What Do We Know About Social and Psychological Effects of Computer Games?:
A Comprehensive Review of the Current Literature

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A Comprehensive Review of the Current Literature

In contrast to the exponential growth of computer games (including console-based video games, arcade games, on-line games, and stand-alone computer games) as entertainment media, empirical studies on games are somewhat limited. As early as 1982, U.S. Surgeon General C. Everett Koop lamented the lack of scientific evidence on the effects of video games on children (Selnow, 1984). Even now, after more than 20 years since the Surgeon General’s lament, there is still a cry about the lack of scientific and theoretical studies on computer games (Dill & Dill, 1998; Villani, 2001; Vorderer, 2000). One of the main factors contributing to this continuing dissatisfaction is the lack of a comprehensive review on existing game literature. Even though some studies provide meta-analyses of the effects of violent games on aggression (Anderson & Bushman, 2001; Griffiths, 2000; Gunter, 1998; Sherry, 2001), computer game literature in general has never been comprehensively reviewed. In order to advance our understanding of this relatively new form of entertainment medium, a comprehensive review on existing game literature is needed. Two lines of research traditions—effect studies vs. uses and gratifications approach—are the major paradigms adopted in the game research. Since chapter 16 will cover the uses and gratifications approach, in the current chapter, we only provide an
extensive review of almost 30 years of computer game studies on effects. Positive or negative effects of diverse game contents will be reviewed individually.

Research on the social and psychological effects of game playing focuses on three aspects: 1) to test negative consequences (effects) of violent entertainment games; 2) to demonstrate the utility of educational (training) games; 3) to examine general effects of entertainment games and game playing without specifying particular content types. In the 80s and early 90s, most of the research mainly focused on the negative effects of entertainment games. Almost all the studies on negative effects of games have focused on violence (including both explicit and implicit manifestations) embedded in games. Positive effects were mainly associated with educational games. Only recently have scholars begun to realize the potential positive effects of entertainment games. Consequently, studies on game effects can be effectively mapped into a 2 (Consequences [Effects]: negative vs. positive) by 3 (Content Types: violent entertainment vs. non-violent entertainment vs. education [training]) table (see Table 1). In this chapter, we will elaborate on four of the six cells in the table—1) Negative effects of violent entertainment games; 2) Negative effects of non-violent entertainment games; 3) Positive effects of non-violent entertainment games; and 4) Positive effects of educational games.

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Positive effects of violent entertainment games and negative effects of educational games will not be reviewed in this chapter for the following reasons. First, even though the catharsis theory proposes that violent computer games can generate positive outcomes to their users by providing a safe outlet to exercise violence (see Sherry, 2001), little evidence has been found to support this argument (see Bushman, Baumeister, & Stack, 1999; Gunter, 1994). Second, there has been little research on negative effects of educational games. As a result, we cannot find sufficient research on the above two issues. Thus, positive effects of violent entertainment games and negative effects of educational games will not be examined.

Negative Effects of Violent Entertainment Games

In a similar way that research on violence in television has been the main concern for media scholars for the last five decades, negative effects of violent games have been the prime focus of most empirical studies on computer games. Three theoretical perspectives—Social Cognitive Theory (Bandura, 1997, 2001); Excitation Transfer Theory (Tannenbaum & Zillmann, 1975; Zillmann, 1988); and priming effects (Berkowitz, 1984; Berkowitz & Rogers, 1986)—have been applied to explain possible detrimental effects of violent games. Based on the Social Cognitive Theory, scholars hypothesize that symbolic violence explicitly justified (Funk & Buchman, 1996) during game playing is easily internalized by players and can be substantially transferred to the real world, because players tend
to identify themselves with the game characters (Chambers & Ascione, 1987; Graybill, Strawniak, Hunter, & O'Leary, 1987; Schutte, Malouff, Post-Gordon, & Rodasta, 1988; Winkel, Novak, & Hopson, 1987). Another popular explanation for the effects of violent games on aggression is the excitation transfer model by Zillmann (1988). According to this model, residual excitement from a previous game playing may serve to intensify a later emotional state of a game player (Anderson & Ford, 1986; Ballard & West, 1996; Calvert & Tan, 1994; Sherry, Curtis, & Sparks, 2001; Silvern & Williamson, 1987; Winkel et al., 1987). This model, therefore, does not necessarily predict the valence of game player’s emotional state. Rather, it’s about the intensity of game player’s emotional state.

The third theoretical explanation of negative effects of violent games is based on cognitive priming. According to this explanation, playing violent games increases accessibility to a subset of cognitions specifically related to violence and aggression, which later can be transferred to real world aggressive behaviors (Anderson & Dill, 2000; Calvert & Tan, 1994; Chory-Assad & Mastro, 2000; Tamborini, Eastin, Lachlan, Skalski, Fediuk, & Brady, 2001).

