris reduced the number of intrusions reported when traumatic memories were artificially induced; while Kessler et al. (2018) emphasized that video games reduced the intrusions concerning real-life situations (64% on average) experienced by PTSD patients.

4.4.3.2 Partial effects

Two studies addressing PTSD and neurocognitive disorders reported only partial effects. James et al. (2015) confirmed only one of the hypotheses driving their experiments: on the one hand, the number of intrusions were reduced by means of playing Tetris, even when the memories were already consolidated (i.e., more than 24 hours after the exposure to the traumatic film); on the other hand, simply playing the video game was not sufficient to decrease the frequencies of unwanted memories. In fact, to be disrupted by the gaming activity, old memories should be reactivated with a reconsolidation activity.

Groenewoud et al. (2017), instead, reported that playing video games may improve the general well-being of elderly, but presents some limitations. Participants' user experience was crucial for the

effectiveness of the whole intervention and, indeed, some participants complained about the ergonomics of the video game platform they used, while others reported that the game did not meet their ambitions, expectations or interests: this ultimately hindered the possibility to reach a state of “flow”, which is important for motivating people to play and, thus, adhere to the intervention.

4.4.3.3 No effects

Only the study conducted by Brühl et al. (2019), in the context of PTSD, showed no effect, i.e., no reduction of intrusive images and associated stress: the authors gave several explanations of these results, which could be ascribed to the design of the experimental setting, e.g., the absence of reminder cues in the procedure and the timing of the gaming and self-reporting activities.

To summarize, the majority of the quantitative and mixed-method studies reported positive effects of video games on mental health, as 18 papers fully confirmed their initial hypotheses. Partial outcomes can be found in 10 studies, while only one study was not successful in delivering a game-based intervention. As for the qualitative studies, findings especially contribute to point out the role that video games can play in mental health interventions: they can foster social interaction and support the relationship with the therapist, help emotion management and expression, and facilitate learning by providing a safe environment.

4.4.4 *Negative effects*

Across all the studies included in the corpus, only a few papers reported potential negative effects of the use of video games in the context of mental health.

Among the quantitative studies, Holmes et al. (2010) found that only Tetris has positive effects on PTSD. By contrast, playing with a different game may even increase undesired flashbacks. Sundberg (2018) emphasized that people with ASD engaging in excessive playing with MMORPGs may hinder their already fragile real-life social interactions and, consequently, exacerbate loneliness feelings

(Sundberg, 2018). Finally, Rowntree and Fenney (2019) noticed that playing video games can make individuals feel more frustrated in themselves.

Six qualitative studies highlighted the potential negative subjective experiences that people may live when playing within a mental health intervention. Elliott et al. (2015), who explored how veterans play with combat-themed games to cope with PTSD symptoms, found that gaming can actually trigger traumatic memories and elicit negative related emotions when it is performed in an unsupervised setting. This points to the importance of having a third person who somehow supervises the gaming experience during psychotherapy. Likewise, Franco (2016b) warns that certain video games defining the rules, the story, and the role of the character risk to limit the client's fantasy as well as her narratives, rather than expanding them. In this vein, Ceranoglu (2010b) reports that video games' fast pace of play and the possibility of reduced face-to-face contact due to intensive playing may interfere with the treatment goals if not monitored. Guhde (2017) stresses that fantasizing elicited by video game playing may remain an isolated phenomenon, absorbing the patient's energy but not contributing to her real life. Two studies further highlight the participants' opinions about the negative effects of playing video games: Colder Carras et al. (2018) point out that some veterans with PTSD felt that they played games excessively or were addicted, and reported that gaming negatively affected relationships, finances or time management; whereas Finke et al. (2018) noticed that individuals with ASD sometimes feel anger, frustration, or sadness during game play, especially when they cannot accomplish an in-game objective.

Among the mixed-method studies, Groenewoud et al. (2017) found that older people with dementia could experience annoyance, low self-esteem, and sense of insecurity when not adequately engaged in the game. Moreover, their sense of mastery can be compromised when they find difficulties in interacting with the game system. Cutler et al. (2016) reported that some participants found it difficult to concentrate using certain games for the Nintendo Wii, due to their bright colors and fast-moving graphics. Several participants also found the Nintendo DS challenging due to the small size of the screen, which compromised their ability to engage with the game. These examples show the importance of the "interaction aspects" when designing a game-based intervention.

5. DISCUSSION

This review analyzes the characteristics and outcomes of 39 studies on commercial video games and mental health published between January 2010 and August 2020. Our analysis was moved by the following research question: How have commercial video games been employed in the mental health domain and what kinds of psychological impacts do they have?

The review findings show that commercial video games are a promising “tool” for mental health research and practice: they have been used both to ameliorate the symptomatology of a variety of mental conditions, like neurodevelopmental disorders (e.g., MacCormack and Freeman, 2019), mood disorders (e.g., Fish et al., 2014), PTSD (e.g., Holmes et al., 2010), and neurocognitive disorders (e.g., Cutler et al., 2016), and to support psychotherapy (e.g., Rosegrant, 2012), encouraging the expression and management of emotions (e.g., Gerhardt & Smith, 2020), as well as creating a safe environment for learning, which can be used by children, adolescents, adults, and the elderly population suffering from dementia (e.g., Finke et al., 2018; Hicks et al., 2019).

By and large, commercial video games have been found to engage and enjoy patients (Elliot et al., 2015; Fenney and Lee, 2010), also yielding states of “flow”, which may produce positive effects on their overall mental health (e.g., Fish et al., 2014; Fish et al., 2018). They also offer people the possibility of choosing among a variety of options, thus matching their interests and tastes, which could result in a more effective intervention (Fenney and Lee, 2010; Hicks et al., 2019; Chung et al., 2015; MacCormack and Freeman).

