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Violent Video Games as Exemplary Teachers: A Conceptual Analysis

Douglas A. Gentile

Institute of Science and Society

Iowa State University

National Institute on Media and the Family

J. Ronald Gentile

University at Buffalo

State University of New York

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Author Note: Douglas A. Gentile is Assistant Professor of Psychology and Research Fellow at the Institute of Science and Society, Iowa State University; he is also director of research for the National Institute on Media and the Family. J. Ronald Gentile is SUNY Distinguished Teaching Professor Emeritus of Educational Psychology, University at Buffalo, State University of New York. The authors wish to thank Julia Maier and two anonymous reviewers for their helpful comments. An early version of this manuscript was presented at the Biennial Meeting of the Society for Research in Child Development, Atlanta, GA.

Correspondence concerning this manuscript should be addressed to Douglas A. Gentile, Iowa State University, Department of Psychology, W112 Lagomarcino Hall, Ames, IA 50011-3180. Phone: 515-294-1472; Fax: 515-294-6424; E-mail: dgentile@iastate.edu

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Abstract

This article presents conceptual and empirical analyses of several of the “best practices” of learning and instruction, and demonstrates how violent video games use them effectively to motivate learners to persevere in acquiring and mastering a number of skills, to navigate through complex problems and changing environments, and to experiment with different identities until success is achieved. These educational principles allow for the generation of several testable hypotheses, two of which are tested with samples of 430 elementary school children (mean age 10 years), 607 young adolescents (mean age 14 years), and 1,441 older adolescents (mean age 19 years). Participants were surveyed about their video game habits and their aggressive cognitions and behaviors. The first hypothesis is based on the principle that curricula that teach the same underlying concepts across contexts should have the highest transfer. Therefore, students who play multiple violent video games should be more likely to learn aggressive cognitions and behaviors than those who play fewer. The second hypothesis is based on the principle that long-term learning is improved if practice is distributed more across time. Therefore, students who play violent video games more frequently across time should be more likely to learn aggressive cognitions and behaviors than those who play the same types of games for equivalent amounts of time but less frequently. Both hypotheses were supported. We conclude by describing what educators can learn from the successful instructional and curriculum design features of video games.

Violent Video Games as Exemplary Teachers: A Conceptual Analysis

“The great thing, then, in all education, is to *make our nervous system our ally instead of our enemy ... we must make automatic and habitual, as early as possible, as many useful actions as we can*, and guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague.”

William James (*The Principles of Psychology*, p 122)

Educators have been discussing the multiple effects of computers in the classroom and the potential of game-based instruction for decades (e.g., Lepper, 1985; Lepper & Chabay, 1985; Lepper & Gurtner, 1989; Parker & Lepper, 1992). Often the discussion centers around the intentional use of educational software (e.g., Murphy, Penuel, Means, Korbak, & Whaley, 2001), but has broadened to include other learning from video games, including from violent games. There is increasing scientific evidence demonstrating that violent video games are linked to increases in aggressive cognitions, feelings, and behaviors (e.g., Anderson & Bushman, 2001; Anderson, 2004; Anderson, Gentile, & Buckley, 2007; Gentile & Stone, 2005). However, there is still much resistance to the evidence among the public and by the video game industry (e.g., Entertainment Software Association, 2007). However, if (as we will argue) violent video games use techniques that we know are effective pedagogy, then it is disingenuous to continue to claim that violent video games have no effects. The goal of this article is to demonstrate two issues: first, how violent video games use many of the best-practice principles of learning and instruction, and second, what we might learn from the successes of the video game curricula that might transfer to our official scholastic curricula. We intend this to be primarily a conceptual article, but we have included some data to demonstrate the utility of these concepts for hypothesis generation and testing.

Playing the Game

Among elementary and middle school populations, girls play video games for an average of about 5.5 hours/week and boys average 13 hours/week (Anderson et al., 2007; Gentile, Lynch, Linder, & Walsh, 2004). In

a nationally representative sample, parents reported that their young children aged two to seven play an average of 43 minutes/day (Gentile & Walsh, 2002), and Woodard and Gridina (2000) reported that preschoolers aged two to five play an average of 28 minutes/day. Comparing these data with previous studies shows that the amount of time spent playing video games is increasing, but not at the expense of television viewing which has remained stable (Gentile & Anderson, 2003). Although most children play video games, the average age of video game players has steadily risen to age 33, demonstrating that many children continue playing into adulthood (Entertainment Software Association, 2007).