By incorporating the three theoretical perspectives explained above into a single theoretical framework, the General Aggression Model (GAM) (Anderson & Dill, 2000; Anderson & Bushman, 2001) tries to explain both short-term effects of violent media on aggressive cognitions, affects, behaviors, and physiological arousal and long-term effects of violent games on aggressive attitudes, schemata,
personality, and aggression desensitization. Violent media increase short-term aggression by teaching users how to aggress, by increasing arousal and aggressive affective states, and by priming aggressive cognitions. Repeated playing of violent games reinforces aggression-related cognitive structures, aggressive perceptual schemata, and aggressive behavioral scripts. Most importantly, repeated playing of violent games increases the aggressive personality of a game player which then leads to the changes in the player’s environment (e.g., new peer groups which are more aggressive). The combination of the newly intensified aggressive personality and the new aggressive environment leads to the use of more violent media, which then increases another short-term aggression. Long-term and chronic aggressive behaviors are thus formulated and reinforced during the above process.

Empirical studies regarding negative effects of violent games on aggressive affects, behaviors, thoughts, physiological arousal, and other social and psychological variables (e.g., empathy, prosocial behaviors, and school performance) reveal mixed results. We summarize them one by one.

*Aggressive Affects*

Violent video games such as *Mortal Kombat* cause more intense feeling of aggression than non-violent video games such as Corner Pocket, a billiard game (Ballard & West, 1996). Violent games also induce higher level of anxiety than non-violent ones, at least temporarily (Anderson & Ford, 1986). In a survey of
college (N = 307) and high school (N=82) students, daily video game uses were found to be highly correlated with general hostility and anger among those students (Chory-Assad & Mastro, 2000). In a survey of 355 students in sixth through eighth grades, Abel-Cooper (2001) found that playing games of any categories (i.e., from most violent to less violent) was a weak predictor of the anger state. Anderson and Ford (1986), however, did not find any significant effects of playing a violent game such as Zaxxon on hostility. In his later study (Anderson & Dill, 2000), he found similar null effects. In an experiment with 210 college students, no significant effect of playing a violent game on hostility was observed, even though a much more graphically violent game (Wolfenstein 3D) was used. Scott (1995) also failed to find a significant relationship between playing violent games and aggressiveness as measured by the Buss-Durkee Hostility Inventory and the Eysenck Personality Questionnaire. As explained before, no significant effect has been found with regard to the impact of violent games on positive affects (Fleming & Rickwood, 2001). Based on the results of mediation analyses, Anderson and his colleague (Anderson & Dill, 2000) suggest that playing violent video games affect violent behaviors through cognitive path, not through affective path. That is, it is aggressive thoughts that cause aggressive behaviors, not aggressive affects.

*Aggressive Behaviors*
Again, the results are mixed. In some experiments, researchers were able to find significant causal relationships between playing violent games and various measures of post-game aggressive behaviors, such as 1) the duration (Anderson & Dill, 2000) and intensity (Cohn, 1996) of a noxious noise blast to opponents, 2) attacking Bobo doll (Schutte et al., 1988), 3) toddlers’ (aged 4-6 years’) aggressive behaviors in a free play setting (Silvern & Williamson, 1987), and 4) time spent for playing an aggressive toy (a spring-release fist that fires darts) (Cooper & Mackie, 1986). However, some researchers found no effect of violent games on other measures of violent behaviors, such as withholding money from another (Winkel et al., 1987), pushing buttons that could punish or reward others (Graybill et al., 1987), and suggesting punishment or reward to friends (Cooper & Mackie, 1986; Kirsh, 1998). Survey results also provide mixed findings, suggesting both significant and non-significant relationships (for a short review, see Goldstein, 2001).

**Aggressive Thoughts**

Unlike results on aggressive affects and behaviors, consistent significant effects of violent games on aggressive thoughts have been reported. As predicted by the cognitive priming hypothesis, playing violent games such as *Wolfenstein 3D* (as opposed to a non-violent game such as *Myst*) increases accessibility to aggressive thoughts, as measured by reaction time speed to aggressive words (Anderson & Dill, 2000). Calvert and Tan (1994) also found that players of a
violent game listed more aggressive thoughts than simple observers of the same violent game. Playing a violent game increased the aggression-attribution bias of the third and fourth grade children, which was measured by the negative interpretation of an ambiguous situation (Kirsh, 1998). With regard to the long term effects of violent games on aggressive cognition, it has been proposed that continuous exposure to violent games makes aggressive thoughts more chronically accessible to players (Bushman, 1998). After continuing exposure to violent games, aggressive thoughts can be fully internalized into players’ minds. These internalized aggressive thoughts are usually measured by Gerbner’s mean world syndrome index (Chory-Assad & Mastro, 2000).

Physiological Arousal

With regard to effects of violent games on physiological arousal, consistently significant effects have been reported with one exception (Winkel et al., 1987). Playing violent games increases heart rate (Ballard & West, 1996; Griffiths & Dancaster, 1995; Fleming & Rickwood, 2001). The increased heart rate, however, was found to be only temporary. It returned to its baseline 15 minutes after play (Griffiths & Dancaster 1995). One study found a gender effect, with boys reporting less arousal change than girls (Fleming & Rickwood, 2001). In addition to heart rate, violent games increase systolic blood pressure more than non-violent games (Ballard & West, 1996). In contrast to the above results,
Winkel et al. (1987) found no significant effect of violent game play on heart rate in an experiment with 56 eighth graders.

