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Introduction

Research dating back to the early 1980s has consistently shown that playing computer games (irrespective of genre) can have positive effects including increases in reaction times, improved hand-eye co-ordination, increases spatial visualization, and raises players' self-esteem (Griffiths, Kuss, & Ortiz de Gortari, 2017). Furthermore, curiosity, fun and the nature of the challenge also appear to add to a game's therapeutic potential (Griffiths, Kuss, & Ortiz de Gortari, 2017). Such features have also been shown to be of educational benefit (Griffiths, 2010), In a therapeutic context, video games allow participants to experience novelty and challenge when engaging in fictional activities without real life consequences (Washburn & Gulledge, 1995). Video games developed specifically for therapeutic interventions or health care (often referred to as "good games" or "serious games") have been used therapeutically. Furthermore, some commercial video games have also been adapted and used for therapeutic purposes (Colder Carras et al., 2018).

Recently, Lu and Kharrazi (2018) carried out a comprehensive systematic content analysis of 1,743 health video games released between 1983 and 2016 across twenty- three different countries. The data were extracted from nine international English health video game directories and databases. The majority of the games were developed in the United States (67 percent) and France (18.5 percent), with 79 percent of games available at no cost. The free video games (n = 1553) were content analyzed and results showed that in-game topics included cognitive training (37 percent), indirect health education (13 percent), and medical care provision (10 percent). Three-quarters of the video games could be completed within one hour. The usability of the videogames was also assessed and the main problems identified comprised non-skippable content, a lack of customization, and a lack of instruction and feedback to those playing the games.

In the past two decades, there has been much research on both the positive and negative effects of playing video games. Most of the research on the negative effects tends to focus on the small minority of individuals who have gaming disorder and who are often said to be addicted to the playing of video games (Griffiths, Kuss, & Pontes, 2016). However, there is much research on the positive benefits to playing video games which focuses on the vast majority of players who play moderately and without any negative detriments. This dichotomy was recently highlighted by two systematic reviews that examined the effect of video game playing on cognitive skills. These reviews showed that moderate video game playing has a positive effect on cognitive skills (Nuyens, Kuss, Lopez-Fernandez, & Griffiths, 2018) whereas problematic video game playing has a negative effect on cognitive skills (Nuyens, Kuss, Lopez-Fernandez, & Griffiths, 2017). More specifically, problematic video game playing is associated with poorer multi-second time perception, inhibition, and decision-making (Nuyens et al., 2017). On the other hand, non-problematic video game players (compared to non- video game players) tend to be better at task-switching, top-down attentional control, and sub-second time perception (Nuyens et al., 2017).

Video Games and Cognitive Remediation

It has long been argued that video games have been used to aid cognitive remediation (Fisher, 1986). Areas that can be helped include perceptual disorders, conceptual thinking, attention, concentration, memory, spatial cognition, mental rotation, creativity computation, visual plasticity, executive functioning, processing speed, attention, fluid intelligence, subjective cognitive performance, and difficulties with language (Achtman, Green, & Bavelier, 2008; Chandrasekharan, Mazalek, Nitsche, Chen, & Ranjan, 2010; Eow, Ali, Mahmud, & Baki, 2010; Leng, Ali, Mahmud, & Baki, 2010; Miller & Robertson, 2010; Reijnders, van Heugten, & van Boxtel, 2013).

Other studies have successfully used video games in rehabilitation programs to improve sustained attention in patients with impulsive and attentional difficulties (Clarke & Schoech, 1994; Kappes & Thompson, 1985; Lim et al., 2010; Weerdmeester et al., 2016), Down's syndrome (Joei Mioto & Goncalves Ribas, 2014), craniocerebral trauma (Funk, Germann, & Buchman, 1997; Lawrence, 1986; Skilbeck, 1991), and as a training and rehabilitation aid to cognitive and perceptual-motor disorders in stroke patients (Broeren, Claesson, Goude, Rydmark, & Sunnerhagen, 2008; Joo et al., 2010; Lauterbach, Foreman, & Engsberg, 2013; Lee, Huang, Ho, & Sung, 2017; Yavuzer, Senel, Atay, & Stam, 2008) and other motor deficits (Cameirao, Bermúdez i Badia, Duarte Oller, Zimmerli, & Verschure, 2007). Swanson and Whittinghill (2015) carried out a systematic review on the efficacy of video game-based rehabilitation interventions in motivating stroke survivors. A total of 18 studies were identified and results demonstrated that video games improved the function and health outcomes among stroke patients including energy expenditure, muscle strength, recovery times, and motor functioning. The authors concluded that video game-based interventions were promising tools in motivating the engagement of stroke patients in effective rehabilitation activities.

