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Videogames as Therapy:
An Updated Selective Review of the Medical and Psychological Literature

Mark D. Griffiths, International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham, UK

Daria J. Kuss, International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham, UK

Angelica B. Ortiz de Gortari, International Gaming Research Unit, Psychology Division, Nottingham Trent University, Nottingham, UK & Psychology and Neuroscience of Cognition Research Unit, University of Liège, Belgium

ABSTRACT

There is a long history of using videogames in a therapeutic capacity including rehabilitation for stroke patients, people with traumatic brain injuries, burns victims, wheelchair users, Erb's palsy sufferers, children undergoing chemotherapy, children with muscular dystrophy, autistic children and individuals looking to overcome real-life challenges (including symptoms of depression) and boost their wellbeing (including boosting life satisfaction, self-efficacy and social support). This paper briefly and selectively examines a number of areas including: (1) videogames as physiotherapy and occupational therapy, (2) videogames as distractors in the role of pain management, (3) videogames and cognitive rehabilitation, (4) videogames and the development of social and communication skills among the learning disabled, (5) videogames and impulsivity/attention deficit disorders, (6) videogames and therapeutic benefits in the elderly, (7) videogames in psychotherapeutic settings, (8) videogames and health care, (9) videogames and anxiety disorders, and (10) videogames and psychological wellbeing. It is concluded that there has been considerable success when games are specifically designed to address a specific problem or to teach a certain skill. However, generalizability outside the game-playing situation remains an important consideration.

KEYWORDS

Health Care, Occupational Therapy, Physiotherapy, Videogames

INTRODUCTION

The most reported effects of videogames typically report the alleged negative consequences. These include videogame addiction (e.g., Griffiths, 2008a, 2008b), increased aggressiveness (e.g., Anderson & Bushman, 2001), and the various medical and psychosocial effects (Griffiths, 2005). However, there are abundant references to the positive benefits of videogames in the literature including various review papers (Griffiths, 2004; Kato, 2010; Lawrence, 1986; Rauterberg, 2004; Wiemeyer, 2010). Despite research into the more negative effects, for over 25 years, researchers have been using videogames as a means of researching individuals. Videogames may be useful in therapy in different ways including:

- **Videogames as a Therapeutic Setting:** Videogames allow participants to experience novelty and challenge when engaging in fictional activities without real life consequences (Washburn &

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Gulledge, 1995). Playing videogames has also been used to establish an effective patient-therapist relationship, particularly with young people (Ceranoglu, 2010b). Furthermore, psychotherapy has been conducted exclusively in videogame settings (Coyle, Matthews, Sharry, Nisbet, & Doherty, 2005). For instance, through game immersion, anxious patients can be presented with aversive stimuli via a videogame to progressively eliminate their anxiety. Adopting fictional roles has also been used for encouraging the practice of healthy behaviors and developing social skills (Brown et al., 1997; Lieberman, 2001).

- **Videogames as a Therapeutic or Intervention Tool:** Playing videogames makes it easier to achieve and maintain a person's undivided attention for long periods of time (Donchin, 1995). For this reason, videogames can be used as a cognitive distractor task helping patients in pain to learn relaxation techniques and/or to achieve the relaxation and ease that can be essential for successful experimentation. Furthermore, videogames' immersive nature may facilitate the suspension of reality that can be used in order to access different states of consciousness helping people regress to childhood play. Moreover, videogame playing has been proposed as a visuospatial task for interfering with the elaboration of sensory imagery that leads to the indulgence of cravings crucial to addictions, or sensory imagery from traumatic events that are stressful (Holmes, James, Coode-Bate, & Deeprose, 2009; Skorka-Brown, Andrade, Whalley, & May, 2015).
- **Videogames as a Measurement Tool:** Videogames can allow measuring of performance on a very wide variety of tasks, and they can be easily adapted, standardized, and understood. Also, videogames can be used to observe individual behavior or performance and examine individual characteristics such as self-esteem, self-concept, goal-setting, and individual differences.
- **Videogames as a Motivating Tool:** Videogames are fun and stimulating, so they can be used to assist patients in setting goals, ensuring goal rehearsal, providing feedback, reinforcement, and maintaining records of behavioral change (Ceranoglu, 2010b).
- **Videogames as a Clinical Research Tool:** Videogames can provide a large spectrum of people's profiles and diversity in study cases since videogames' diversity can attract participation of individuals across many demographic boundaries (e.g., age, gender, ethnicity, educational status) (Washburn & Gulledge, 1995), especially with the implementations of online videogames in clinical settings that may facilitate access to individuals situated in different physical locations and/or to provide therapy to the ones that have difficulties to attend health care services.
- **Videogames to Increase Knowledge:** Videogames have been successfully used to increase knowledge regarding academia, health and society (Donohue, 2015). A meta-analysis (Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013) revealed that videogames using student-centered learning were significantly better than more conventional learning in terms of learning and retention. However, it has been suggested that guidelines for using videogames in the school context need to be developed to ensure that all learners benefit from using videogames in educational contexts (Baranowski et al., 2016).
- **Videogames to Change Behavior:** Videogames 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 64 different videogames targeting improvements in lifestyle indicated that using games had beneficial consequences for health. These beneficial outcomes include effects on diabetes (DeShazo, Harris, & Pratt, 2010), obesity prevention (Lu, Kharrazi, Gharghabi, & Thompson, 2013), as well as health and safety behaviors in young individuals aged 18 years and under (Hieftje, Edelman, Camenga, & Fiellin, 2013).
- **Videogames as Physical Activity:** Videogames are also used in the context of exergaming – using games as physical exercise (Baranowski, et al., 2016). Research regarding exergaming is mixed, with some naturalistic research (Baranowski et al., 2012) suggesting 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). It has been suggested that exergaming should be implemented in everyday school routines of children and adolescents given the primarily sedentary nature of school education (Baranowski, et al., 2016).