Other social and psychological variables

In addition to the negative consequences listed above, other negative effects of violent games on prosocial behaviors, delinquency, self-perception, and school performance have been found. In an experiment with 160 (80 third and fourth graders and 80 seventh and eighth graders) children, Chambers and Ascione (1987) found that playing violent games significantly reduced the amount of donation. In a survey of 278 children (aged 10-14) in the Netherlands, Wiegman and van Schie (1998) found that children, especially boys with a high preference for violent games showed significantly less prosocial behaviors than those with a low preference for violent games. In a survey of 227 college students (Anderson & Dill, 2000), playing violent games predicts delinquent behaviors, such as drinking alcoholic beverages and destroying school properties. In a survey of 364 children in fourth and fifth-grade levels, a significant association between a high preference for violent games and low self-perceptions of behavioral conduct was found for both boys and girls (Funk, Buchman, & Germann, 2000).

Research Syntheses

There have been a series of attempts to synthesize literature on negative effects of violent games. Surprisingly, the results are mixed. Though two quantitative research syntheses based on meta-analysis (Anderson & Bushman,
2001; Sherry, 2001) provide a conclusion that violent games have small but
significant negative effects on various social and psychological outcomes, some
scholars (Griffiths, 2000; Gunter, 1998) hesitate to draw a conclusion based on
critical reviews of existing literature. After conducting a meta-analysis of 35
research reports, Anderson and Bushman (2001) conclude that playing violent
games significantly increases aggressive affects (r = 0.18), behaviors (r = 0.19),
cognition (r = 0.27), and physiological arousal (r = 0.22) and significantly
decreases prosocial behaviors (r = - 0.17). In their analysis, gender, types of
research (survey vs. experiment), and age (children vs. adults) do not moderate
the negative effects of violent games. Based on a meta-analysis of 25 empirical
studies, Sherry (2001) also acknowledges the existence of a small yet significant
effect of violent game play on aggression-related measures (r = 0.15). Some
scholars, however, argue that the state of current game literature does not warrant
any conclusion due to two main methodological limitations: 1) no measurement
of long-term effects (Griffiths, 1999), and 2) few observations of real aggression
rather than simulated or pretended aggression (Gunter, 1998).

Negative Effects of Entertainment Games in General

Aggressive behaviors triggered by violent content are the main concerns
of the studies on the negative effects of entertainment games. Besides violence,
there are also other possible detrimental effects resulted from general game
playing, such as poor academic performance, social isolation, addiction or
computer game dependency, gender stereotyping, vision and other physical health problems. Though school performance and social isolation were thought to be serious negative effects of games in late 1980s and early 1990s, recent studies indicate that playing games has no significant correlation with suboptimal school performance and social isolation. Actually, some surveys even showed that computer game players scored better than non-players in several measurements, including self-concepts of mechanical and computer skills, family closeness, and attachment to school (Durkin & Barber, 2002). Thus, in this part, only addiction or game dependency, gender stereotyping, vision and other physical health problems will be discussed.

Addiction or Game Dependency

It is widely believed that playing computer games will result in addictive behaviors and thus bring a number of detrimental outcomes, such as irrational spending of money and time on playing and decrease in healthy leisure activities. While there is some anecdotal evidence of game addiction, such as the recent tragedy in Korea where an adult gamer died after 36 hours of continuous playing, current literature does not provide a consistent support for the game-addiction hypothesis. A general review of studies on computer game addiction by Tejeiro (2001) reveals that most of them are based on either a general survey with unrepresentative samples, or an experiment usually focusing on a particular type of non-popular games. Therefore, generalizability of these studies is somewhat
limited. Some researchers correctly suggest not using the word “addiction” but rather “dependency,” which applies to a particular category of person for whom playing games is not simply a preoccupation, but also serves special social and psychological functions in their lives (Shotton, 1989). Adopting the concept of “dependency” rather than “addiction,” Griffith and Hunt (1998) conducted a survey with 387 adolescents (aged 2-16 yrs). The analysis indicated that one in five adolescents were currently “dependent” upon computer games. Boys played significantly more regularly than girls and were more likely to be classified as "dependent." The earlier children began playing computer games it appeared the more likely they were to be playing at “dependent” levels.

Gender Stereotyping

The organization “Children Now” surveyed 1716 characters of video games on market. Male human characters totaled 1106 (64%) whereas female human characters numbered only 283 (17%) – the remaining 19% were characters with no explicit gender. On average 17 male characters appear in each game compared to only four female characters. Moreover, among the game characters, female characters are even less likely to be player-controlled characters with which players usually identify themselves. In this study, of the 874 player-controlled characters, 635 (73%) are males, and only 107 (12%) are females (Children Now, 2001). The frequency of the gender of characters is just one indicator of gender stereotyping of computer games. When it comes to the
characteristic of the game characters, it is even more obvious. Female and male characters are portrayed in stereotypical ways. Female characters are often very sexy, with either very thin or very voluptuous bodies. Male characters are usually hyper-masculinized. Female characters are usually victims and male characters are the heroes who usually rescue female characters. The concern is that the portrayals of females in games will not only affect the self-image of young girls but also boys’ expectations of and attitude towards females (Cesarone, 1994). For more discussion about the content of computer game, refer to chapter 4 and chapter 5.