There are also a number of studies showing that video games may have beneficial therapeutic effects for the elderly. Given that video game playing involves concentration, attention, hand-eye co-ordination, memory, decision-making, and speed reactions, the activity may be of great benefit to this particular cohort. Researchers working in this area have postulated that the intellectual decline which is part of the natural aging process may be slowed (and perhaps counteracted) by getting the elderly involved as active users of technology (Farris, Bates, Resnick, & Stabler, 1994). Technology with the aged can therefore foster greater independence and can be put to therapeutic use. Dustman, Emmerson, Laurel, and Shearer (1992) showed that video games could increase reaction times among the elderly after an eleven-week period of video game playing. Other studies among the elderly have shown that playing video games can improve self-esteem, wellbeing and mental functioning (Farris et al., 1994; Goldstein, et al., 1997; Hollander & Plummer, 1986; McGuire, 1984, 1986; Riddick, Spector, & Drogin, 1986; Ryan, 1994; Schueren, 1986; Weisman, 1983, 1994). In addition to this, video games have been found useful regarding home-based step training for older people in terms of choice stepping reaction time (and consequent decreased risk of fall- ing down), better physical assessment scores, and postural sway compared to controls (Schoene et al., 2013).

Video Games as Distractors in the Role of Pain Management

Studies have shown that cognitive/attentional distraction may block the perception of pain (Wohlheiter & Dahlquist, 2012). The reasoning is that distractor tasks consume some degree of the attentional capacity that would otherwise be devoted to pain perception. Video game playing offers an ideal way to analyse the role of distraction in symptom control in pediatric patients. Redd and colleagues (1987) argued that the main reasons for this are that video games (i) are likely to engage much of a person's individual active attention because of the cognitive and

motor activity required; (ii) allow the pos- sibility to achieve sustained achievement because of the level of difficulty (i.e. challenge) of most games during extended play; and (iii) appear to appeal most to adolescents.

Video games have also been used in a number of studies as "distractor tasks." For instance, one early study (Phillips, 1991) reported the case of using a handheld video game (*Nintendo Game Boy*) to stop an eight-year-old boy picking at his face. The child had neurodermatitis and scarring due to continual picking at his upper lip. Previous treatments (e.g., behavior modification program with food rewards for periods free of picking and the application of a bitter tasting product to the child's fingers) had failed so a handheld video game was used to keep the boy's hands occupied. After two weeks the affected area had healed. This pain management technique utilizing video games has also been applied successfully to children undergoing treatment for sickle cell disease (Pegelow, 1992).

There are also a number of studies (e.g., Cole, Yoo, & Knutson, 2012; Comello, Francis, Marshall, & Puglia, 2016; Francis, Comello, & Marshall, 2016; Kato, Cole, Bradlyn, & Pollock, 2008; Kolko & Rickard-Figueroa, 1985; Redd et al., 1987; Reichlin et al., 2011; Vasterling, Jenkins, Tope, & Burish, 1993) that have demonstrated that video games can provide cognitive distraction during cancer chemotherapy in children, adolescents, and adults. All these studies have reported that distracted patients report less nausea prior to chemotherapy and lower systolic pressure after treatment (when compared with controls). Such distraction tasks also reduce the amounts of painkillers needed. There are many practical advantages for using video game therapy for patients during chemotherapy treatment. Redd and colleagues (1987) argue that video games (i) can be easily integrated with most chemotherapy administration procedures; (ii) can be played without medical supervision; and (iii) represent a more cost-effective intervention than many traditional behavioral procedures such as hypnosis and relaxation.

Govender and colleages (2015) reviewed the clinical and neurobiological perspectives of empowering child cancer patients using video games. Children often experience physical and mental fatigue following chemotherapy. The authors noted that "patient empowerment" reflects an individual's ability to positively affect their own health behavior and that empowerment interventions can enhance patients' resilience, coping skills, internal locus of control, and self-management of symptoms related to their health issues. Govender and colleagues' review summarized clinical strategies for empowering child cancer patients via video games to help develop a "fighting spirit" in mental and physical health. The authors concluded that video games (and accompanying mobile health applications) present translational research opportunities in developing and delivering empowerment interventions to child cancer patients and those with other chronic diseases. To date, there has been no long-term follow-up to such interventions and it is unclear whether patients eventually tire of such games. Therefore, factors need to be explored such as novelty, game preference, and relative level of challenge.