More specifically, casual video games were found effective in mitigating some depressive and anxiety symptoms in adults (e.g., Fish et al., 2014; Russoniello et al., 2013) and a puzzle game like Tetris has been discovered to prevent negative intrusions that contribute to worsen PTSD symptoms (e.g., Kessler et al., 2018, 2020). In the context of PTSD, FPS games also appear promising, as they are able to recall traumatic episodes, producing a diminished affective response over time (Colder Carras et al., 2018). The neuropsychological properties of action video games, instead, might be effective on

depression and DD (e.g., Kühn et al., 2018; Cancer et al., 2020); whereas active video games improve the social functioning of children with ASD (e.g., Dickinson and Place, 2016), or the cognitive functioning of older adults (Weybright et al., 2010), as they provide opportunities for playing together.

We also found that unstructured video games (like sandbox games, MMORPGs or action-adventure video games), which provide the player with an open world to explore, have the potential to be used as a diagnostic tool for several mental health conditions (e.g., Segev et al., 2017). In fact, game logs may have a diagnostic value: they can be collected and analyzed to capture players' behaviors and identify the disorder they suffer from (Segev et al., 2017), or to study dynamics relevant to their specific condition, like social interaction and mutual understanding in ASD (Chung et al., 2015; MacCormack and Freeman, 2019). Moreover, these games can be used within research protocols that give them a structure, favoring social interaction and social skills acquisition in ASD children (e.g., MacCormack and Freeman, 2019).

However, not all the analyzed studies report "full positive" effects, as some research points to partial or even no effects. This signals that further research is needed in order to confirm or disconfirm the potentialities of video game usage highlighted in this review. Finally, the review points out several side effects that may emerge from the usage of commercial video games in a mental health context. Risks of problematic gaming (e.g., Elliott et al., 2015), escapism into another reality (Guhde, 2017), and the consequent reduction of real-world interactions (Sundberg, 2018), could be detrimental for the intervention, especially for people that already have a fragile social life (like people with ASD).

Based on these findings, in the following we emphasize several key points and research opportunities emerging from our analysis.

5.1 Commercial video games: important features and possible shortcomings

The analysis of existing work points to several commercial video games' features that make this technology particularly suitable for being used in the context of mental health, especially if compared

to serious games, which currently appear to be “the gold standard” in game-based interventions (Fleming et al., 2017; Lau et al., 2017; Michael & Chen, 2005; Pine et al., 2020).

First, they can be used in different contexts, for different objectives, in different ways, and to treat various conditions. Gerhardt and Smith (2020), for instance, employed Minecraft to treat a child with ASD, ADHD and a trauma disorder. Their flexibility usually comes from their greater complexity in terms of opportunities for action within the game, which is often due to the big investments that video game companies are able to make, given the mass market to which they are addressed (Altay, 2015). For instance, in the first 4 years since the launch in 2004, WoW cost 200 million dollars (Plunkett, 2008). By contrast, serious games have a potentially narrower range of application. They are designed for a specific goal, are usually endowed with simple tasks, and thus are not easily adaptable to other contexts and aims (Klemke et al., 2015).

Second, commercial video games are conceived to be fun and are voluntarily played by the player, who might be involved more easily in the intervention (Colder Carras et al., 2018; Fenney and Lee, 2010; Fish et al., 2018; Finke et al., 2018; Etter et al., 2017). On the contrary, serious games are not designed to entertain the player. Nonetheless, players still need to be engaged by the game in order to spontaneously comply with the program (Franzwa et al., 2013). In this sense, the lower focus of serious game design on the “engagement and fun factors” may hinder the development of a long-standing involvement with the game, which may become boring or repetitive, and consequently jeopardize the user experience (Buday et al., 2012).

Third, commercial video games are already integrated into the everyday practices of many individuals, so that therapists may exploit those games that are already played by the patients, without “constraining” them to adopt any new habit (e.g., Rosegrant, 2012). By contrast, serious games need to be introduced as a new “therapeutic tool”, and the individual can perceive the game as “extraneous” to her routines, requiring adherence to and compliance with the intervention (Lau et al., 2017).

However, the usage of commercial video games in the mental health domain also presents several shortcomings when compared to serious games.

First, COTS video game researchers do not have the possibility to exert any control on the design of the game they use. In this sense, commercial video games are often just “one piece of the puzzle” and need to be combined with group activities (Hicks et al., 2019; MacCormack and Freeman, 2019), medications (e.g., Fish et al., 2014, 2018), or other specific tasks (Groenewoud et al., 2017; James et al., 2015; Łuniewska et al., 2018), or be used within a social context that plays its own role, like the family (Gerhardt and Smith, 2020) or the circle of peers (Chung et al., 2015). This may require large efforts even in terms of professional figures involved in the design and delivery of the game-based intervention. Instead, serious games are usually developed for a specific purpose within a rigorous design process, which allows researchers to control every aspect of the game and embed into its design those levers that are thought to be effective on a specific mental condition (Verschueren et al., 2019).

Second, commercial video game researchers may find it difficult to isolate the effects of specific game features and consequently understand what worked in a specific video game and why. They cannot manipulate the game design features that may be responsible for producing a certain impact, while maintaining unaltered all the other aspects of the game. Therefore, COTS video game researchers often need to engage in a laborious process of “reverse engineering” to understand what worked in the video game or undermined the effects of the program. Instead, serious game developers can create slightly different versions of the same game and then compare their effectiveness: in doing so, they can identify which design elements are most beneficial to the intervention goal, as well as the reasons of their effectiveness (e.g., Fuchslocher et al., 2011).

Third, by not being specifically designed to improve a specific mental health condition, commercial video games may also produce undesired side effects. For instance, albeit it may have a positive impact on the patient’s involvement in the intervention, the engagement that commercial video games commonly elicit in the player can lead to problematic gaming, which might reduce face-to-face interaction (Ceranoglu, 2010), interfere with the therapeutic process (Franco, 2016; Rosegrant, 2012), or even produce a worsening of the patient’s everyday life (Colder Carras et al., 2019).