Physical Health Problems

There are some anecdotal reports of children having seizures while playing video games. The issue is whether this is a mere coincidence provoked by fatigue or stress resided in a particular individual, or a systematic phenomenon related to specific colors, movements, and electronic signals of a particular game. In a study of 387 patients who were extremely sensitive to electronic visual simulation, Kasteleijn-Nolst and colleagues (Kasteleijn-Nolst, da Silva, Ricci, Binnie, Rubboli, Tassinari, & Segers, 1999) found that patients became more sensitive when playing games than when simply viewing them. Interestingly, the patients were more sensitive to Super Mario than any other standard games. Other potential negative effects are that game players tend to sit in front of the television or computer for a long time. It is not only harmful to vision; the sedentary habits
also substitute outdoor activities, which will eventually affect game players’ physical health and development.

Positive Effects of Entertainment Games in General

When positive effects of games are discussed, most often it is in the context of educational games. When it comes to entertainment computer games, most often than not, negative effects such as alienation, addiction, and violent behaviors are discussed. However, a growing number of empirical studies have indicated that non-violent entertainment games can also produce positive outcomes. In this section, positive effects of non-violent entertainment games on improving training, spatial skills, cognitive abilities, academic performance, adolescents’ sociability, and therapy will be examined.

Training

Since the purpose of educational games is to facilitate educational outcomes, they should produce learning of intended skills. For instance, educational computer games and simulations have long been used for training in military sectors. However, entertainment games, which are not specifically designed for instruction or training, can also result in some positive training effects. For example, the Marine Corps Modeling and Simulation Management Office modified and used the game Doom to teach combat tactics. Recently, the Marine Corps awarded a contract to MaK Technologies for a high-level architecture (HLA)-compliant PC game for operational training of Marine
commanders and staffs (Coleman, 2001). The recently released game *America’s Army* provides civilians with insights into soldiering, from the barracks to the battlefields, and has been used for Army recruitment. Conservatively speaking, violence is involved in the game, *America’s Army*. However, considering the context of the training project, which is for the army, this kind of violence is probably necessary to simulate the real battlefield.

**Spatial Skills**

Research consistently shows that computer games can facilitate spatial skills. Playing computer games was found to facilitate the development of spatial skills for three-dimensional mental rotation in fifth, seventh, and ninth grade students (McClurg & Chaille, 1987). For two-dimensional mental rotation, a positive effect was also found among seventh and eighth graders (Miller & Kapel, 1985). Though it has long been acknowledged that girls are weaker than boys in spatial skills, computer games can improve spatial skills for girls and boys equally. Subrahmanyam and Greenfield (1996) and De Lisi and Wolford (2002) found that video game practice or computer-based instructional activity could significantly improve spatial skills for both girls and boys. Another experiment with kindergarten children in Israel observed a similar result (Perzov & Kozminskey, 1989). Two studies conducted by Pepin and Dorval (1986) assessed the effects of playing video games on spatial visualization of college students (N=70) and seventh grade students (N=101). The first study with college students produced
significant results indicating that both men and women gained equally from playing the video game. The second study with seventh-grade students, however, did not reveal any significant difference. One possible explanation is that the adult sample had no prior experience with video games whereas the adolescent sample had some previous experience with games, which probably introduce more noise to the study. Another plausible explanation is that age is an important factor determining the effect of computer games for improving spatial skills. Empirical results on mediating or moderating effects of age on gaining spatial skills through computer games are mixed. For example, studies found mild, mixed, or no effects of game playing on spatial skills among elderly participants (Gagnon, 1985; Pepin & Dorval, 1986). It is still not very clear why playing computer games can improve spatial skills. It is plausible that the 3D visualization effect of the video game facilitate spatial perception, mental rotation, and spatial visualization, which are the three most important spatial skills (Linn and Petersen 1985).

Cognitive Abilities

Playing computer games demands that the users acquire certain cognitive skills, such as proactive and recursive thinking, systematic organization of information, interpretation of visual information, general search heuristics, means-ends analysis, and so forth (Pillay, 2003). It is, thus, hypothesized that playing computer games can help children develop cognitive skills. Considerable
empirical evidence supports the claim that cognitive skills obtained in playing computer games can be transferable to other tasks.

Greenfield and her associates found that exposure to computer games—either in the long term through the natural experience of playing games or in the short term via the use of games as part of experimental manipulation—was positively correlated with better cognitive skills in understanding and interpreting scientific and technical information presented graphically on the computer screen (Greenfield, Brannon, & Lohr, 1994; Greenfield, Camaioni, Ercoloni, Weiss, Lauber, & Perrucchini, 1994). It was also found that playing computer games facilitated flexibility in dealing with knowledge structures to overcome functional fixedness (Doolittle, 1995). In this experiment, students who played computer games and solved computer riddles were more likely to generate a wide variety of alternative hypotheses for a problem situation.