- **Videogames to Influence Health Precursors:** Videogames have been successfully used to impact on health precursors (such as anxiety) in the context of health outcomes following hospital stays (Yip, Middleton, Cyna, & Carlyle, 2009). Beneficial outcomes have been observed regarding chemotherapy (Cole, Yoo, & Knutson, 2012) and enhancing resilience and health in clinical populations (Govender, Bowen, German, Bulaj, & Bruggers, 2015) suggesting videogames can be powerful tools in various physical-health related circumstances (Baranowski, et al., 2016).

Research dating right back to the early 1980s has consistently shown that playing computer games (irrespective of genre) produces increases in reaction times, improved hand-eye co-ordination, and raises players' self-esteem. What's more, curiosity, fun and the nature of the challenge also appear to add to a game's therapeutic potential. Commonly, videogames developed specifically for therapeutic interventions or health care (often referred to as 'good games' or 'serious games') have been used in therapy. However, some commercial videogames have also been adapted and used for therapeutic purposes.

This paper focuses on some of the reported therapeutic benefits of videogame playing. Some evidence suggests that important skills may be built or reinforced by videogames. For example, spatial visualization ability (i.e., mentally, rotating and manipulating two- and three-dimensional objects) can be improved through videogame playing (Green & Bavelier, 2006; Subrahmanyam & Greenfield, 1994). However, videogames were more effective for children who started out with relatively poor skills. It was therefore suggested that videogames may be useful in equalizing individual differences in spatial skill performance.

Many people seem surprised that videogames have been used in a wide variety of therapeutic and medical contexts. As we shall see during the course of this paper, "videogame therapy" has been used successfully in rehabilitation for stroke patients, people with traumatic brain injuries, burns victims, wheelchair users, Erb's palsy sufferers, children undergoing chemotherapy, children with muscular dystrophy, and autistic children. This paper briefly examines a number of areas including: (1) videogames as physiotherapy and occupational therapy, (2) videogames as distractors in the role of pain management, (3) videogames and cognitive rehabilitation, (4) videogames and the development of social and communication skills among the learning disabled, (5) videogames and impulsivity/attention deficit disorders, (6) videogames and therapeutic benefits in the elderly, (7) videogames in psychotherapeutic settings, (8) videogames and health care, and (9) videogames and anxiety disorders.

Videogames as Physiotherapy and Occupational Therapy

Videogames have been used as a form of physiotherapy and/or occupational therapy in many different groups of people (e.g., those who are physically handicapped, learning disabled, emotionally disturbed, etc.). 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 videogames into this context can be of huge therapeutic benefit. As we shall see, the same appears to be true for more complex psychological abnormalities.

Videogames have been used innovatively as a form of physiotherapy for arm injuries (Szer, 1983), in training the movements of a 13-year old child with Erb's palsy (Krichevets, Sirotkina, Yevsevicheva, & Zeldin, 1994), cerebral palsy (Huber et al., 2010; Hurkmans, van den Berg-Emons, & Stam, 2010; Jannink et al., 2008; Weightman et al., 2010), finger and hand function (Szturm, Peters, Otto, Kapadia, & Desai, 2008), chronic severe hemiparesis (Housman, Scott, & Reinkensmeyer, 2009), rheumatology (McCormack et al., 2009), postural stability and balance (Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010), and as a form of occupational therapy to increase hand strength (King, 1993). For instance, King (1993) showed that videogames could be used in an occupational therapy setting to increase hand strength among patients with just three-minute "exercise" periods on computer games. Videogames have also been used as therapeutic interventions to promote and increase arm reach in persons with traumatic brain injury (Sietsema, Nelson, Mulder, Mervau-Scheidel, & White, 1993). This paper reported the use of a computer game (described as an occupationally embedded intervention) to promote and increase arm reach in persons with traumatic brain injury. The study showed that the game produced significantly more range of motion in all of their 20 participants. Moreover, 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), and muscular dystrophy sufferers. More specifically, some wheelchair users find regular exercise programs too difficult physically or psychologically, and many find that using standard arm crank or roller systems is monotonous. O'Connor, Cooper, Fitzgerald, Dvorznak, Boninger, VanSickle and Glass (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 videogame system (*Gamewheels*) that provided an interface between a portable roller system and a computer. This system enabled wheelchair users to play commercially available videogames 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%) reported that they would like a *Gamewheels* system for their home.

Adriaenssens, Eggermont, Pyck, Boeckx and Gilles (1988) reported the use of videogame 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, in another study (Fung et al., 2010), occupational therapists and physiotherapists advocated the use of videogame systems for burn- and nonburn patients for similar reasons. Additionally, videogames were also used as a respiratory muscle training aid for young patients with Duchenne Muscular Dystrophy (Vilozni, Bar-Yishay, Shapira, Meyer, & Godfrey, 1994).

Joei Mioto and Goncalves Ribas (2014) furthermore found that using virtual reality games appears beneficial in the physical rehabilitation of individuals with Down's syndrome, a genetic disease that has negative impacts on basic motor skills, including gross and fine motor skills. The commercially available *Nintendo Wii* and *Wii Sports* CDs have been used with five volunteers with Down's syndrome, and *Wii* games including tennis, bowling, boxing, baseball and golf games were used for 30 minutes twice weekly. Results indicated that these games increased motivation to engage in physical rehabilitation in a playful manner. Moreover, it was suggested to replicate and extend these results beyond this small population to increase external validity.

The use of videogames in almost all these differing contexts capitalizes on a number of interrelated factors. One of the most important is the person's motivation to succeed. Furthermore, videogames 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).

Videogames 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. Videogame playing offers an ideal way to analyze the role of distraction in symptom control in pediatric patients. Redd et al. (1987) argued that the main reasons for this are that:

1. Videogames are likely to engage much of a person's individual active attention because of the cognitive and motor activity required.
2. Videogames allow the possibility to achieve sustained achievement because of the level of difficulty (i.e., challenge) of most games during extended play.
3. Videogames appear to appeal most to adolescents.

Videogames have also been used in a number of studies as "distractor tasks". For instance, one study (Phillips, 1991) reported the case of using a handheld videogame (*Nintendo Game Boy*) to stop an 8-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 videogame was used to keep the boy's hands occupied. After two weeks, the affected area had healed.