To counteract these shortcomings, researchers should better consider what lies “outside of the game”, controlling the “conditions of application” of the video game in the intervention (Section 5.4), find ways to collaborate with game developers, in order to improve existing games (Section 5.5), and develop their design knowledge, in order to foresee potential negative impacts of specific game aspects (Section 5.3).

5.2 Methodological limitations

The predominant methodological approach identified by this review across the papers analyzed is experimental and quantitative, with a prevalence of studies conducted in a laboratory-like setting. A first methodological limitation, therefore, relates to the lack of field trials aimed at understanding the transferability of the results gained in the artificial context of the laboratory to the real world. This is particularly evident in PTSD studies using the Trauma Film Paradigm (e.g., Kessler et al., 2020), where the employment of film footage as an analogue of real-life traumatic events may undermine the generalizability of the study results.

A second limitation concerns the duration of the studies. Most research had limited duration, with only one study employed a program lasting for several (9) months (Dickinson and Place, 2016). Moreover, only seven studies (Brühl et al., 2019; Butler et al., 2020; Fenney and Lee, 2010; Fish et al., 2018; Iyadurai et al., 2018; Russoniello et al., 2013; Weybright et al., 2010) conducted a follow-up, and only two studies (Butler et al., 2020; Fenney and Lee, 2010) followed participants in the long term (with follow-ups executed six and five months after the end of the program). The limited time window in which research has been carried out thus makes it difficult to assess the maintenance of the positive effects of video games over time.

Three main opportunities can thus be identified for future research. Longitudinal and more ecological studies should be conducted in order to understand if the employed treatments are able to transfer the observed improvements to the “real life” outside the laboratory setting, as well as be maintained over the long term.

Adding to this, quantitative measurements could be paired with qualitative tools more often, in order to gather more in-depth insights on the reasons why a certain intervention succeeded and to understand, e.g., if playing the game has been fully integrated into the everyday habits of the individual. For instance, if playing with casual video games showed promising results for treating depression (Russoniello et al., 2013), researchers could explore if the person has integrated the practice into her daily life e.g., if she has spontaneously played the game every time that she has experienced some symptoms and why, by using semi-structured interviews or diaries.

Finally, standard methodologies to evaluate the commercial video games' outcomes should be developed in the future. This would help in comparing results from different studies and in developing more effective game-based interventions.

5.3 Lack of design knowledge

Achieving positive outcomes by means of video games seems to require an interdisciplinary approach, as both game design and clinical competences are involved in the definition of a game-based treatment. In particular, an in-depth knowledge about video games and their mechanics appears essential, as practitioners and researchers need to thoroughly understand what aspects of a specific game may be effective on a particular symptomatology, also given the limited possibilities of manipulating the game design.

Nevertheless, the analyzed studies appear to lack awareness of the importance of game design related aspects when defining a mental health program based on commercial video games. Even though they often discuss how the features of a game genre may affect the outcomes of the intervention, the choice of a specific game is often poorly explained with reference to the study goals. Most authors appear to equalize all the video games belonging to a specific genre (e.g., action video games) or platform (e.g., the Nintendo Wii), missing to point out the peculiar design features of the selected game (e.g., Chesler et al., 2015). For instance, the choice of *Nintendo Wii Bowling* appears to have no rationale in Fenney and Lee (2010), apart from “the simplicity of playing instructions” (Fenney and Lee, 2010, p. 306).

However, different game design elements may engender different effects on players, and also slight modifications of the game logic can produce very different game experiences (e.g., Rapp, 2017, Schell, 2020). This entails that researchers need to understand in depth the features of the games they use, and how these differ from other games if they want to fully exploit their potentialities.

The importance of developing game design knowledge in this research area also stems from the transformations that game industry has undergone over the last ten years with the increasing demand and popularity of online multiplayer games (Grand View Research, 2020), the diversification of game content and genres (Vervoort, 2019), as well as the dissemination and sharing of game experiences by means of platforms and streaming services (Jia et al., 2016). This implies that game-based mental health research has to keep the pace with the rapid evolution of game technologies and practices: otherwise, the provided interventions could appear outdated and little engaging from the patients' perspective. If one of the main advantages of the usage of commercial video games lies in the fact that people can be easily involved in the gameplay, using an outdated video game, or relying on old game practices, might undermine the engagement and thus the effectiveness of the program. This risk appears evident in the studies analyzed in this review. For instance, while technology favored the transformation of digital games from solo experiences into more socially-oriented, multiplayer configurations (Herodotou, 2009; Herodotou et al., 2012), most of the research we reviewed uses single-player modalities of playing: the employment of multiplayer games or group playing is an exception in our corpus (e.g., Fenney and Lee, 2010; Gallup and Serianni, 2017; MacCormack and Freeman, 2019).

Fast-pace modifications of the video game market and rapid technological advancements also mean that video games are naturally subject to obsolescence: games are played on platforms (consoles, computers, mobile phones, etc.) that are gradually replaced over time (Moore, 2009). Moreover, video games are characterized by a certain longevity, which is an indication of how long the content can engage the player (Thygesen, 2014), and by a degree of replayability, which concerns the reasons encouraging a player to replay a game over time (Frattesi et al., 2011). These aspects are completely ignored in the analyzed corpus, signaling a lack of knowledge on a fundamental aspect of video game

design. For instance, WoW owes its fortune to the large community of players playing the game around the world: Rosegrant (2012) reports that participating in a community had a major role for his client Carl, who developed a social life in the game and, in there, learned to relate to other players. As time goes by, this community could contract or change, so that the game could not produce the very same benefits: however, this potential issue is not even mentioned in the paper. The “temporal design aspects” should then be carefully considered, in order to sustain the player’s participation in the long term, especially in those interventions where people are expected to comply with the program without any supervision or control from a researcher (e.g., Franco, 2016b; Kühn et al., 2018).