Some evidence also suggests that computer games enhance inductive reasoning (Camaioni, Ercolani, Perrucchini, & Greenfield, 1990; Honebein, Carr, & Duffy, 1993), and facilitate the development of complex thinking skills related to problem solving (Keller, 1992), strategic planning (Jenkins, 2002; Keller, 1992) and self-regulated learning (Rieber, 1996; Zimmerman, 1990). Computer games also enable the development of different learning styles, since the speed and the level of difficulty can be adjusted according to the player (Jenkins, 2002).

Academic Performance
One of the most disturbing concerns about entertainment games is that they might interfere with players’ academic performances by offering a more attractive option than doing homework. Research findings with regard to the effects of playing computer games at home on academic performance are mixed. In his testimony before the United States Congress, David Walsh (2000), President of the National Institute on Media and the Family, suggested that a strong preference for violent games is associated with a poor school performance among teens. Yet, for non-violent entertainment games in general, a positive relationship was found between time spent on entertainment computer games and a child's intelligence in a survey of 346 seventh and eighth graders from seven elementary schools (van Schie & Wiegman, 1997). Durkin and Barber (2002) also found that children who played games in moderation had higher GPAs than children who did not play games at all. However, excessive playing of games does deteriorate academic performance. For instance, in a large-scale study of 10 and 11 year-olds, Flemish, Roe and Muijs (1998) found that heavy use of computer games was associated with negative outcomes in terms of academic achievement, self-esteem, and sociability.

**Sociability**

The popular hypothesis is that game play has a negative effect on children in terms of social adjusting because children who play games just stay at home with their console or computer and will have less social interaction with their
peers. However, some recent surveys reveal that the reality is not like what people assume it to be. Three surveys among elementary school children showed that the frequency of video game use had no correlation with children's popularity among classmates (Sakamoto, 1994). In contrast to the above results, a Japanese study found that children who played console games developed higher sociability than children who are non-players (Shimai, Masuda, & Kishimot, 1990). Similarly, heavy video game players were more likely to see their friends outside school and had a need to see their friends on a regular basis than non-players (Colwell, Grady, & Rhaiti, 1995). Frequent players were also found to enjoy just as many friendship and contacts with friends as less frequent players (Philips, Rolls, Rouse, & Griffiths, 1995). The most recent survey conducted by Durkin and Barber (2002) in Australia demonstrated similar results. The survey examined the relationship between game play and several measures of adjustment or risk taking in a sample of 1,304 16-year-old high school students. They classified players into three categories, based on the frequency of playing video games: high-, low-, and non-players. No evidence was obtained of negative outcomes among game players. Actually, high players scored higher on several measurements, including self-concepts of mechanical and computer skills, family closeness, and attachment to school. Low players scored higher on most measurements, such as lower depressed mood, lower aggression, lower disobedience, higher self-esteem, and higher GPAs. Surprisingly, non-players did not score high on any measure. Thus
the authors concluded that computer game play could be a positive feature of a healthy adolescent. One of the reasons that playing video games does not result in isolation but rather improve sociability might be that when adolescents play video games, they do not just play by themselves but with friends and family. They also exchange their gaming experiences with peers, not only face to face but also through the Internet.

**Therapy**

Computer games have the potential for therapeutic treatment for psychological as well as physical problems. Lynch (1981) used video games as a training aid for certain cognitive and perceptual-motor disorder, and various types of mental disorders (e.g. stroke patience). Gardner (1991) concluded that the application of video games in his psychotherapy sessions was more successful than the traditional technique, because video games provided common grounds between himself and his clients, and facilitated excellent behavioral observation opportunities. Computer games can also alleviate feelings of anxiety (Naveteur & Ray, 1990), trigger motivation to exercise and increase metabolic activity during wheelchair use (O'Connor, Fitzgerald, Cooper, Thorman, & Boninger, 2001), divert attention from side effects of cancer chemotherapy and reduce the feeling of pain (Redd, Jacobsen, Dietrill, Dermatis, McEvoy, & Holland, 1987), treat disabled children with speech difficulties (Horn, Jones, & Hamlett, 1991), rehabilitate a child with palsy (Krichevets, Sirotkina, Yevsevicheva, & Zeldin,
rehabilitate cognitive problems (Larose, Gagnon, Ferland, & Pepin, 1989), and retard memory decline among the elderly (Drew & Waters, 1986; Dustman, Emmerson, Steinhaus, & Dustman, 1992; Goldstein et al., 1997) (see Griffiths, 1997, for a general review of using computer games for clinical treatment).