Video Games as Physiotherapy and Occupational Therapy

Video games have been used as a form of physiotherapy and/or occupational therapy. Much has been written about how boring and repetitive exercises are if someone is attempting to recover from or cope with a physical problem. The introduction of video games into this context can be of huge therapeutic benefit. For instance, video games have been used innovatively as a form of physiotherapy for finger and hand function (Szturm, Peters, Otto, Kapadia, & Desai, 2008), increasing hand strength (King, 1993), arm injuries (Szer, 1983), shoulder injuries

(Dahl-Popolizio, Loman, & Cordes, 2014), lower back pain (Butler, 1985), back and neck pain (Jansen-Kosterink et al., 2013), rheumatology (McCormack et al., 2009), chronic severe hemiparesis (Housman, Scott, & Reinkensmeyer, 2009), postural stability and balance (Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010; Sato, Kuroki, Saiki, & Nagatomi, 2015), training movements in Erb's palsy (Krichevets, Sirotkina, Yevsevicheva, & Zeldin, 1994), and cerebral palsy (Huber et al., 2010; Hurkmans, van den Berg-Emons, & Stam, 2010; Jannink et al., 2008; Weightman et al., 2010). Additionally, interactive games have been successfully used to improve balance, mobility, and gait after brain injury (Lange, Flynn, Proffitt, Chang, & Rizzo, 2010). Therapeutic benefits have also been reported for wheelchair users (Synofzik et al., 2013), burns victims (Sharar et al., 2008). Additionally, video games were also used as a respiratory muscle training aid for young patients with Duchenne Muscular Dystrophy (Vilozni, Bar-Yishay, Shapira, Meyer, & Godfrey, 1994).

For instance, some wheelchair users find regular exercise programs too difficult phys- ically or psychologically, and many find that using standard arm crank or roller systems is monotonous. O'Connor and colleagues (2000) looked for ways that individuals with spinal cord injuries would be motivated to exercise on a regular basis. As a consequence, they developed an interactive video game system (*Gamewheels*) that provided an inter- face between a portable roller system and a computer. This system enabled wheelchair users to play commercially available video games and their results demonstrated improved physical fitness in a sample of people with spinal cord injuries, spinal cord diseases, amputations, nerve diseases, and multiple sclerosis. Most of their participants (86 percent) reported that they would like a *Gamewheels* system for their home.

Adriaenssens, Eggermont, Pyck, Boeckx, and Gilles (1988) reported the use of video game playing as an exercise program to facilitate the rehabilitation of upper- limb burn victims (using a variety of large to smaller joysticks). This technique not only helped overcome initial therapy resistance but also encouraged and shaped movement of the hand, wrist, and elbow by providing feedback for the desired performance while also offering a distraction from pain. Moreover, Fung So and colleagues (2010) found that occupational therapists and physiotherapists advocated the use of video game systems for burn- and non-burn patients for similar reasons. The use of video games in almost all these differing contexts capitalizes on a number of inter-related factors; one of the most important is the person's motivation to succeed. Furthermore, video games have advantages over traditional therapeutic methods that rely on passive, repetitive movements and painful limb manipulation (i.e., they focus attention away from potential discomfort).

Video Games and the Development of Social and Communication Skills among the Learning Disabled

Video games have also been used in comprehensive programs to help develop social skills in children and adolescents who have learning disabilities, such as dyslexia (Bavelier, Green, & Seidenberg, 2013), who are severely retarded, or who have severe developmental problems like autism (Gaylord-Ross, Haring, Breen, & Pitts-Conway, 1984; Sedlak, Doyle, & Schloss, 1982; Tanaka et al., 2010). Horn, Jones, and Hamlett (1991) used video games to train three children with multiple handicaps (e.g. severely limited vocal speech acquisition) to make scan and selection responses. These skills were later transferred to a communication device. Other researchers have used video games to help learning disabled children in their development of spatial abilities (Masendorf, 1993), problem-solving exercises (Hollingsworth & Woodward, 1993) and mathematical ability (Okolo, 1992a), as well improving achievement and enhancing

motivation among the learning disabled (e.g. Blechman, Rabin, & McEnroe, 1986; Okolo, 1992b).