Another creative use of videogames has been to help increase sitting tolerance for people with lower back pain (Butler, 1985). Furthermore, a study (Leibovici, Magora, Cohen, & Ingber, 2009) reported that virtual reality immersion (VRI) helped patients suffering from pruritus to distract them from the pain they felt. Moreover, it decreased scratching before and after playing. Functional magnetic resonance imaging indicated that the brain activity associated with the pain experience was significantly reduced.

There are also a number of studies (e.g., 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 videogames 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 amount of painkillers needed. There are many practical advantages for using videogame therapy for patients during chemotherapy treatment. Redd et al. (1987) argue that:

1. Videogame playing can be easily integrated with most chemotherapy administration procedures.
2. Videogames represent a more cost-effective intervention than many traditional behavioral procedures such as hypnosis and relaxation.
3. Videogames can be played without medical supervision.

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. This pain management technique utilizing videogames has also been applied successfully to children undergoing treatment for sickle cell disease (Pegelow, 1992). As mentioned in the previous section, the studies by Adriaenssens et al. (1988) and O'Connor et al. (2000) on burns victims and wheelchair users claimed that success was in part due to the distraction from pain.

Finally, in this section it is worth noting that one report alerted doctors that children may mistake patient-controlled analgesia (PCA) devices for videogame consoles. Blunt, Hastie and Stephens (1998) reported the case of a seven-year old boy with Ollier's disease undergoing an operation whose pain was managed via a PCA pump. On the third day following his operation the boy's PCA usage escalated from zero to a total of 74 demands during a four-hour period. Upon questioning it became clear that on the night in question the boy had been playing a videogame and he had mistakenly been pressing his PCA pump as if it had been a videogame!

Videogames and Cognitive Rehabilitation

One way in which videogames have been used is as a rehabilitation aid among various groups of people. Fisher (1986) argued that computers (including videogames) have the potential to aid cognitive remediation. 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, and 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). These ideas have been studied empirically by a number of researchers.

For instance, Larose, Gagnon, Ferland and Pepin (1989) carried out a study to test the hypothesis that computer games may be an efficient therapeutic tool in a cognitive rehabilitation program. Sixty participants who showed attention difficulties with or without cerebral dysfunctions participated in a 12-hour training program based on intensive use of a videogame. Analyses showed improvement for the experimental group on scanning and tracking variables, notwithstanding the nature of their particular dysfunctions. Other studies have successfully used videogames in rehabilitation programs to improve sustained attention in patients with craniocerebral trauma (Funk, Germann, & Buchman, 1997; Lawrence, 1986), 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; Lynch, 1983; Yavuzer, Senel, Atay, & Stam, 2008), and other motor deficits (Cameirao, Bermúdez i Badia, Duarte Oller, Zimmerli, & Verschure, 2007).

Other authors have advocated the use of videogames as a cognitive rehabilitation aid (attention, perceptual spatial abilities, reasoning, memory) to assist patients who have had brain damage to regain lost function (Lawrence, 1986; Skilbeck, 1991). Videogames have also been used to increase spatial visualization (Dorval & Pepin, 1986). However, more recent research by Subrahmanyam and Greenfield (1994) has suggested that spatial skills are only improved in those whose skills were very weak to begin with but unlikely to improve skills for those with average or above-average spatial abilities.

Videogames and the Development of Social and Communication Skills Among the Learning Disabled

Videogames 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), 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). Case studies such as those by Demarest (2000) are persuasive. Demarest's account of her own autistic seven-year old son reported that although he had serious deficiencies in language and understanding, and social and emotional difficulties, videogame playing was one activity he was able to excel. This was ego-boosting for him and also had a self-calming effect. Videogames provided the visual patterns, speed, and storyline that help children's basic skills development. Some of the therapeutic benefits Demarest (2000) outlined were language skills, mathematics and reading skills, and social skills.

Horn, Jones and Hamlett (1991) used videogames 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 videogames to help learning disabled children in their development of spatial abilities (Masendorf, 1993), problem-solving exercises (Hollingsworth & Woodward, 1993), and mathematical ability (Okolo, 1992a). Other researchers have offered critiques on how best to use computer technology for improved achievement and enhanced motivation among the learning disabled (e.g., Blechman, Rabin, & McEnroe, 1986; Okolo, 1992b).

Videogames and Impulsivity/Attention Deficit Disorders

There are now a few studies that have examined whether videogames might be able to help in the treatment of children with impulsive and attentional difficulties. Kappes and Thompson (1985) tried to reduce impulsivity in incarcerated juveniles (ages 15- to 18-years) by providing either biofeedback or experience with a videogame. Impulsivity scores improved for both conditions. Improvement was also noted in negative self-attributions and in internal locus of control. The authors concluded that the most likely explanation for the improvement in both experimental conditions was the immediate feedback. Clarke and Schoech (1994) also used videogames to help adolescents learn impulse control. A videogame was used for four weeks with four subjects (11-to 17-years) diagnosed with impulse control problems. After the experimental trial, the participants became more enthusiastic and co-operative about treatment.

Unpublished research (Wright, 2001) suggests videogames linked to brain-wave biofeedback may help children with attention deficit disorders. Biofeedback teaches patients to control normally involuntary body functions such as heart rate by providing real-time monitors of those responses. With the aid of a computer display, attention-deficit patients can learn to modulate brain waves associated with focusing. With enough training, changes become automatic and lead to improvements in grades, sociability, and organizational skills. Following on from research involving pilot attentiveness during long flights, a similar principle has been developed to help attention-deficit children stay focused by rewarding an attentive state of mind. This has been done by linking biofeedback to commercial videogames. In their trial, Pope and Palsson (2001; cited in Wright, 2001) selected half a dozen *Sony PlayStation* games and tested 22 girls and boys between the ages of 9 and 13 years who had attention deficit disorder. Half the group got traditional biofeedback training and the other half played the modified videogames. After 40 one-hour sessions, both groups showed substantial improvements in everyday brain-wave patterns as well as in tests of attention span, impulsiveness, and hyperactivity. Parents in both groups also reported that their children were doing better in school. The difference between the two groups was motivation. The video-game group showed fewer no-shows and no dropouts. The researchers do warn that the 'wrong kinds of videogame' may be detrimental to children with attention disorders. For instance, 'shoot 'em up' games may have a negative effect on children who already have a tendency toward short attention and impulsivity. They also state that the technique is an adjunct to drug therapy and not a replacement for it.