In sum, lack of awareness of game design aspects might undermine the effectiveness of the intervention. Future research should develop guidelines about what aspects of video games we should consider and why when designing a mental health intervention. Having such information available would help researchers in taking informed decisions about the video game to be used, on the basis not of generic factors like the availability of the game or its simplicity, but of its specific design features. This could also lead to the development of a transdiagnostic perspective based on the wider identified impacts of specific game design elements: knowing what kinds of elements work better in certain contexts and what kind of effects they may have on cognitive abilities that may be relevant for diverse mental health conditions would contribute to the creation of common methodological and theoretical frameworks, as well as “standard protocols” for using games in mental health interventions, going beyond the categorial and “nosographic” game usage reported in the articles included in our corpus.

As the formulation of these design guidelines goes beyond the scope of this systematic literature review, here, we only hint at a preliminary list of design elements that have been proved to affect the players’ experience in game research literature, which thus could be explored more in depth in future mental health research.

i) *The time of the game world and how it differs from the real world* (e.g., Juul, 2004; Zagal & Mateas, 2007; Wolf, 2012): How much time should the player spend playing before she can achieve a certain, desirable, state? How much time should the player spend in the game to avoid detrimental effects (e.g., depression, anxiety state, dependency)?

ii) *The presence of cooperation and competition modes* (e.g., Asgar et al., 2017; Kwak et al., 2015):

What kind of sociality is encouraged by the video game (e.g., competitive multiplayer, cooperative multiplayer, team-based, single player)? Are game practices aimed at harming other players (e.g., cheating, grinding) encouraged? Could they compromise cooperation-based interventions?

iii) *The narrative and story's characteristics* (e.g., Zimmerman & Salen, 2003; Zarzycki, 2015):

What is the degree of realism of the story told by the game? How much is the story structured? What kinds of emotions are elicited by the story? Does the game storyline allow the development of players' "own stories"?

iv) *The features of the characters played by the player and by the artificial intelligence* (Schell, 2020, Rogers et al., 2015; Tychsen et al., 2008):

What kinds of characters can be used in the game? Can they foster the player's identification? What is the player's relationship with the main character? Does the player's character interact with other characters and in which ways? Can the player choose and personalize the character? How does this affect the intervention?

v) *The structure of gameplay* (e.g., Adams, 2006; Hallford & Hallford, 2001; Johnson et al., 2015).

How are the game rewards designed? How is the system designed to guide the interaction of the player with the game? How do the game challenges stimulate the player at cognitive, emotional, or behavioral levels? How are the actions that players put in place supposed to work towards the goals of the intervention?

5.4 From research to practice

Design knowledge is fundamental to select the right game for a specific mental health goal and identify all the opportunities that it may offer. Nonetheless, in COTS game-based research it is also paramount to consider what lies "outside of the game", which relates to either i) the "conditions of application" of the video game in the intervention, or ii) the "instructions" for using the video game in the "real world" of the clinical practice.

As for the first point, the research reviewed in this article emphasizes that commercial video games alone may not be sufficient to determine the successfulness of a program. As we have noticed, COTS video game researchers cannot manipulate the game that they use: they cannot implement features that directly affect the disorder or modify and adapt the game's characteristics to the intervention goals, as it often happens in serious game research. For this, they have to intervene on the program's setting, that is how the game is used and the context in which it is used. For instance, playing Tetris must be accompanied by other activities that should be conducted in a laboratory by specialized professionals in order to prevent PTSD symptoms (e.g., Brühl et al., 2019; James et al., 2015). This suggests that researchers should always specify the conditions of application of the video game, in order to ensure the replicability of the intervention. Nonetheless, most of the reviewed articles miss to make such conditions explicit or report incomplete information.

In other words, there is a variety of information that is needed to be known in order to understand how an intervention with a commercial video game has been effectively delivered. A preliminary list of aspects that are partially described in some of the articles we reviewed (albeit none of them reports on all these aspects) and that should be recounted with more details in future research concern: i) at what stage of the gameplay the intervention should start (e.g., at the beginning of the game/at an advanced level) and how the person is introduced to the game, e.g., whether a tutorial is needed, or the player has to learn by doing (e.g., Kühn et al., 2018); ii) the exposure time and the frequency of playing, as well as the duration of the intervention, e.g., approximately 15 minutes of playing, four times a week for 2 to 3 weeks (Weybright et al., 2010); iii) the characteristics of the environment where the game is played in order to e.g., shield the player from external stimuli (e.g., Russoniello et al., 2013); iv) whether a supervision before, during or after the play sessions is needed, in order to e.g., observe the players (e.g. Gallup and Serianni, 2017), facilitate player-game interaction (e.g., Hicks et al., 2019), or debrief the game experiences (e.g. Franco, 2016b); iv) which competences are needed to conduct the intervention, e.g., "3 years' experience as facilitators of play-based social programs" (MacCormack and Freeman, 2019, p. 220); v) the ergonomics aspects of the human-system interaction (Groenewoud et al., 2017); vi) how the game has to be played, e.g., whether some supplementary "rules" or tasks

need to be provided (MacCormack and Freeman, 2019); vii) any other element that could hinder or facilitate the intervention, as the presence of trusted peers or significant others during the game sessions (Elliott et al., 2015).

As for the second point, paying attention to the “game outside” means also to consider how the video game could be effectively used in clinical practice. Game-based research in mental health mainly aims to improve the patient’s condition: this implies that research results should also be used for informing interventions in “real contexts of use”, which in this case mostly refers to the clinical domain.