Video Games in Psychotherapeutic Settings

The playing of video games has also been used to establish an effective patient-therapist relationship, particularly with young people (Ceranoglu, 2010a; Favelle, 1994; Franco, 2016; Horne-Moyer, Moyer, Messer, & Messer, 2014; Matthews et al., 1987; Rico-Olarte et al., 2017). Furthermore, psychotherapy has been conducted exclusively in video game settings (Coyle, Matthews, Sharry, Nisbet, & Doherty, 2005). Therapists working with children have long used games in therapy and games for therapy in sessions with their young patients (Ceranoglu, 2010a, 2010b; Gardner, 1991). The recent technological explosion has brought a proliferation of new games, which some therapists claim to be an excellent ice-breaker and rapport builder with children in therapy and behavior management (Gardner, 1991; Spence, 1988).

Gardner (1991) claimed that the use of video games in his psychotherapy sessions provided common ground between himself and his child clients, and provided excellent behavioral observation opportunities. According to Gardner, such observations allowed him to observe (among other things): (i) the child's repertoire of problem-solving strategies; (ii) the child's ability to perceive and recall subtle cues as well as foresee consequences of behavior and act on past consequences; (iii) the release of aggression and control; (iv) the ability to deal with appropriate methods of dealing with the joys of victory and frustrations of defeat in a more sports-oriented arena; (vi) the satisfaction of cognitive activity in the involvement of the recall of bits of basic information; and (vii) the enjoyment of mutually co-ordinating one's activities with another in the spirit of co-operation

Gardner went on to describe four particular case studies where video games were used to support psychotherapy. Although other techniques were used as an adjunct in therapy (e.g. storytelling, drawing, other games), Gardner claimed it was the video games that were the most useful factors in the improvement during therapy. It is Gardner's contention that clinical techniques tend to change as a function of the trends of the times, although the goals remain the same. Slower paced and more traditional activities like those outlined above may lengthen the time it takes to form a therapeutic relationship as the child may perceive the therapist not to be "cool" or "with it."

Similar techniques have also been advocated for behavioral management of exceptional children (Buckalew & Buckalew, 1983). Brezinka (2008) has argued that therapeutic games can help therapists to structure therapy sessions and reports that psychotherapeutic computer games translated into foreign languages can form a useful tool in the treatment of migrant children. For instance, *Treasure Hunt*, a game based on principles of cognitive behavior modification, was developed for eight- to twelve- year-old children who are in cognitive-behavioral treatment for various disorders. Brezinka claimed reactions of children and therapists to experimental versions of the game are positive and that serious games might prove a useful tool to support psychotherapeutic treatment of children.

Eichenberg and Schott (2017) carried out a systematic review of empirical studies examining the use of serious video games in psychotherapy and psychosomatic rehabilitation using the terms "serious game," "computer game," "psychotherapy," "rehabilitation," "intervention," and "mental disorders" in two databases. A total of fifteen studies met the inclusion criteria. Most

of the studies primarily used cognitive- behavioral techniques across a range of mental disorders. The authors concluded that video games were shown to be an effective therapeutic component as both part of psychotherapy as well as a stand-alone intervention.

Video Games and Health Compliance

Video games have been used in order to change the players' behavior regarding health in a positive way (Baranowski et al., 2016). A meta-analysis (DeSmet et al., 2014) using research on sixty-four different video games targeting improvements in lifestyle indi- cated that using games had beneficial consequences for health. These beneficial out- comes include effects on diabetes (DeShazo, Harris, & Pratt, 2010), obesity prevention (Lu, Kharrazi, Gharghabi, & Thompson, 2013), visual impairments (Gasperetti, Foley, Yang, Columna, & Lieberman, 2018), as well as health and safety behaviors in young individuals aged eighteen years and under (Hieftje, Edelman, Camenga, & Fiellin, 2013).