Positive Effects of Educational Games

As early as 1980s, scholars have begun to notice the potential of computer games for education and the learning process. It is believed that children engaged in computer game playing may acquire more general strategies for “learning to learn” in novel environments (Stowbridge, 1983). By playing games, kids growing up in the digital age learn the rules of processing multimedia information, which is fundamentally different from how information in the printing age is presented and processed. They learn how to learn in a nonlinear way using the aid of abundant hypertextual and visual cues. These skills learned during game playing may be applied in instructional settings (Malone, 1981) and help develop other important skills, such as inductive discovery and problem-solving through trial-and-error learning (Greenfield, 1983), and eye-hand coordination and spatial visualization (Pepin & Dorval, 1986). For a long time, the military has been aware of the potential of computer games for simulative training of flying aircrafts (Kennedy, Bitter, & Jones, 1981; Lintern & Kennedy, 1984) as well as cognitive skills, such as rapid information processing and the ability to think about a number of things at the same time (Trachtman, 1981). Though academic research
on the positive effects of educational computer games and simulations has been
done since 1980s, studies on this issue are scarce compared with the studies done
on the negative effects of violent computer games. Existing studies on this issue
have mainly focused on the positive effects of computer games on learning,
motivation, retention memory, and utility for special groups such as attention-
deficit children, the elderly, or patients. The following section will elaborate on
each area. We will start this section with several theoretical approaches that
explain why computer games can generate such positive effects.

Theoretical Models

The theoretical explanation of why computer games can facilitate positive
learning outcomes is still not very clear. Currently we have three theoretical
concepts offering possible explanations—Immersion (or presence); Flow; and
Intrinsic Motivation.

According to Hubbard (1991), the learning process that results from
playing video games is due to the immersion effect. This immersion effect creates
an environment in which the players submerge themselves and progressively
increase their attention and concentration on the goal to obtain. This theoretical
approach could be used to explain the positive effects of games on retention
memory and their utility for special groups. Computer games can engage players
very deeply in the learning environment, which makes the players be very
attentive to the educational materials embedded in the environment. The concept
of immersion is similar to the concept “Presence,” which has been discussed extensively in other domains including Virtual Reality, Computer-Mediated Communication, Human-Computer Interaction. Following Lombard and Ditton (1997) and Lee (2004a), we believe that presence—“psychological state in which virtual objects are experienced as actual objects” or “perceptual illusion of non-mediation”—lies at the heart of virtual experiences mediated or created by communication and/or computer technologies (for a general review, see Lee, 2004a, 2004b). Computer games can create more intense feeling of presence than other media due to the interactive nature of game playing (see Steuer, 1992). As demonstrated by Lee and Nass (2004), the feeling of presence will mediate computer games’ various psychological effects on users.

Similar to Hubbard’s idea of “Immersion” is Csikszentmihalyi (1990)’s concept of Flow (see Klimmt & Vorderer, 2003 for a detailed differentiation between the two concepts). Flow is the state of optimal experience whereby a person is so engaged in an activity that self-consciousness disappears, time becomes distorted, and the person engages in complex, goal-oriented activities not for external reward, but simply for the exhilaration of doing. Using Csikszentmihalyi and Larson’s (1980) discussion of “flow,” Bowman (1982) analyzed Pac-Man players and illustrated the appeal of video games as their ability to place users in “flow states.” When using computer games in the learning environment, students learn in a flow state where they are not just passive
recipient of knowledge but active learners who are in control of the learning activity and are challenged to reach a certain goal. However, the flow state is not necessarily easy to attain. It rests on certain skills of the learner and the condition of the challenge. Since every game has certain rules and requires certain skills of the user in order to perform well, when the learning process is embedded in the game environment, the skills of the learner should match with the challenge of the game so as to gain the optimal enjoyment. If the game is too challenging, the learner will not have the sense of control and cannot gain pleasure while playing the game.

The third concept is intrinsic motivation adopted by Garris, Ahlers, & Driskell (2002) in their Input-Process-Outcome Game Model which tries to elucidate the learning process during the game. The input elements involve the instructional content and the game characteristics. The effective process is what the authors called the “game cycle” in which certain characteristics of games trigger intrinsic motivation of the users and then generate the repeated cycles of user judgment (e.g., enjoyment), behavior (game play), and feedback. The game cycle engages the user in repetitive play and the user continually return to the game activity over time. When the user is engaged in playing games continuously, experiential learning based on intrinsic motivation can occur. The characteristics of computer games that trigger intrinsic motivation are fantasy, rules/goals, sensory stimuli, challenge, mystery, and control. When instructional contents are
successfully paired with appropriate games features, the game cycle results in recurring and self-motivated game play. Malone (1981) also identified three aspects of computer games that trigger intrinsic motivation: challenge, fantasy, and curiosity. The assumption of this model is based on the experiential learning approach of Dewey (1938) and Kolb, Boyatzis, and Mainemelis (2000). According to the experiential learning paradigm, people do learn from active engagement with the environment. Coupled with some instructional support, the active engagement during the game can produce an effective learning environment.