Data about children's amount of time spent playing video games are content-independent and, like the data on television watching, are correlated with many other risk factors for health such as obesity (Berkey et al., 2000; Subrahmanyam et al., 2000; Vandewater, Shim, & Caplovitz, 2004) as well for poorer academic performance (e.g., Anderson & Dill, 2000; Anderson et al., 2007; Gentile et al., 2004; Harris & Williams, 1985). When video game play is analyzed for violent content, additional risk factors are observed for aggressive behavior and desensitization to violence (again in parallel with the data on viewing violent television; e.g., Anderson & Dill, 2000; Anderson et al., 2003; Anderson et al., 2007; Bartholow, Bushman, & Sestir, 2006; Carnagey, Anderson, & Bushman, 2007; Gentile, 2003; Gentile et al., 2004).

As the entertainment industries regularly point out, viewer discretion and parental monitoring are advised. Most parents do not know that as many as 89% of video games include violent content (Children Now, 2001), with about half including violence against others culminating in serious injury or death (Children Now, 2001; Dietz, 1998; Dill, Gentile, Richter, & Dill, 2005). Furthermore, because the average age of gamers has risen, many parents have likely become desensitized to violent content and may be less likely to monitor children's games. This progression almost seems inevitable. By inventing educational and entertaining games for preschoolers and then slowly but surely including more and more need for "viewer discretion," the industry trains people to be accepting – emotionally, cognitively, and behaviorally – of violent video games. Most consumers are not conscious of the learning principles underlying this progression, but the developers and marketers probably are, if only by realizing that they need to keep creating games that outdo previous games in order to capture a larger share of the market.

Seven Exemplary Dimensions of Video Games

Our goal here is to enumerate the ways video games systematically and effectively use educational principles of learning, cognition, and instruction. The research is becoming increasingly clear that violent video games can cause people to have more aggressive thoughts, feelings, and behaviors (for recent meta-analyses of the literature, see Anderson & Bushman, 2001; Anderson, 2004), yet this set of findings is still considered “controversial.” Video games themselves are becoming increasingly sophisticated (e.g., Poole, 2000; Provenzo, 1991) to the point that the violence simulated in such games as *Doom II* have been adopted by the military to train marine combat units (Provenzo, 2003), who obviously believe in the educational benefits that will result. Video games are excellent teachers along several dimensions (see also Gee, 2003, for his list of 36 learning principles exemplified by video games).

First, the games have clear objectives, often set at multiple difficulty levels (1) to adapt to the prior knowledge and skills of each learner and (2) the pace of each learner (faster or slower, novice or expert). Inventing ways of matching objectives and pace to the capabilities of learners is no small accomplishment, since it is central to most if not all models of instruction, from Glaser’s (1962) and Hunter’s (1982) specification of objectives at the correct level of difficulty to Carroll’s (1963; 1989) concept of aptitude as the time needed to learn to an established standard of mastery. Moreover, there is empirical evidence that for many memory tasks the average learning rate of the top third of any class is at least three times faster than the bottom third, with the fastest and slowest learners in the same class differing by even larger multiples (e.g., Gentile & Lalley, 2003; Gentile, Voelkl, Mt. Pleasant, & Monaco, 1995).

The second dimension along which video games excel is that they require learning to be active with practice, feedback, and more practice to the point of mastery (e.g., Gee, 2003). This is in contrast to much classroom learning in which teachers lecture on or demonstrate a concept or skill, then take questions, if any, and move on to cover other material. However, as is well known in the development of skills such as sports or music, learners will likely develop good questions only after attempting to *do* what was demonstrated. Feedback and corrections operate only then, which in classrooms often happens only much later (e.g., on a unit test) and thus is too late to be of much help. Practice to the point of mastery – that is, to a higher rather than

lower standard of accuracy – is predictive of how much is remembered later, as well as how much savings will occur in relearning at a later date (Bahrick, 1984; Ebbinghaus, 1885; Gentile & Lalley, 2003; Semb & Ellis, 1994; Willingham, 2004).

Third, once mastered, the knowledge and skills are practiced further to provide *overlearning*. With overlearning the knowledge and skills become automatized and consolidated in memory, so that the learner can begin to focus consciously on comprehending or applying new information. In other words, the novice is beginning to process and organize new information with more expertise (Chase & Simon, 1973; Chi, Glaser, & Rees, 1982). Bloom (1986) illustrated this process for reading ability. The budding reader can recognize whole words easily only after knowledge of letters and sounds is automatized. Once the reader has achieved a number of “sight words,” then the reader can focus on the meaning of the sentences (Bloom, 1986).