Nonetheless, among the 39 papers analyzed, only a few produced specific suggestions for clinicians on how to transfer the intervention to a real clinical context (Fish et al., 2018; Finke et al., 2018; Kessler et al., 2020; MacCormack and Freeman, 2019) and, among them, only two (MacCormack and Freeman, 2019; Finke et al., 2018) dedicated a whole section to describing the “implications for clinicians and practitioners”. MacCormack and Freeman (2019) highlighted the importance of consulting both parents and patients to determine the social validity of the intervention goals; whereas Finke et al. (2018) emphasized that patients’ interests and abilities should be put at the center of the clinical intervention. Such indications might help practitioners understand how to translate research results into effective clinical practice: in this perspective, a sort of “implications for practice” section should be included more frequently in game-based research articles. In other words, future studies should better allow scholars and practitioners to draw practical insights from the conducted research in order to increase its replicability and the applicability of its findings to real world practices.

5.5 Strengthening collaboration between mental health researchers and game developers

COTS games are developed with the purpose of creating an entertaining experience, following, of course, a business-oriented approach. In this review, we showed that they can be used as “ready-to-use tools” to support patients suffering from specific mental disorders. As we have seen, opportunities for “personalizing” their usage may arise from the careful definition of research and clinical protocols, which may be enacted without modifying the original game. In fact, intervening during the design

process to adapt a commercial video game to the researcher's or therapist's needs would require time and costs: actually, only one of the reviewed studies sought collaboration with game developers in order to make an existing game able to collect certain players' log data (Kühn et al., 2018).

On the other side, modifying existing commercial video games to better fit in with specific intervention objectives may have lower costs than those required by the development of serious games from scratch. In this sense, researchers could collaborate with game developers: for instance, games that may have already proven to produce some positive effects on certain mental conditions (e.g., Tetris for PTSD) could be reworked by developers in order to better pursue the therapeutic goals. For this aim, small or independent video game companies could be more suitable than big players of video game industry, which are more business oriented. Researchers could also think of working on joint interdisciplinary research projects, where psychologists and independent game designers or game companies may cooperate to design games that are both "commercial" and "serious" (that is, video games that are thought for addressing a specific mental health problem, but also have a wider applicability, potentially appealing to multiple populations given the engaging experience that they are able to elicit).

Alternatively, researchers could cooperate with communities of "modders" (Postigo, 2007), fan programmers who are both amateur game developers and passionate video game players and are willing to modify existing games with the intent to update, ameliorate or change their game elements. In this sense, they could represent a precious resource to adapt existing commercial video games to more "serious" aims.

6. LIMITATIONS

The participants involved in the reviewed research are different (from children to elderly): even within a certain age group or within the same disorder (e.g., children in the context of ASD), participants recruited by different studies may have diverse characteristics (e.g., different Intelligence Quotients),

so that their performance may vary. Therefore, it is difficult to compare different studies and it is not possible to generalize to any population.

In addition, different authors adopted different approaches and “epistemologies”, conceptualizing video games in diverse ways, and often described the employed game differently (even avoiding providing any description). Moreover, even when the game used in the interventions was exactly the same, different studies may have focused on different game elements. These differences may account for the diverse and at times contrasting outcomes that we discovered in the findings of different studies.

The review was also broad in scope and included a wide range of different methodologies, conditions and outcome measures: because of this diversity, it was not possible to conduct a meta-analysis.

Nonetheless, the aim of this systematic review was to survey the variety of uses of commercial video game play across multiple mental health conditions, so that limiting its scope was not appropriate.

We limited our analysis to those studies involving populations affected by one or more mental disorders, exploring the psychological impacts of commercial video games on such disorders: this entailed the exclusion of works focused on the organic, physical aspects of health or aimed at ameliorating the well-being of a healthy population. Furthermore, we decided to narrow our analysis to papers written in English and published in journals and main conference proceedings, excluding research appeared in workshops, posters and “adjunct” conference proceedings, as well as written in other languages. A final limitation is that relevant research may have been unintentionally excluded due to the range of search terms used and the databases selected. However, we conducted backward snowballing to partially overcome this limitation.

7. FUTURE WORKS

Eleven of the studies we reviewed found partial or null results, thus opening opportunities for continuing research and confirming or disconfirming these partial results. For instance, as for the children with DD, it should be determined whether action video games are really able to improve

attention and reading abilities, by isolating the normal reading development related to schooling or the test practice effects (Franceschini et al., 2013, 2017). Moreover, it should be further explored why active video games can impact on certain symptoms of depression, like rumination, but cannot reduce depression severity (Kühn et al., 2018). Likewise, researchers could investigate more in depth the role of the gender variable in interventions aimed to support the social skills of ASD people, as Dickinson and Place (2016) found that game-based activity has the potentiality to improve the social functioning of male children only.

Furthermore, quantitative or mixed-methods studies could investigate the impact of certain individual differences on the effectiveness of game-based protocols, such as the individual's previous experience with video games and how much she usually plays. Since a few studies, mostly qualitative, pointed to the negative aspects of playing when used within a therapeutic framework, scholars are also encouraged to describe the potential shortcomings of their research more thoroughly.

Future works should also address the issues that we highlighted in the Discussion Section. To overcome methodological limitations and give order to a research field that intertwines different disciplines, approaches, and "epistemologies", future studies should attempt to elaborate common methodological and theoretical frameworks for both designing "standard" intervention protocols and for evaluating the outcomes of the interventions. Acknowledging some game design aspects (e.g., the temporality of games, their narrative elements) may further give researchers an informed guide to create effective programs. Moreover, the recounting of the conditions within which the game is used should find more room in future works, in order to facilitate the replicability of the studies and to enable the application of the research protocols to the clinical practice.

As for the future reviews on the topic, we believe that this field of research would gain benefits from any analysis that will rigorously compare the usage of commercial and serious games within the mental health domain, thoroughly contrasting how they address mental disorders, their effectiveness, and their potential side effects.