Learning

Research findings with regard to the effectiveness of educational computer games on learning are mixed. Randel, Morris, and Wetzel (1992) conducted a literature review to compare the instructional effectiveness of electronic simulations or games to conventional classroom instruction. This review produced the following results: 56% of the studies found no difference, 32% found differences favoring simulations/games, 7% favored simulations/games but raised questions about their experimental design, and the remaining 5% found differences favoring conventional instruction. Randel et al. (1992) also investigated the effectiveness of using games to deliver knowledge of different subject matters, including social sciences, math, language arts, logic, physics, and biology. Not all subject matters demonstrated beneficial effects of using games.
Math was the subject with the greatest percentage of results favoring games. 33 out of 46 social science games/simulations exhibited no difference from classroom instruction. A more recent empirical study found that computer games and multimedia instruction had reliable and positive effects on achievement in mathematics problem solving, reading comprehension, and word study, yet the same study found no reliable effects on mathematics procedure and reading vocabulary (Blanchard, Stock, & Marshall, 1999). In addition, visual and interactive components in educational business games did not improve the knowledge in the specific domain, though the games were more appreciated (Sedbrook, 1998). Computer games and simulation also produced no significant improvement in basic electricity and electronics training in the military (Parchman, Ellis, Christinaz, & Vogel, 2000). Computer games and simulations are effective compared with the traditional instructional mode. Yet their effectiveness depends on subject/content domains.

Investigations have also found that educational computer games are beneficial in the area of teaching strategic management (Hsu, 1989; Wolfe, 1997), statistical concepts (Lane & Tang, 2000), scientific discovery learning (de Jong & van Joolingen, 1998), language learning (Jordan, 1992; Hubbard, 1991; Kovalik & Kovalik, 2002), skill-based learning (Gopher, Weil, & Bareket, 1994), health education (Dorman, 1997) such as safe sex education (Cahill, 1994; Kashibuchi & Sakamoto, 2000) and juvenile diabetes self-care (Brown, Lieberman, Gemeny,
Fan, Wilson, & Pasta, 1997), and medical education (Boreham, Foster, & Mawer, 1989).

Besides the subject/content factor, characteristics of a particular computer game also matter with regard to instructional effectiveness. Malone (1981) identified three aspects of computer games that triggered intrinsic motivation of users to be the main features of successful instructional games: fantasy, challenge, and curiosity. Fantasies can make the instructional environment more interesting and facilitate focalization of attention. An emotionally appealing fantasy or metaphor that is related to game skills will more easily engage the learner in the learning process. Rieber (1996) amended Malone’s approach by differentiating endogenous and exogenous fantasies. According to Rieber, only endogenous fantasy, which could weave the content into the game, will produce positive learning effects. Just adding fantasy context that has nothing to do with the learning material (exogenous fantasies) does not help. In order for an instructional environment to be challenging, it must provide goals whose attainment is uncertain. The goals should be obvious and personally meaningful to players. Players also need to get feedback on whether they are achieving their goals or not.

Another issue concerning the use of computer games for education is whether non-computer-based games provide the same effectiveness as computer-based games. In other words, the question is whether the effectiveness results from the particular delivery medium—computer—or from the content embedded
in the computer game environment. Wiebe and Martin (1994) investigated the impact of a computer-based adventure game involving geography content on students' recall of geography facts and their attitudes toward studying geography. They found no differences between “non-computer classroom games and activities” and “computer-based adventure games for reinforcing geography facts and student attitudes.” Similarly, Antonietti and Mellone (2003) conducted an experiment to explore a computer based version and a traditional version of Pegopolis, a solitaire game. These two versions of games were the same, except that they were played by moving pieces either on a real board or on a virtual computer-presented board. No significant difference was found between conditions with respect to the performance and strategies followed during the game. Though two studies are not enough to ensure a conclusion, it is plausible to make a tentative proposal that it might be the pure characteristics of game, not the medium of computer, that makes the learning process of computer game based education more effective.

**Motivation**

Different from the mixed findings on effectiveness of educational computer games on learning, it is commonly agreed that educational computer games have positive effects on motivation. Randel et al. (1992) summarize in their literature review that students reported more interest in simulation and game activities than in conventional classroom instruction. A study conducted with
learning-disabled students of sixth through eighth grades (n=25) found that game features produced higher levels of continuing motivation (Malouf, 1987). A similar experiment with intermediate-level students (n=41) with learning disabilities also showed that game format had a facilitative effect on continuing motivation of students with low initial attitudes toward mathematics (Okolo, 1992). Many theoretical explanations of why computer games can enhance learning are usually based on enhanced motivation. Nevertheless, enhanced motivation does not fully guarantee more effective learning. For example, though Parker and Lepper (1992) found that a fantasy game increased both children's motivation and their actual learning, Druckman (1995) found no convincing evidence that enhanced motivation by games increase actual learning. Some other mediating variables are probably needed for a fuller explanation.