Fourth, mastery of an objective is reinforced both extrinsically (with points, totals, better weapons, more money, more health, etc.) and intrinsically (by advancement to higher levels of complexity and the self-esteem that accompanies increased competence). This last point is perhaps underappreciated by educators who have been told to praise often so as to increase children’s self-esteem. Video games teach self-efficacy through increasing mastery. Teachers often offer praise instead of encouraging self-discovery and mastery. A wide range of developmental theorists agree that perceived self-efficacy arises from competence or efficacy (Bandura, 1977), and lack of competence leads to learned helplessness (Seligman, 1975). Mastering the essential tasks of school is critical for solving the identity crisis of that age (“I am what I can do”), while the lack of mastery leads to feelings of inferiority (Erikson, 1963; 1968; 1980). Vygotsky (1962) also speaks of the “rupture,” “turning point,” or “struggle” that is involved in maturation and which is resolved by mastering society’s developmental tasks. Piaget’s central motivational construct is “cognitive conflict,” which arises when there is a discrepancy between a child’s perception of an event and disconfirming evidence (e.g., in the conservation of liquids tasks; Piaget & Inhelder, 1941). This cognitive conflict establishes a tension (between assimilation and accommodation in the equilibrium mechanism), which produces the ultimate teachable moment. That is, the child recognizes what he or she does not understand and is now ready to learn it. Accomplishing this difficult task earns self-esteem, self-efficacy, and indeed a new identity (when, for example, a non-reader is now a

reader). Gee takes these traditional theories a step further in suggesting that video games require and reinforce a player's commitment of "time, effort and active engagement" in such a way that they can experiment with identities and eventually "...see themselves as the *kind of person* who can learn, use, and value..." what is being learned (2003, p. 59). Wouldn't we wish, he continues, to have our students trying on a scientist identity in our science classes?

Fifth, and related to the fourth, video games are well-sequenced in levels of increasing difficulty, complexity or pace, with success at subsequent levels contingent upon competencies mastered at previous levels. Consider the example of the popular first-person-shooter game¹ *Halo*. For the first hour of play, the game not only sets up the story (you are a warrior, in a science fiction future, saving humans from attacking aliens), but also teaches you how to play. The game characters and spaceship computer teach you systematically which control buttons to use to look around, to walk, to crouch, to jump, to pick up weapons, to reload, etc. This is necessary partly because of the complexity of the game controller (13 buttons, joysticks, pads, and triggers), but after teaching a specific skill, the game immediately gives you a chance to practice it. Then the game provides immediate feedback, including adapting to your specific skill using the controller. For example, the first author had difficulty with the joystick in looking up and down – it was more "natural" to pull back to look up and push forward to look down (as one would in an airplane). This was contrary to the default settings on the game. The game noticed this, inverted the joystick controls to fit the author's predilection, and asked if this was better. Over the course of the first hour of play, a series of skills are taught systematically, with feedback and opportunities for practice, until one has learned several skills necessary for successful game play (such as how to use the information shown on the display, when to reload, and how to sneak up behind one's prey for silent kills).

This fifth dimension is the embodiment of the *spiral curriculum* (Bruner, 1960), in which each learning objective has identifiable prerequisites which, when mastered, facilitate transfer to the next level of difficulty.

¹ A "first-person-shooter" game is one in which the action is seen from the point of view of the main character. Usually one sees as if one were "in" the game, so when you hold a gun in front of you, you see the barrel of the weapon and sometimes the hand holding it. The "shooter" part of the definition should be self-evident. This type of game can be distinguished from other violent games in which the action is seen from a distance (a third-person perspective). First-person-shooters have become so popular, they are now known by that title as a distinct genre of game.

Thus, learners come to see mastery of an objective not as the completion of a learning objective, or “benchmark” in current educational lingo, but rather mastery is properly conceived as the beginning (Gentile & Lalley, 2003). You are now ready to use that knowledge or skill in some meaningful way on the road toward expertise. Video games do not achieve exemplary spiral curricula by “making the games shorter and simpler to facilitate learning” as schools often do (Gee, 2003, p. 6). Rather, they make the games longer, more complex, and harder, requiring (as noted above) more investment of time, effort, activity, and reflection. If at first you do not succeed, alter your identity, and try, try again.