Finally, Lim et al. (2010) used a brain-computer interface program to improve inattention in ten children diagnosed with attention deficit hyperactivity disorder. They found that compared to a control group which received no treatment, inattention symptoms had significantly decreased. Although these findings appear promising, the researchers call for larger-scale studies to improve the generalizability of results.

Videogames and Therapeutic Benefits in the Elderly

It could perhaps be argued that videogame manufacturers have done very little to target older persons as prospective videogame users. This might be different if they were aware that there is a growing body of evidence that videogames may have beneficial therapeutic effects for the elderly. Given that videogame 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).

For instance, a game as simple as *Tetris*, can engage the mind in an enjoyable problem solving exercise. The same enjoyable pleasures that occur when any of us master a new computer skill may have therapeutic value to both young and old. Learning something new on the computer results in a sense of accomplishment and satisfaction that invariably creates a feeling of wellbeing. Technology with the aged can therefore foster greater independence and can be put to therapeutic use. Dustman, Emmerson, Laurel and Shearer (1992) showed that videogames could increase reaction times among the elderly after an 11-week period of videogame playing

For instance, McGuire (1984, 1986) examined the effectiveness of videogames in improving self-esteem among elderly long-term care residents. In one wing of the institution, videogames were made available for an eight-week period. Residents of a second wing did not have the opportunity to play them and were used as a control group. Results showed that the videogame group exhibited significant improvement in self-esteem. Similar results have been found by other researchers. For instance, Goldstein, Cajko, Oosterbroek, Michielsen, van Houten and Salverda (1997) reported that elderly (non-institutionalized) people increased reaction times, self-esteem, and positive sense of wellbeing, as a result of playing videogames for five hours a week for five weeks. However, there was little improvement in cognitive performance compared with controls. Riddick, Spector and Drogin (1986) examined the impact of videogame play on the emotional states and affiliative behavior of elderly nursing home residents. The experimental group had an opportunity to play videogames three times per week for up to three hours per session, over a six-week period. In comparison to the control group, the experimental group underwent significant changes in their arousal state and affiliative behavior.

Weisman (1983) suggested that videogames may have a role to play in meeting clients' needs for fun and mental stimulation and in enhancing self-esteem. He reported that moderate mental and physical impairments did not prevent 50 nursing home residents from participating in four videogames which were especially adapted for this population. Further research by Weisman (1994) on the institutionalized elderly found that computer and videogame use was found to be a valuable learning and diagnostic tool. The author urged practitioners to investigate the possibilities of using videogames in their work with the elderly.

Farris et al. (1994) suggested that older adults can benefit significantly from ongoing education, and that computers can be valuable tools in this process. They advocate the use of computers for long- and short-term memory functioning memory skills. They reported a study using the videogame *Memory of Goblins*. This game was developed primarily for use in the assessment of working memory but can also be used for the training of working memory. Conclusions were difficult to draw from this particular study, but there is evidence to suggest that the impact of computer use among the elderly population can be profound. Ryan (1994) also used the Memory for Goblins videogame to assess memory skills among various groups. Preliminary results with older users suggested they find it novel and interesting although there appeared to be little effect on improvement of working memory.

Hollander and Plummer (1986) reported the use of a hands-on microcomputer experience in 41 senior adults. Over a three-week period, videogames served as a therapeutic and rehabilitative tool, as well as a form of social and educational enrichment. Results indicated that thought-provoking games (*Trivia* and *Hangperson*) held the participants' highest level of attention, and were perceived as exciting and stimulating. Schueren (1986) also analyzed the value of videogames as an activity program for geriatric populations in skilled nursing home facilities. It was concluded that videogame playing may be a successful small group recreational activity for those residents with adequate eye-hand coordination, vision and mental functioning. Suggestions were also proposed for equipment adaptations to correct problems of poor visual clarity and awkward manipulation of controls. Such findings have also been reported in more recent studies (Gamberini et al., 2008). In addition to this, videogames have been found useful regarding home-based step training for older people in terms of choice stepping reaction time (and consequent decreased risk of falling down), better physical assessment scores, and postural sway compared to controls (Schoene et al., 2013).

Given this small but growing body of evidence, there is clearly a need for more research on videogame use among this particular group of people. There are many areas that need to be explored in more detail including elderly use of technology in general, the use of computers and videogames to develop and strengthen memory skills, intergenerational computing projects (teaming seniors with school aged students), and the use of computers and videogames to assess cognitive functions, etc. Many older adults may be receptive to using technology if introduced to it in a comfortable environment. If introduced in the right way, technology (including videogames) may become a major hobby and interest in the lives of the elderly, and may also be of therapeutic value.

Videogames in Psychotherapeutic Settings

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). Play has been a feature in therapy since the work of Anna Freud (1928) and Melanie Klein (1932) and has been used to promote fantasy expression and the ventilation of feeling. 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 (e.g., Gardner, 1991; Spence, 1988). Research in the mid-1980s had already suggested that videogames may actually facilitate co-operative behavior and reinforcement in more educational settings (e.g., Salend & Santora, 1985; Strein & Kochman, 1984).

Lawrence (1986) advocates that videogames can be used in the treatment of psychological problems during therapy. In an overview, he reported that there had been approximately two dozen efforts in the published literature to deliver counseling or other psychological intervention services by computer. Although not concentrating on videogames specifically, he did refer to games, computer-aided instruction, biofeedback, and behavior therapy. He concluded that computers (including games) could make meaningful contributions to the treatment of psychological problems.