**Retention Memory**

Randel et al. (1992) found that educational computer games and simulations produced greater retention over time than conventional classroom instruction in 12 out of 14 studies. In a military training context, participants assigned to the game condition scored significantly higher on a retention test compared to pre-test performance. Furthermore, participants assigned to the game condition scored significantly higher on a retention test than participants assigned to the text condition (Ricci, Salas, & CannonBowers, 1996). In a comparison of learning outcomes between a computer game environment and a multimedia
environment, Moreno and Mayer (2000) found that personalized rather than neutral messages produced better retention performance in the computer game condition and better problem-solving on the both the computer game and the multimedia environments. A possible explanation for why games can improve retention might be that users are more attentive to the media stimuli when playing games than when using other types of media. As psychologists have long established, this intense attention during games will increase retention memory (Nelson, 1995; Norman, 1976). It is also proposed that greater engagement during learning, which is the result of intrinsic motivation triggered by the game features, leads to longer retention of information (Hannafin & Hooper, 1993). However, no scholar has offered a specific mechanism and thus we cannot draw any conclusion now.

Utility for Special Groups

Educational computer games also serve as useful tools for special groups, such as children with learning disabilities and the cognitively impaired elderly. Educational computer games improve motivation for children with learning disabilities (Malouf, 1987; Okolo, 1992). They have also been used to help children with attention-deficit/hyperactivity disorders. For example, Pope and Bogart (1996) developed a video game that becomes more difficult to play, when the brainwaves of a player indicate waning attention of users. The player can succeed at the game only by maintaining an adequate level of attention.
Educational games are also used to help elderly people who are often cognitively impaired. For example, a game called *Memory of Goblins* was used to study its effects on elderly people’s memory ability and life satisfaction. Though no statistically significant result was obtained due to the small sample size, the study suggests some evidence for the positive impact of computer games on the cognitive ability of the elderly population (see Farris, Bates, Resnick, & Stabler, 1994). Another experiment with 22 non-institutionalized elderly people (aged 69 to 90) investigated the effects of video game playing (Super Tetris) on reaction time, cognitive/perceptual adaptability, and emotional well-being. The videogame playing group had faster reaction times and felt a more positive sense of well-being compared to their non-playing counterparts (Goldstein et al., 1997).

**Conclusion and Suggestions for Future Research**

Based on our extensive review of the current literature, we find that the media effect paradigm still dominates the academic research on computer games. As a result, there has been a paucity of research on the nature of game playing as an entertainment experience. This is a perplexing situation, because studies on consequences of something can be significantly enhanced by the understanding of its intrinsic nature. In fact, studies on social consequences of game play would have been more systematically done, if they were based on theoretical understanding of the nature of game experience. We believe that if we want to
have a fuller understanding of this new form of media entertainment, we need to know what users actually experience while they are playing games.

In addition, the existing game literature usually focuses on the effects of media contents (predominantly violent or educational contents) and neglects the impacts of media forms. According to Reeves and Nass (1996), media forms such as size, fidelity, cuts, synchrony, and movements are equally important factors for determining psychological impacts of media. In fact, early studies on television effects during 1970s have confirmed that formal features (e.g., loud noises, unusual camera effects, fast action) of television are at least partly responsible for television’s effects on children’s aggressive behaviors (Lowery & DeFleur, 1995, p. 360). More importantly, media forms and contents interact with each other. For example, violence depicted on small screen with poor audio fidelity might have less impact on aggressive thought (Anderson & Dill, 2000) and cardiovascular activities (Ballard & West, 1996) than the same violence depicted on large screen with high fidelity audio. In fact, most researchers are increasingly concerned about the potential harmful effects of the newer generation of violent games due to the increasing realism in games made possible by new form factors such as high fidelity video and audio, life-like display size, and seamless interactivity (see Anderson & Dill, 2000; Ballard & West, 1996; Calvert & Tan, 1994; Dill & Dill, 1998; Provenzo, 1991). Therefore, studies on the main effects of computer games’ form factors (e.g., cut, motion, 3D, fidelity, audio, and so on) and possible
interaction effects between the form factors and the content types (e.g., violence, sex, humor, sports, and so on) are needed in order to get a fuller understanding of game effects.
References


Griffiths, M. D. (2000). Video game violence and aggression: Comments on “Video game playing and its relations with aggressive and prosocial behavior” by O.


Table 1

Effects of Computer Game Playing

<table>
<thead>
<tr>
<th>Consequences (Effects)</th>
<th>Negative effects</th>
<th>Positive effects</th>
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<tbody>
<tr>
<td>Affect (hostility, anxiety)</td>
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<td>Catharsis</td>
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<td>Aggressive behaviors</td>
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<td>Arousal</td>
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<td>Violence</td>
<td>Empathy toward others</td>
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<td>entertainment games</td>
<td>Physiological responses (hear rate, blood pressure, hormone)</td>
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<td></td>
<td>Priming of aggressive thoughts</td>
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<td>Pro-social behavior</td>
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<td>Non-violent</td>
<td>Addiction or game dependency</td>
<td>Training</td>
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<td>entertainment games</td>
<td>Gender stereotyping</td>
<td>Sociability</td>
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<td>Educational games</td>
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<td>Utility for special groups</td>
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<td>(attention-deficit children, patients)</td>
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