8. CONCLUSION

This systematic literature review analyzes 39 research articles on how commercial video games have been used in the mental health domain. It identifies four relevant themes emphasizing that COTS video games have been effectively employed to treat specific mental disorders. Research has used quantitative, qualitative and mixed-method approaches and has addressed different conditions spanning from neurodevelopmental (ASD, ADHD) and trauma-related disorders (PTSD), to mood (depression with accompanying anxiety) and neurocognitive disorders (dementia). We pointed out that studies cluster around 8 main genres of video games, describing their peculiar features and how they relate to certain conditions. Finally, we synthesized the outcomes of the studies, emphasizing the effectiveness of the proposed interventions. By and large, current research showed promising results, even though several limitations exist.

Based on these findings, we highlighted the main advantages and challenges of COTS video game-based interventions. We identified several lines of research that could be interesting to explore in the future. First, we recommended that researchers conduct more longitudinal and field studies. Then, we stressed that scholars should acknowledge the interdisciplinary nature of this research field and develop design knowledge, so to exploit all the potentialities of the technology. Finally, we suggested that researchers should better specify what lies “outside of the game” and provide some implications for the clinical practice, in order to ensure replicability and allow for the translation of research findings to the clinical context. We hope that these preliminary insights could help researchers and practitioners develop this line of research further.

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APPENDIX

Table 1. Articles included in the review.

Article	Goal	Sample	Method	Disorder	Video game	Platform	Main findings
Brühl et al. (2019)	To test whether playing Tetris limits the development of trauma-related symptoms and to compare its effectiveness to aerobic exercise.	71 participants (mean age = 31.27).	Mixed methods; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	PC	Neither exercising nor playing Tetris alone reduced analog post-traumatic symptoms. Voluntary memories associated to the trauma film did not diminish.
Butler et al. (2020)	To test whether playing Tetris, compared to EMDR-only intervention, would increase hippocampal volume and reduce symptoms of PTSD of a group of veterans.	40 participants (exp. group, n=20, mean age = 34.2; control group, mean age=32.5)	Quantitative; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	Console (Nintendo DS XL) and PC	In the experimental group, hippocampal volume increased, while PTSD symptoms decreased, also at 6-month follow-up.
Cancer et al. (2020)	To compare the effectiveness of different methods for DD with an action video game training.	24 participants aged between 8 and 14 years old.	Quantitative; between-subjects design	Dyslexia	<i>Rayman Raving Rabbids</i> (action video game)	Console (Nintendo Wii)	Both the traditional and the game-based interventions improved reading speed and accuracy but the video game, when combined with Visual Hemisphere-Specific Stimulation (VHSS), was more effective in ameliorating reading accuracy.
Ceranoglu (2010)	To explore the use of video games in psychodynamic therapy.	A child aged between 7 and 18 years old	Qualitative; case study	Obsessive Compulsive Disorder; Dyslexia	<i>Lego Star Wars II</i> (action-adventure Video Game)	Console (not specified)	The video game play helped the patient elaborate his conflict, feel understood, and take a more active role in the treatment.
Chung et al. (2015)	To test if active video gaming would increase pro-social behavior, while decreasing aggression, in children with ASD.	6 children: 3 children aged between 6 and 12 years old with ASD + their siblings (n=3) who did not have ASD.	Quantitative; single-subject design	ASD	<i>Lego Star Wars II</i> (action-adventure Video Game); <i>Disney Universe</i> (action-adventure video game); <i>Fruit Ninja Kinect</i> and <i>Kinect Party</i> (active video game)	Console (Xbox Slim)	Playing with the active video game did not improve children's social behavior but was associated with higher joint "positive affect".
Colder Carras et al. (2018)	To examine both the beneficial and the problematic uses of video games among veterans in treatment for PTSD-related disorders.	20 participants aged between 25 and 62 years old.	Qualitative; non-experimental study	PTSD and related disorders (e.g., depression, sleep problems...)	A range of video games (e.g., <i>WoW</i> , <i>Call of Duty</i> , <i>GTA</i>) of different genres (e.g., MMORPG, FPS, etc.)	Not specified (both mobile and non-mobile games)	Playing may e.g., promote psychological decentering and provide eudaemonic benefits, but may also negatively affect the player, e.g., by interfering with her relationships.