Gardner (1991) claimed that the use of videogames 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:

1. The child's repertoire of problem solving strategies
2. The child's ability to perceive and recall subtle cues as well as foresee consequences of behavior and act on past consequences
3. Eye-hand co-ordination
4. The release of aggression and control
5. The ability to deal with appropriate methods of dealing with the joys of victory and frustrations of defeat in a more sports oriented arena
6. The satisfaction of cognitive activity in the involvement of the recall of bits of basic information
7. 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 videogames were used to support psychotherapy. Although other techniques were used as an adjunct in therapy (e.g., story telling, drawing, other games etc.), Gardner claimed it was the videogames 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, though 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'.

Spence (1988) is another advocate of the therapeutic value of videogames and has incorporated them into his repertoire of behavior management techniques. Spence believes that videogames can be used instrumentally to bring about changes in a number of areas and provided case study examples for each of these changes. These are briefly outlined below.

1. **Development of Relationships:** Used videogames to provide the basis to develop a therapeutic relationship. The videogames gave an acceptable "middle ground" for both parties to "meet" which provided an enjoyable experience that could be shared. Relationships become close and trusting.
2. **Motivation:** Used videogames as "bargaining counters" to motivate children to do things. This simply involved negotiating with an individual for a set period of work time or tasks in return for a set period of time playing videogames.
3. **Co-operative Behavior:** Used videogames to develop social skills and co-operation in individuals by making them share a computer with peers. Through the medium of videogames, individuals developed friendships that fostered co-operation.
4. **Aggressive Behavior:** Used videogames to "take the heat out of situations", i.e., individuals played videogames when they were angry so that the "damage" was inflicted on the videogames' characters rather than human beings.

5. **Self-Esteem:** Used videogames as a measure of achievement to raise self-esteem. Since videogames are skill based and provide scores, they can be compared and provide a basis for future goals. Beating personal high scores raised self-esteem in the individual.

As can be seen from Spence's brief summaries, the benefits outlined are similar to those outlined by Gardner (1991). 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.

Coyle, Matthews, Sharry, et al. (2005) reported their use of the *Personal Investigator* (*PI*), a 3D computer game specifically designed to help adolescents overcome mental health problems such as depression and help them engage more easily with professional mental health care services. Their model had its theoretical foundations in play therapy and therapeutic storytelling and applied current research on the educational use of computer gaming and interactive narrative. The *PI* incorporated a goal-oriented, strength-based model of psychotherapy called Solution Focused Therapy (SFT). By engaging adolescents, in a client-centerd way, it aimed to build stronger therapeutic relationships between therapists and adolescents. Results of trials of *PI* with four adolescents, referred to clinics for issues including anxiety and behavior problems, attempted suicide, and social skills difficulties, were presented and argued to be effective.

Olsen-Rando (1994) reported on the development and initial assessment of a videogame version of the *Talking, Feeling, and Doing Game*. The game was developed by Dr. Richard Gardner in order to facilitate the therapeutic process for those children who are inhibited, constrained, or resistive or as an alternative therapeutic tool for children who are not characterized as resistive and thus freely reveal information. The game provides children an opportunity to talk about themselves in a way that is less anxiety provoking than traditional methods of eliciting information about their underlying psychodynamics. Unfortunately, this was a descriptive account only and contained no evaluation. Similarly, Kokish (1994) described the use of a personal computer loaded with various videogames to aid play therapy with children. Case studies were outlined and reference was made to the fact that learning to use the computer as a play therapy tool was more difficult and slower than expected.

Favelle (1994) also described some therapeutic applications of computer software and videogames in work with both individuals and groups. The applications described were used with adolescents at a psychiatric treatment center and involved using commercially available software and videogames. An adventure-fantasy game and a role-playing game were described as helpful in work with individuals. This is because the importance and utilization of fantasy in play was expressed. A mystery computer game was presented as useful when working with groups. The author concluded that videogames have useful therapeutic value if applied by skilled professionals. It was suggested that further research would result in improvements to computer-assisted therapy.

Sherer (1994) described the development and application of a computerized therapeutic simulation game for the purpose of raising the moral level of youth in distress. The effects of the videogame on moral development were determined by a moral development measure. The level of moral development of a research group (n=13) and a control group (n=14) were measured before and after exposure to the therapeutic videogame. A total of five indices of moral development were used. Two of these, Moral stage and Punishment revealed a positive effect on the participants.

There is some research suggesting that videogames can be useful when evaluating schizophrenics in their attitudes and responses (Samoilovich, Riccitelli, Scheil, & Siedi, 1992). To do this, Samoilovich et al. (1992) investigated the initial attitude of ten chronic, defected schizophrenic patients to a computer videogame session. Six of them enjoyed the experience and wanted to repeat it. Cooperation and performance were compared by means of videogames and a standard psychometric test (Wechsler Adult Intelligence Scale). Videogame performance correlated with the execution test IQ more than with the verbal test IQ. The authors also claimed that videogames can be used for psychological testing, motivation and reward, and can be used to evaluate psychomotor activity.

More recent research (Ducharme et al., 2012) reported the case of a 16-year-old girl who underwent Acceptance and Commitment Therapy (ACT) using a RAGE-Control intervention designed to increase emotion control abilities by monitoring and controlling physiological arousal whilst faced with stress in a virtual reality environment. This treatment used five CBT techniques together with a videogame using active biofeedback. The aim was to improve the individual's self-regulation, and was implemented on a daily basis over five consecutive days. The results of this study showed that the patient's state and trait anger scores decreased significantly following treatment, suggesting both her anger and aggression levels benefitted from this videogame therapy element. Additional benefits included increased control over physiological arousal (i.e., heart rate). Although this study only provides evidence from one person, the results showed promise regarding reductions of both anger and aggression and increases in self-control, and should be replicated in larger samples.

It has also been suggested that some psychiatric patients who are socially undisciplined may be reachable with computers and videogames (Matthews, De Santi, Callahan, Koblenz-Sulcov, & Werden, 1987). Studies were reported that explored the usefulness of computers with chronic psychiatric patients. In one study, videogames were made available to patients and one half showed an active interest. The second study showed a neutral relationship between patients' social communication skills and their involvement with videogames. Thus, some patients who were socially intractable may be reachable with computers. It was argued that the computer can be used effectively to automate many tasks normally undertaken by clinicians and that the computer may have special advantages over the clinician for some purposes.