In randomized clinical trials, it has been reported that children and adolescents improved their self-care and significantly reduced their use of emergency clinical services after playing health education and disease management video games (Brown et al., 1997; Lieberman, 2001). Three games have been investigated: *Bronkie the Bronchiasaurus* for asthma self-management; *Packy & Marlon* for diabetes self-management; and *Rex Ronan* for smoking prevention. In these interactive video games, children and adolescents assume the role of a main character who also has their chronic condition or is battling the effects of smoking and nicotine addiction. Children who used them for one week (smoking prevention) to six months (diabetes self-care) increased their resolve not to smoke, markedly improved their ability to manage their asthma or diabetes, and reduced by as much as 77 percent, on average, their urgent or emergency care visits related to their illness. More recent research on using video games to promote a smoking-free lifestyle has also found similar findings (Parisod et al., 2017)

.Theng, Lee, Patinadan, and Foo (2015) carried out a systematic review concerning the use of video games, virtual environments, and gamification in the self-management of diabetes. A total of ten studies met the inclusion criteria and most of the studies identified had small sample sizes with short intervention duration. All of the interventions examined the (i) reduction of diabetes-related risk and (ii) promotion of healthy behavior. The authors concluded that video games appeared to be helpful tools in educating individuals, whereas gamification and virtual environments provided positive reinforcement and increased extrinsic motivation among participants.

Electronic games have also been used to enhance adolescents' perceived self-efficacy in HIV/AIDS prevention programs (Cahill, 1994; Thomas, Cahill, & Santilli, 1997). Using a time travel adventure video game format, information and opportunities to dis- cuss prevention practices were provided to high-risk adolescents. Video game playing resulted in significant gains in factual information about safe-sex practices, and in the participants' perceptions of their ability to successfully negotiate and implement such practices with a potential partner.

DeSmet and colleagues (2015) carried out a systematic review and meta-analysis of serious video game interventions for sexual health promotion. A total of seven studies were identified that included a control group, allowing the calculation of an effect size (using Hedges' g). The studies identified showed positive effects on determinants ($g = 0.242$; 95 percent confidence interval) but with a small effect size. Behavioral effects were only assessed in two studies and neither were significant ($g = 0.456$; 95 percent confidence interval). The authors noted that most

video games used strongly relied on pure gamification features (e.g. rewards, feedback). It was concluded there is a need for more rigorous evaluation studies of video game effectiveness, with longer-term follow-ups, and using measures of behavior rather than merely their determinants.

Video games and simulations have been used extensively in a comprehensive health promotion for adolescents. For instance, Bosworth (1994) used these strategies to attract adolescents to BARN (Body Awareness Resource Network), as well as helping to hold interest. In each of the six topic areas (AIDS, Alcohol and Other Drugs, Body Management, Human Sexuality, Smoking, and Stress Management) video game quizzes challenged users to test their knowledge on a topic. Simulations challenged users to apply health information in hypothetical situations. Video games were a more important factor in the selection of BARN for younger users than for older users. BARN game users were not more likely than non-game users to be users of other computer or video games, nor did game users engage in more risk-taking behaviors (e.g. alcohol, other drugs) than non-game users. Similar types of health promotion video games have been used successfully for cystic fibrosis (Davis, Quittner, Stack, & Young, 2004), drug use (Oakley, 1994), alcohol use (Resnick, 1994a), marijuana use (Henningson, Gold, & Duncan, 1986), depression (Russoniello, Fish, & O'Brien, 2013), sexual behavior (Brüll, Ruiter, Wiers, & Kok, 2016; Chu et al., 2015; Starn & Paperny, 1990), life choices (Thomas, 1994), and anti-social behavior (Resnick, 1994b). One of the major problems with this area is that reported positive effects from video games in a health promotion context is that almost all of the video games evaluated were specially designed rather than those that were already commercially available. This does raise questions about the utility of generally commercial games in helping health promotion activities.

Video Games, Stress, Anxiety, and Emotional Regulation

Reinecke (2009) demonstrated that the playing of video games can help in recuperation from stress and strain. In fact, therapeutic uses of video games to reduce stress, anxiety, and specific anxiety disorders have taken place in different ways (Fish, Russoniello, & O'Brien, 2014). Potential benefits of video game playing have been reported as a way of reducing preoperative anxiety among children (Patel et al., 2006). There is also evidence that suggests playing puzzle games, specifically the game *Tetris*, can mitigate flashbacks of traumatic experiences (Holmes, James, Coode-Bate, & Deeprose, 2009; James et al., 2015). There is also evidence suggesting that video game playing by military person- nel has a protective mechanism versus nightmares (Gackenbach, Ellerman, & Hall, 2011) and in developing their coping skills (Procci, Bowers, Wong, & Andrews, 2013).