Cutler et al. (2016)	To explore how "off the shelf" digital gaming technology could support healthy aging of people with dementia.	29 community-dwelling people, aged between 65 and 80 years old.	Mixed methods; non-experimental study	Dementia	A range of games (e.g., <i>Wii Resorts</i> , <i>Mario Kart...</i>) of different genres (active video games, CVGs...)	Console (Nintendo DS, Nintendo Wii) and tablet (iPad)	Participants heightened their well-being, alertness and feeling of empowerment, as well as shown the ability to learn new concepts, which were considered positive signs of healthy aging.
Dickinson and Place (2016)	To examine if a game-based activity program could strengthen the positive social functioning of children with ASD.	100 children aged between 7 and 16 years old.	Quantitative; between-subjects design	ASD	<i>Mario & Sonic at the Olympic Games</i> (active video game)	Console (Nintendo Wii)	The results suggest the game-based activity has the potentiality to improve the social functioning of male children with ASD, while the data about girls did not reach statistical significance.
Elliott et al. (2015)	To better understand the quality of FPS gaming experiences of combat veterans living with PTSD.	6 adults who reported weekly use of FPS video games, aged between 32 and 40 years old.	Qualitative; non-experimental study	PTSD	A range of FPS games (e.g., <i>Call of Duty</i>)	Console (not specified)	Albeit several participants reported potentially deleterious consequences of playing with FPS video games, the whole playing experience was positive for them.
Etter et al. (2017)	To examine the relationship between MFPS playing and post-traumatic symptoms among current and former military service members.	111 participants (mean age = 36.65 years).	Quantitative; survey	PTSD	A range of MFPS or FPS video games	Not specified	Playing video games was not predictive of PTSD symptoms, while several psychosocial factors may be relevant.
Fenney and Lee (2010)	To investigate the capacity of people with dementia to learn motor tasks by engaging them in an active video game.	3 participants (68, 79 and 90 years old).	Mixed methods; single-subject design	Dementia (Alzheimer)	Nintendo Wii™ Bowling game (active video game)	Console (Nintendo Wii)	The game improved attention (in terms of motor learning capacity) of older adults and was considered enjoyable by them.
Finke et al. (2018)	To explore the motivations for playing video games and the role of video games in ASD people's lives.	10 participants aged between 18 and 24 years old, who play video games.	Qualitative; non-experimental study	ASD	Not specified	Not specified	Participants perceived video games having a positive impact on their lives.
Fish et al. (2014)	To test whether a regimen of prescribed CVG play could reduce individuals' anxiety symptom severity in a depressed population in treatment with SSRI.	59 participants aged between 18 and 74 years old.	Quantitative; between-subjects design	Depression with anxiety symptoms	<i>Bejeweled II</i> , <i>Peggle</i> , <i>Bookworm Adventures</i> (CVGs)	PC	A regimen of play with casual video games significantly reduced both state and trait anxiety symptoms severity in depressed individuals prescribed with SSRI.
Fish et al. (2018)	To test if CVG play, along with SSRI prescription, would decrease symptoms of anxiety comparing it to a traditional, medication-only, intervention.	59 participants aged between 19 and 70 years old.	Quantitative; between-subjects design	Depression with anxiety symptoms	<i>Plant vs Zombies</i> (CVG)	PC	Compared to the medication-only intervention, playing a casual video game, in addition to an SSRI prescription, significantly reduced State-Anxiety symptom severity while effects on Trait-Anxiety did not show significance.
Franceschini and Bertoni (2019)	To investigate if an active video game could improve visual attention abilities of DD children.	18 children (mean age=9.79 years, sd = 1.33)	Quantitative; between-subjects design	Dyslexia	<i>Plant versus Zombies Garden Warfare</i> ; <i>Nanostray 2</i> (action video game)	Console (PlayStation 3)	The phonological decoding speed and phonological short-term memory were increased only in DD children in which their video game score was improved.

Franceschini et al. (2013)	To test reading, phonological, and attentional skills in DD children before and after they played action or nonaction video games	20 children.	Quantitative; between-subjects design	Dyslexia	<i>Rayman Raving Rabbids</i> (action video game)	Console (Nintendo Wii)	Playing action video games improved children's reading speed and attentional skills: these results could be translated into better reading abilities.
Franceschini et al. (2017)	To test reading skills in children with dyslexia before and after an intervention with action and non-action video games.	28 children (mean age=10.1 years, range=7.8-14.3)	Quantitative; between-subjects design	Dyslexia	<i>Bunnies Don't Like Being Disturbed on Holiday</i> ; <i>Rayman Raving Rabbids</i> (action video games)	Console (Nintendo Wii)	The speed of word recognition, phonological decoding, focused visuospatial attention, and visual-to-auditory attentional shifting improved after sessions of action video game playing.
Franco (2016)	To explore the role of video games as a tool in narrative therapy.	1 person of 17 years old	Qualitative; case study	Depression	<i>The Elder Scrolls III: Morrowind</i> (RPG)	PC	By using video games as a "homework assignment", the therapist was able to make connections between the events or characters which were present in the game and her life.
Gallup and Serianni (2017)	To describe emotional awareness and expression among young adults with ASD who socialize within a virtual environment.	5 participants aged between 18 and 24 years old.	Qualitative; non-experimental study	ASD	MMORPGs genre video games	Not specified	All participants showed emotional awareness and the ability to self-reflect about similar situations that were addressed both in context of the MMORPG and in face-to-face settings.
Gerhardt and Smith (2020)	To explore how the narrative component of the Trauma-Focused Cognitive Behavioral Therapy can be adapted using a video game to improve a patient's symptoms.	One 11-year-old boy with ASD, ADHD and a history of abuse/trauma.	Qualitative; case study	Trauma-related symptoms and depression	<i>Minecraft</i> (sandbox video game)	PC	The client demonstrated improvements in depression symptoms and reduced perseveration about the trauma itself. The client's father benefitted from this process as well.
Groenewoud et al. (2017)	To look at the impact of iPad games on people with dementia, and to study the factors that influence their use among the patients.	54 participants (mean age = 83.5)	Mixed methods; non-experimental study	Dementia	Ten iPad games (e.g., <i>Fish Pond</i> , <i>Talking Tom</i> , <i>Solitaire...</i>) (CVGs)	Tablet (iPad)	Participants both had positive (self-esteem, sense of connection) and negative (e.g., failure and a sense of insecurity) experiences from playing video games.
Guhde (2017)	To explore how to support a patient therapy path by means of his online gaming experience.	1 patient in psychoanalytic treatment (aged ~20 years old).	Qualitative; case study	Not specified	<i>World of Warcraft</i> (MMORPG)	PC	Playing a video game and sharing gaming experiences within the therapy helped the patient integrate split-off aspects of himself and develop the capacity to own his desires.
Heasman and Gillespie (2019)	To investigate how autistic people build social understanding, when they are put in a game-based, social activity.	Adults with a diagnosis of ASD (N=30) or who had been referred for assessment (n=6) (mean age=23.6)	Mixed methods; non-experimental study	ASD	Several games (e.g., <i>Assassin's Creed: Syndicate</i> , <i>Call of Duty</i> , <i>GTA V</i>) belonging to several genres (e.g., action-adventure, FPS)	Console (Xbox 360)	Autistic people adopted unconventional forms of social relating when playing collaborative video games.
Hicks et al. (2019)	To engage rural-dwelling older men with dementia in a technological initiative by means of off-the-shelf computer games.	42 participants (age 65 and above).	Qualitative; non-experimental study	Dementia	<i>Sports Golf Game</i> ; (active video game); <i>Game of</i>	Console (Nintendo Wii, Nintendo)	The use of video games contributes in many ways (e.g., by offering the opportunity to release discomfort feelings) to the initiative's success, along with other mechanisms