Videogames and Health Care

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 videogames (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 videogames, 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 6 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.

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 videogame format, information and opportunities for practice discussing prevention practices were provided to high-risk adolescents. Videogame 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.

Videogames 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) videogame quizzes challenged users to test their knowledge on a topic. Simulations challenged users to apply health information in hypothetical situations. Videogames 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 videogames, nor did game users engage in more risk-taking behaviors (e.g., alcohol and other drugs) than non-game users. Similar types of health promotion videogames have been used successfully for cystic fibrosis (Davis, Quittner, Stack, & Young, 2004), drug use (Oakley, 1994), alcohol (Resnick, 1994a), marijuana use (Henningson, Gold, & Duncan, 1986), sexual behavior (Starn & Paperny, 1990), life choices (D. L. Thomas, 1994), and anti-social behavior (Resnick, 1994b). One of the major problems with this area is that reported positive effects from videogames in a health promotion context is that almost all of the videogames 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.

Finally, Murphy, Carson, Neal, Baylis, Donley and Yeater (2009) reported that music and rhythm videogames (usually referred to as 'exergaming') 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 35 overweight children. The results showed that after 12 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.

Videogames and Anxiety Disorders

Therapeutic uses of videogames to reduce stress, anxiety, and specific anxiety disorders have taken place in different ways. Potential benefits of videogame playing have been reported as a way of reducing preoperative anxiety among children (Patel, et al., 2006). There is also evidence which suggests that playing puzzle games, specifically the game *Tetris*, can mitigate flashbacks of traumatic experiences (Holmes, et al., 2009; James et al., 2015).

There is also evidence suggesting that videogame playing by military personnel has a protective mechanism versus nightmares (Gackenbach, Ellerman, & Hall, 2011). However, it seems that the therapeutic effects of videogames depends largely on what context, with what intensity and who is playing. In a qualitative study done by Ortiz de Gortari, Aronsson and Griffiths (2011), high frequency players reported disturbing, intrusive and stereotypical after images after playing games like *Tetris*. Also, in an experimental study with normal and amnesic volunteers playing *Tetris*, the participants experienced visual images from the game at sleep onset (Stickgold, Malia, Maguire, Roddenberry, & O'Connor, 2000).

Videogames have also been used, not only in a palliative context but also as a more structured form of therapy via the use of simulation videogames for the treatment of clinical disorders. Specifically, virtual reality exposure therapy (VRET) has been applied to target 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).

In VRET, therapy does not take place *in vivo*, but via a virtual game-like simulation. VRET can be delineated as an intermediary between in vivo and imaginal cognitive behavioral therapy (CBT). In VRET, virtual environments (VEs) are made use of, by means of which anxiety-provoking situations are not merely imagined, but virtually *reconstructed*. In fact, reality is reconstructed in such a way so as to make the patient feel present in the VE (Krijn, Emmelkamp, Olafsson, & Biemond, 2004). Presence, in this respect, can be defined as a

…psychological state or subjective perception in which even though part of or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience (International Society for Presence Research, 2000).

Therefore, even though the experience in VRET is entirely mediated, it feels as if it was real for the patient. They immerse in the VE so that the experience becomes seemingly de-mediated.

There are two ways in which a virtual experience can be created. On the one hand, there is the possibility to use a head-mounted display (HMD), a technical apparatus attached to the patient's head, which consists of glasses and speakers. The VE will be projected inside the glasses. Attached sensors are connected to a computer. The patient can follow the movements of the virtual scenery by means of moving his head. His experience is closely monitored by the therapist, who views the VE which the patient is confronted with on his own computer screen (Krijn, Emmelkamp, Olafsson et al., 2004).

The second technological equipment that can be used is the computer automatic virtual environment (CAVE). It allows for the synchronous attendance of both the patient and the therapist, who experience the VE in a four-to-six sides cubicle, which projects the virtual scenario. Utilizing an electromagnetic tracking system, the CAVE enables the patient to move freely in the VE (Krijn, Emmelkamp, Olafsson, et al., 2004). As such, the CAVE offers the option for a more immersive experience in such a way that the patient is entirely surrounded by the VE.

VRET works by exposing the patient to threat-provoking situations, while the level of threat is increased gradually. To describe but one instance of a therapy session, Roy, Klinger, Légeron, Lauer, Chemin and Nugues (2003) made use of a particular VRET, in which they created four treatment environments associated with real social situations that provoke fear in social phobics, namely performance, intimacy, scrutiny, and assertiveness environments, respectively. Using the most common instance in which anxiety would be provoked, namely the performance situation, the patient was asked to speak in public. This was achieved through the VE, which reconstructed a meeting room, in which seven people were present. The patient was asked to take a seat, introduce himself, and present a project. For the patient, this situation provoked anxiety since he saw himself confronted with strangers, whom he was asked to interact with publicly. In fact, he was directly exposed to his fear. By means of repetition of the treatment, that was gradually modified to provoke more fear (e.g., the number of persons in the audience was increased), the patient learned to cope with his fears and the anxietal response diminished. In this particular study, patients drew attention to the fact that they experienced the situation in a way comparable to *in vivo* procedures (Roy, et al., 2003).

In fact, in another study the fear-provoking quality of VEs for patients suffering from fear of public speaking as compared to a non-phobic control group has been proven. The fear response in the experimental group was provoked when the participants were asked to hold a speech in front of a virtual audience, whereas this scenario instigated lessened degrees of anxiety in the control group as measured by questionnaires quantifying levels of anxiety and heart rate. This result leads to the conclusion that in fact, the study participants experienced presence during the experimental conditions, which testifies to the real effectiveness of the treatment (Slater, Pertaub, Barker, & Clark, 2006).