Video games have also been used not only in a palliative context but also as a more structured form of therapy via the use of simulation video games for the treatment of clinical disorders. Specifically, virtual reality exposure therapy (VRET) has been applied to tar- get anxiety disorders. It has been efficiently used in the treatment of acrophobia (Krijn et al., 2004), claustrophobia (Botella, Banos, Villa, Perpina, & Garcia-Palacios, 2000), panic disorder with agoraphobia (Vincelli et al., 2003), fear of flying (Rothbaum, Hodges, Smith, Lee, & Price, 2000), driving phobia (Wald & Taylor, 2000), spider phobia (Garcia-Palacios, Hoffman, Carlin, Furness, & Botella, 2002), and post-traumatic stress disorder (Holmes et al., 2009; James et al., 2015; Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001; Wiederhold & Wiederhold, 2010). A meta-analysis of VRETs for anxiety disorders conducted by Powers and Emmelkamp (2008) evaluated thirteen studies and reported highly positive results with regards to the efficacy and efficiency of VRET for treating anxiety disorders.

Villani and colleagues (2018) carried out a systematic review assessing empirical studies that had investigated the effects and modalities of using video games in managing affective states (i.e., emotional regulation which is known to promote mental health and wellbeing). A total of twenty-three studies met the inclusion criteria and were classed as (i) qualitative and cross-sectional studies, (ii) experimental studies, and (iii) emotional regulation (ER) intervention studies (with serious games rather than commercial video games). The findings showed that improvements in ER were found most with commercial games (related to enjoyment and gameplay). However, these studies did not use clinical populations so the health benefits needed to be interpreted cautiously.

Video Games as Physical Activity Using "Exergames"

Active video games have also used in the context of "exergaming"—using games as physical exercise (Baranowski et al., 2016; Christison et al., 2016). Research regarding exergaming is mixed, with some naturalistic research (Baranowski et al., 2012) suggest- ing little effects on physical activity intensity and duration, whereas other research shows that exergaming can decrease body mass index (BMI) and weight (Trost, Sundal, Foster, Lent, & Vojta, 2014). There have been a number of systematic reviews examining the efficacy of exergames. Tabak, Dekker-van Weering, van Dijk, and Vollenbroek- Hutten (2015) carried out a systematic review on the promotion of daily physical activity via mobile video gaming. More specifically, they examined studies utilizing a mobile game that required players to perform physical activity in daily life and where the game included specific goals, rules, and feedback mechanisms (therefore excluding non- mobile "exergames"). A total of eleven studies met the inclusion criteria. The results showed that most studies used goal setting as the motivation strategy for gaming engagement. The majority of the studies used avatars or metaphors to visualize activity, whereas feedback was typically provided in relation to the goal. The most commonly incorporated game elements were competition and rewards. Clinical evidence of efficacy of such games was lacking because only two randomized controlled studies were identified. Most study evaluations simply focused on the feasibility of using such games.

Liang and Lau (2014) systematically reviewed the effects of active video games on physical activity and related outcomes among healthy children. They identified fifty- four studies, of which thirty-two examined the immediate physical activity effects (i.e., energy expenditure and physical activity levels) during the playing of active video games. The remaining studies mainly comprised intervention studies (n = 21) aimed at promoting physical activity. The authors reported that energy expenditure was light to moderate in the studies examining immediate physical activity outcomes. Children playing action video games at home had no effect on physical activity. However, some studies suggested that structured video game play could improve physical activity.

Parisod and colleagues (2014) carried out a systematic review of other systematic reviews concerning the promotion of children's health using video games. A total of fifteen systematic reviews met the inclusion criteria. Results showed that the playing of active video games using both upper and lower body movements can lead to light to moderate levels of physical activity and energy expenditure. In sedentary games the findings showed there was potential to facilitate children's health education, especially dietary habits and in diabetes- and asthma-related behavior.

Murphy and colleagues (2009) reported that music and rhythm video games used with overweight children have a positive effect. *Dance Dance Revolution* (DDR), a game that

requires players to move their feet in co-ordination with arrows scrolling across the screen was used in the study with thirty-five overweight children. The results showed that after twelve weeks of playing, the children improved their flow-mediated dilation, aerobics fitness, and mean arterial pressure without changes in inflammatory markers or nitric oxide production. However, a review by Daley (2009) stressed caution on this topic and asserted that active gaming was no substitute for real sports and activities. She also stressed the need for high-quality, randomized, controlled trials to evaluate the effectiveness and sustainability of active gaming.