					<i>Life</i> (board video game)	Balance Board, Microsoft Kinect) and tablet (iPad)	(the male-only environment and the empowering approach adopted).
Holmes et al. (2010)	To test if playing with Tetris would reduce PTSD flashbacks and to compare the effects of two different video games.	60 participants aged between 18 and 60 years old.	Quantitative; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	PC	In both the experiments, playing Tetris post-trauma film reduced flashbacks, while Pub Quiz did not have this effect.
Iyadurai et al. (2018)	To investigate if negative, intrusive memories of trauma would be reduced by an intervention with Tetris.	71 participants (mean age= 39.66 years)	Mixed methods; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	Console (Nintendo DS XL)	The Tetris-based intervention was effective, compared with the control condition: participants experienced fewer intrusive memories with quick reduction over time.
James et al. (2015)	To test the efficacy of combined cognitive tasks (e.g., playing with Tetris) in reducing intrusive memories of trauma.	Experiment 1: 52 participants aged between 18 and 62 years old; Experiment 2: 72 participants aged between 18 and 62 years old.	Mixed methods; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	PC	Even “established” memories (i.e., 24 hours after the induced trauma) could be reduced by disrupting reconsolidation via playing with Tetris, but not if the game is played alone without a reactivation task.
Kaufman and Zhang (2015)	To investigate whether and how playing with (MMORPGs) could benefit older adults on a social-emotional point of view.	176 respondents aged 55 and over.	Quantitative; survey	Depression	<i>World of Warcraft</i> (MMORPG)	PC	The enjoyment of relationships and the quality of guild play were recounted to have strong impact on older adults’ social and emotional well-being.
Kessler et al. (2018)	To test if an intervention with Tetris would reduce the occurrence of intrusive memories among PTSD patients.	20 inpatients with PTSD, aged between 18 and 65 years old.	Mixed methods; within-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	Tablet	The game-based procedure reduced negative symptoms of PTSD, i.e., the number of intrusions reported by participants.
Kessler et al. (2020)	To examine if a single session of game playing with Tetris would reduce later intrusive trauma memories.	86 participants aged between 18 and 42 years old.	Mixed methods; between-subjects design	PTSD	<i>Tetris</i> (puzzle video game)	PC	Compared to both the reminder-only condition and the Quiz game, the intervention with Tetris led to a reduction in the occurrence of the induced intrusions.
Kühn et al. (2018)	To investigate the effects of action video game training on cognition and depression severity among depressed patients.	50 participants aged between 18 and 65 years old.	Quantitative; between-subjects design	Depression	<i>Boson X</i> (action video game)	PC	The action video game contributed to reduce rumination and led to higher levels of subjective cognitive ability but did not reduce the depression severity.
Łuniewska et al. (2018)	To test how a training based on action and non-action video games would affect reading skills in children with dyslexia.	54 children (mean age=11 years, range=9.0-13.2)	Quantitative; between-subjects design	Dyslexia	<i>Rayman Raving Rabbids</i> (action video game)	Console (Nintendo Wii)	The reading progress in the two experimental groups did not differ from a dyslexic control group which did not participate in any training.
MacCormack and Freeman (2019)	To support the development of social competence of youths with ASD by let them play with a sandbox video game.	4 children, aged between 11 and 13 years old.	Mixed methods; non-experimental study	ASD	<i>Minecraft Pocket Edition</i> (sandbox video game)	Tablet	Findings showed that structured play can help adolescents with ASD to socialize.

Rosegrant (2012)	To describe how gaming technology can be used as part of a psychoanalytic treatment.	2 subjects in psychoanalytic treatment.	Qualitative; case study	Not Specified	<i>World of Warcraft</i> (MMORPG)	PC	One of the subjects who played with video games could express and develop meanings.
Rowntree and Feeney (2019)	To better understand video and smartphone game use and perceptions among outpatients who attend a mental health service.	93 participants (mean age = 40.04 years).	Quantitative; survey	Not Specified	Not specified	Not specified	Most of the participants considered playing with video games as a waste of time, still a consistent part of the respondents acknowledged the positive role of gaming.
Russoniello et al. (2013)	To test whether a prescribed regimen of CVG play could reduce symptoms associated with depression.	59 participants, aged between 18 and 74 years old.	Quantitative; between-subjects design	Depression	<i>Peggle, Bejeweled, Bookworm Adventures</i> (CVGs)	PC	Playing CVGs facilitated a significant decrease in depression both in the short and in the long term (1 month): CVG play appeared to positively affect people suffering from depression whether it was mild or severe.
Segev et al. (2017)	To study how adolescents, suffering from externalizing and internalizing psychopathologies, differ in the ways they play different types of games	47 outpatients of a psychiatric clinic, aged between 13 and 18 years old.	Quantitative; between-subjects design quasi-experiment.	Not specified	<i>GTA IV</i> (action-adventure video game); <i>Need for Speed</i> (racing video game)	PC	Player attributes had a significant effect on the “non-structured” video game playing (GTA IV), while this variability was not detected in relation to a “structured” game (Need for Speed).
Sundberg (2018)	To investigate online gaming’s connections and the feeling of loneliness experienced by teenagers and adults with ASD.	151 participants, aged between 14 and 69 years old.	Quantitative; survey	ASD	Not specified	Not specified	A low to moderate use of MMORPGs is linked to lower levels of perceived loneliness in individuals with ASD, while an excessive playing may exacerbate loneliness feelings.
Weybright et al. (2010)	To examine the effects of an interactive video game on “attention to task” and “positive affect” of older women with dementia.	2 older adults (ages 86 and 93) with MCI.	Mixed methods; single-subject design	Dementia (MCI)	<i>Wii Sports bowling</i> (active video game)	Console (Nintendo Wii)	Participating in an interactive video game had a positive effect on both “attention to task” and “positive affect” in older adults with dementia.