The meta-analysis of VRETs for anxiety disorders conducted by Powers and Emmelkamp (2008), in which they compared 13 studies, offers highly positive results with regards to the efficacy and efficiency of VRET for treating anxiety disorders. The measures of between-group effect sizes (measured by Cohen's d) comparing the effects of VRET treatment for specific phobias, social phobia, PTSD and panic disorder to control conditions (Cohen's $d = 1.1$) and/or in vivo therapies (Cohen's $d = 0.35$) revealed that VRET is highly efficient in treating anxiety disorders and even outperforms the golden standard of therapy, *in vivo* procedures, in efficacy (Powers & Emmelkamp, 2008).

Overall, there appear a number of advantages involved in making use of VRET for the purpose of treating anxiety disorders. First, the therapist has complete control over the therapy. Therapists not only monitor the therapy, but they also ensure that the patient is gradually exposed to his or her individual anxieties. Second, VRET is entirely private and confidential and it includes low risk of the patient to be embarrassed in front of others. Patients receive therapy by themselves and do not have to interact with other patients seeking help. Moreover, he does not have to fear their disapproval, as is the case with group CBT. Therefore, VRET is very appealing to patients. This might seem a hindrance at first sight because a therapist would want to expose the patient to their feared situation. However, this takes place in VRET by means of the virtual environment which functions as a realistic simulation of the real world.

Third, the anxietal response is provoked easily, for the VE is constructed so as to expose the patient directly to the fearful situations. Fourth, there are certain economic considerations involved as well. Administering VRET to a patient requires relatively low costs. Still, instruments such as the HMD and especially the CAVE as well as the development of effective software involve significant costs. A second drawback is the fact that VRET is a new therapy and thus both researchers as well as therapists are rather unacquainted with it heretofore (Bush, 2008). Still, the problem of high costs of the technological equipment can be overcome.

Tichon and Banks (2006) found that both 150-degree screens (semi-immersive interfaces) as well as regular desktop PCs incorporating VEs designed to treat schizophrenia can provide patients with a sense of presence. In their study, this was measured by a presence questionnaire (PQ), which asked for causal factors of the experience of presence, such as control, distraction, sensory, and realism factors, as well as an introspective group presence questionnaire (IGPQ), by means of which individual presence experiences were recorded. In both conditions, the experience of being present in the VE was reported by the study's participants (Tichon & Banks, 2006). Consequently, high-end technological devices, such as the HMD and CAVE do not necessarily have to be included in VRET in order to produce experiences of presence. Nevertheless, current scientific knowledge is in need for a controlled study that compares VRET utilizing HMD and CAVE with one another as well as with more cost-efficient technological devices, such as regular desktop PCs. The utilization of the latter is in fact an appealing idea not only because it saves costs, but also because the computer has become a popular and familiar device for most people nowadays. Today, the computer cannot be assumed away of everyday life. Therefore, VRET including computers could very soon gain significant popularity among the patient population.

Videogames and Psychological Wellbeing

It also needs to be noted that videogames are now being used with new platforms, including smartphones, making them accessible on the move. One game that has recently been developed to function via both the Internet and smartphones is *SuperBetter. SuperBetter* has been designed to improve any individuals' resilience, to foster personal growth, and to be better able to cope with life's challenges (McGonigal, 2015). Following a traumatic head trauma that left her depressed and suicidal, the game developer decided she wanted to get better and developed simple but effective strategies to overcome her difficult condition. These included recruiting allies (family and friends), engaging in low-level physical activity (e.g., walking around the block), and creating happy emotions (e.g., cuddling her dog). These strategies quickly lifted her out of her miserable state and allowed her to cope effectively with her difficult condition.

Given her professional interest in game design, she decided to design a game that can be used by individuals in a similar position, suffering from some form of physical, mental, emotional or other ailments – *SuperBetter* emerged. *SuperBetter* uses game-mechanisms and play to confront difficulties in life, harnessing characteristics of the game player (i.e., optimism, creativity, courage, resilience, and willpower). It asks players to engage in various tasks, including physical, mental, emotional and social challenges to reach personally identified goals (e.g., overcoming depression). Whilst playing, players are encouraged to activate power-ups (i.e., bonuses that make them stronger). Examples may include anything that creates moments of happiness, strength, and connection, such as a song that increases the player's strength, particular food that provides energy, or a short activity that creates calm. Playing *SuperBetter* resulted in positive outcomes for psychological wellbeing, self-efficacy, and success in life (McGonigal, 2015).

In order to test the effectiveness of *SuperBetter,* Roepke and colleagues (2015) recruited 283 adult *iPhone* users who had clinically significant depression scores as based on self-reports including the Center for Epidemiological Studies Depression (CES-D) questionnaire (Radloff, 1977) to participate in a randomized controlled trial (RCT). Participants were randomly allocated to one of three groups. The first group played a version of *SuperBetter* that included cognitive behavioral therapy elements and positive psychotherapy strategies to alleviate depression (CBT-PPT SB). The second group used a general version of *SuperBetter* that was aimed to increase self-esteem and acceptance (general SB). The third group was a waiting list (WL) control group. Each of the group members were asked to play *SuperBetter* for the period of ten minutes over one month, and were asked to fill in self-report questionnaires online that assessed psychological distress and wellbeing every two weeks.

Results indicated that playing *SuperBetter* resulted in decreased self-reported depression scores, and that CBT-PPT SB and general SB were similarly effective to decrease depression symptoms, in comparison to the WL group. In addition to this, similar effects were observed with regards to decreases in anxiety, improvements in life satisfaction, self-efficacy, and social support, where both SB groups faired similarly significantly better than the WL group (Roepke, et al., 2015). Using a sophisticated RCT methodology, this study was able to show the significant benefits of using general *SuperBetter* (which is freely available via the Internet and downloadable using app stores on both *iPhone* and *Android* smartphones) regarding decreasing negative mental symptoms (including anxiety and depression) whilst at the same time boosting positive outcomes for psychological wellbeing (such as life satisfaction, self-efficacy, and social support). Future studies should attempt to replicate these results, possibly including samples of clinically diagnosed patients suffering from various mental ailments to ascertain the viability of serious games for psychological wellbeing, such as *SuperBetter*. Nevertheless, it seems safe to state that *SuperBetter* can be used by anybody for real-life everyday challenges.