Lu and colleagues (2013) carried out a systematic review of the efficacy of health video games on childhood obesity prevention and intervention. They identified fourteen papers examining twenty-eight different health video games published between 2005 and 2013. Most of the video games identified were commercially available. Most studies were of short duration and involved both boys and girls who typically played video games at home. They reported that positive outcomes related to obesity were observed in approximately 40 percent of the studies, all of which targeted overweight or obese participants.

It has been suggested that the playing of exergames are an innovative approach in enhancing physical activity among the elderly. Larsen, Schou, Lund, and Langberg (2013) carried out a systematic review to determine the efficacy of exergames in healthy elderly individuals using validated quantitative physical outcomes. The authors identified forty-five studies that met the initial inclusion criteria. However, only seven studies using randomized controlled trials with low-to-moderate methodological quality were reviewed for the final review. The seven studies comprised 311 participants in total, and six of the studies reported a positive effect of exergaming on the health of the elderly. The authors concluded that exergames have potential in improving elderly physical health but that better-designed studies are needed to assess the effectiveness and long-term adherence in this age group.

Staiano and Flynn (2014) carried out a systematic review concerning therapeutic uses of active video games. The authors identified sixty-four studies that evaluated the health outcomes of active video games. The papers included the use of video games used to rehabilitate (in alphabetical order) balance, burn treatment, cancer, cerebral palsy, Down's syndrome, extremity dysfunction or amputation, hospitalization, lupus, Parkinson's disease, spinal injury, or stroke. Results indicated that the majority of studies demonstrated positive results for improved health outcomes of video game interventions compared to usual care. However, the authors also noted that many of the studies were pilot studies with small samples, and that many studies lacked a suitable comparison or control group, with little or no follow-up to test for sustainability. It is also worth noting that some commercial games that are not exergames (such as *Pokémon Go*) have also been shown to foster physical activity in children and adolescents, although such effects have not been rigorously evaluated (Althoff, White, & Horvitz, 2016)

Conclusions

Many of the studies outlined in this chapter used serious video games rather than those that are commercially available. The use of commercial video games in therapy may be controversial since these games have not been created for therapeutic purposes and lack the carefully standardized conditions of therapeutic games. However, it appears important to investigate their uses in therapy as some current video games allow the personalization of the video game settings and content, e.g. modifying the character appearance, integration of real-life elements into the game. This may provide new avenues for clinicians to explore the therapeutic use of

video games at a low cost compared to specialized and expensive video games platforms. The recent commercialization of virtual reality headsets, which enhance the sense of presence in the virtual world making gaming a more realistic experience, has opened a world of opportunities for therapy (Griffiths, 2017). Moreover, the advance in artificial intelligence (through the use of more receptive video game characters that simulate understanding and that respond to players' behaviors) may facilitate the use of video game characters as companions. This may be of therapeutic help to specific sub-groups (e.g., autistic children, those with learning difficulties).

It is clear from the studies outlined that, in the right context, video games can have a positive therapeutic benefit to a large range of different sub-groups. Video games have been shown to help children undergoing chemotherapy, children undergoing psychotherapy, children with particular emotional and behavioral problems (attention deficit disorder, impulsivity, autism), individuals with medical and health problems (Erb's palsy, muscular dystrophy, burns, strokes, movement impairment), patients suffering from a variety of anxiety disorders, groups such as the elderly, and individuals looking to overcome real-life challenges (including symptoms of depression) and boost their wellbeing (including increasing life satisfaction, self-efficacy, and social support). In terms of video games being distractor tasks, it seems likely that the effects can be attributed to most commercially available video games.

However, as with the literature on video games aiding health promotion, one of the major problems is that reported positive effects in some of these other instances were from specially designed video games rather than those that were already commercially available. It is therefore hard to evaluate the therapeutic value of video games as a whole. As with research into the more negative effects, it may well be the case that some video games are particularly beneficial, whereas others have little or no therapeutic benefit whatsoever. What is clear from the empirical literature is that the negative consequences of video game playing almost always involve people who are excessive users. It is probably fair to say that therapeutic benefits (including such things as self-esteem) can be gained from moderate video game playing (Nuyens et al., 2018). Video games appear to have great positive therapeutic potential in addition to their entertainment value. Many positive applications in health care have been developed. There has been considerable success when games are specifically designed to address a specific problem or to teach a cer- tain skill. However, generalizability outside the game-playing situation remains an important consideration.

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