Videogame Playing for Interfering with Distressful Imagery

Treatments for post-traumatic stress disorder and addiction are well established, but there are scarcely any effective early interventions and management strategies. Playing videogames such as the tile puzzle game *Tetris* has been proposed as a visuospatial task to compete with the working memory resources required for the formation of sensory imagery in post-traumatic stress disorder and addiction (Holmes, et al., 2009; James, et al., 2015; Skorka-Brown, et al., 2015). The use of videogame playing as an interfering task is still being investigated, although the use of videogames in this context appears to have potential as previous findings have suggested. Holmes and colleagues (2009) demonstrated the benefits of playing *Tetris* under laboratory settings for interfering with the consolidation of traumatic memories that manifested as flashbacks of scenes of a traumatic film. Also, Skorka-Brown and colleagues showed that participants that played *Tetris* in a laboratory setting (2014) or in day-to-day contexts (2015) experienced reduction in cravings for various substances and behaviors. According to Ortiz de Gortari and Griffiths (2016), videogames are both, a useful exercise combining visual and spatial memory, and game content (including videogame elements, sensory perception) remains active upon discontinuation of playing (also referred to as *Game Transfer Phenomena*). This can potentially provide further advantages to overcoming unwelcome intrusions.

FUTURE RESEARCH DIRECTIONS

Clearly there are potentially interesting areas or future research and development in this area is disparate in terms of positive therapeutic consequences. To advance the field there is also a need to closely examine the factors that facilitate therapeutic benefits in the first place. This is because benefits (such as educational learning) depend on other factors than the nature of the videogame itself. For instance, psychologists have shown that working in-group co-operatively can speed up the time taken to do problem-solving tasks but it can also slow down the speed when the tasks are done competitively. Also, psychologists have found that girls who do problem-solving tasks together with other girls tend to co-operate whereas boys compete against each other. For those videogames reliant on strategy and problem solving, such findings may have implications for therapeutic potential.

One unexplored area in videogame research is people's attitudes towards playing. How a person thinks about a particular game - or videogame playing in general - may actually affect the therapeutic value. For instance, it could be speculated that when it comes to videogames there are three different types of people. The first are the technophobes who think that videogames are (literally) a complete waste of time and want nothing to do with them whatsoever. They would probably take every opportunity to be critical about them on a matter of principle and therefore gain little therapeutically. The second are the techno-sceptics who use and enjoy the technology but are not convinced that it is a vital therapeutic tool although there may be some therapeutic uses in some circumstances. The third are the techno-romantics who raise people's expectations about the capabilities and potential of computer games, and who sing their praises at every available opportunity. It is these individuals who may benefit most therapeutically from videogames.

The use of commercial videogames in therapy may be controversial since these games were not 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 videogames allow the personalization of the videogames' settings and content such as modifying the character appearance, and even integration of real life elements into the game. This may provide new avenues for clinicians to explore the therapeutic use of videogames at a low-cost compared to specialized and expensive videogames platforms. Particularly, the recent commercialization of virtual reality head-sets which enhance the sense of presence in the virtual world making gaming a more realistic experience has opened a world of opportunities for therapy.

Moreover, the advance in artificial intelligence (through the use of more receptive videogame characters that simulate understanding and that respond to players' behaviors) may facilitate the use of videogame characters as companions. This may be of therapeutic help to specific sub-groups (e.g., autistic children or those with learning difficulties).

Also, control devices in some of the latest videogames offer new possibilities to explore videogames' physiotherapeutic qualities since some control devices require physical challenge. For example, the use of motion sensing controls that track acceleration and movement allows users to operate the videogames by pointing at the screen that is different from gamepads based only on pushing buttons. It is also possible to use peripheral platforms where players stand while playing, controlling the game with body movements such as the *Wii* balance board, or (perhaps even better) to use videogames for treatment of patients incapable of using videogame controls via natural user interfaces where gestures, movements and spoken commands can be used to control the game. Moreover, haptic technology provides tactile feedback with vibration enhancing videogame playing experiences that may result positively in the treatment of certain patients.

Even involuntary phenomena provoked by playing videogames such as spontaneous visualization of videogame images or recurrently hearing music from the game after stopping playing can potentially be used with therapeutic means if used properly (Ortiz de Gortari & Griffiths, 2016).

Lastly, it has been suggested that design choices, specific effects and working mechanisms in videogames and their impact on behavior change need to be investigated further, particularly with regards to the games' effectiveness on the one hand and the reduction of potentially disadvantageous consequences of playing videogames for children and adolescents. It has furthermore been stated that a number of of individuals and organizations should be involved in creating videogames to make them more effective. These include policymakers, the gamers, the gamers' families, scientists, game designers, retailers, and publishers, and supported by appropriate funding bodies (Baranowski, et al., 2016).

CONCLUSION

It is clear from the preceding overview that in the right context, videogames can have a positive therapeutic benefit to a large range of different sub-groups. Videogames have been shown to help children undergoing chemotherapy, children undergoing psychotherapy, children with particular emotional and behavioral problems (ADD, impulsivity, autism), individuals with medical and health problems (such as Erb's palsy, muscular dystrophy, burns, strokes, movement impaired), 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 boosting life satisfaction, self-efficacy and social support). In terms of videogames being distractor tasks, it seems likely that the effects can be attributed to most commercially available videogames. However, as with the literature on videogames aiding health promotion, one of the major problems is that reported positive effects in some of these other instances were from specially designed videogames rather than those that were already commercially available. It is therefore hard to evaluate the therapeutic value of videogames as a whole. As with research into the more negative effects, it may well be the case that some videogames 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 videogame 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 videogame playing.

Videogames do seem to have great positive therapeutic potential in addition to their entertainment value. Many positive applications in education and health care have been developed. There has been considerable success when games are specifically designed to address a specific problem or to teach a certain skill. However, generalizability outside the game-playing situation remains an important consideration.

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