Sixth, because video games are adaptable in level of difficulty and pace, they encourage a close-to-optimal combination of massed and distributed practice. Initial attempts at the game, no matter how abysmal, receive feedback or a score immediately and few can resist trying again and again until they begin to show progress. Such massed practice eventually begins to produce diminishing returns (when a plateau is reached or fatigue sets in); however, the repetition has begun to develop both physical and mental skills and habits on parts of the task (e.g., eye-hand coordination, knowledge of what is required, etc.), always in the context of the whole sequence. Each subsequent encounter with the game provides the memory benefits of distributed practice – relearning anything that was forgotten, providing new cues for memory, interpreting new information or examples with what is already in memory and reorganizing the memory accordingly. This combination of massed practice to build sufficient initial mastery to play the game, followed by distributed practice over days or weeks to prevent forgetting is optimal for the development of automatized structures of knowledge, or schemas (e.g., Ellis & Hunt, 1993; J. R. Anderson, 1983; Glaser, 1984).

Seventh, knowledge or skills learned and practiced in multiple ways on several problems, or in a variety of contexts, are more likely to transfer than when practiced in only one way on a single kind of problem, or in the same context. One reason for this is suggested by Bransford, Brown, and Cocking (1999): “with multiple contexts, students are more likely to abstract the relevant features of concepts and develop a more flexible representation of knowledge” (p. 66). Multiple contexts also provide a variety of cues for recall rather than memory having to rely on availability of cues from the original context or problem situation – what Tulving and

Thompson (1973) called the encoding specificity principle and Brown, Collins, & Duguid (1989) called situated cognition.

Multiple ways of solving problems or performing skills also avoid the mental sets or rigidities that naturally arise from success with a particular method (e.g., Luchins, 1942). Learning multiple ways of representing division of fractions is more likely to lead to greater comprehension than the same amount of time spent simply practicing the “invert and multiply” algorithm. Returning to video games, this is likely to be one of the reasons violent video games have shown effects on aggressive thoughts, feelings, and behaviors (e.g., Anderson, 2004). Violent video games are set in many contexts: some are set in historical times, some are modern, some are very realistic, some are cartoonish, some are futuristic, etc. The games also employ a variety of tools: hand-to-hand combat, small arms, military weapons, laser guns, and one popular game even uses a golf club as a lethal weapon. The common feature among all of these different games and contexts is that violence is the solution to whatever problem the gamer/student faces. This is exactly the best way to teach so that the student will be able to transfer the underlying concept to new situations.

In addition to the above well-known principles of educational instruction, video game producers also use time-honored “tricks” that have been well-known by the media and advertisers. For example, Kubey & Csikszentmihalyi (2002) describe how the “orienting response,” first described by Ivan Pavlov, has been used to increase attention to television ads. Visual or auditory changes, such as edits that change the angle of camera view or sound effects, make us look at them. Increasing the frequency of edits has been shown to improve recognition memory (up to a point...there is an optimal level). Furthermore, provocative scenes of sex and violence not only capture one’s attention, but also supply vivid visual images, which are known to create better memory than the same information provided verbally (e.g., Paivio & Begg, 1981). Active participation in aggressive or provocative scenes in video games increases physiological arousal (e.g., Ballard & Weist, 1996; Gwinup, Haw, & Elias, 1983; Lynch, 1999; Murphy, Alpert, & Walker, 1992; Segal & Dietz, 1991). This physiological responding in the context of “playing fun games” is likely to condition one’s emotions to such activities, not unlike other addictive “highs.” Indeed, there is some research demonstrating that the brain releases dopamine in response to playing violent video games (Koepp et al., 1998). Dopaminergic

neurotransmission may also be involved in learning, reinforcement of behavior, attention, and sensorimotor integration as well (Smith, McEvoy, & Gevins, 1999). Because the difficulty of the games, which varies as one progresses, guarantees that reinforcement will be intermittent, not continuous, games take full advantage of the addictive nature of intermittent reinforcement (e.g., slot machines).

Finally, these games are marketed widely as cool, and something everyone must have. One of the roles mass media play in youth and adolescence is as a way of defining oneself (Christenson & Roberts, 1999). For example, adolescents often define their cliques by musical style (e.g., Goths, hip-hop, metalheads, punks, etc.; Christenson & Roberts). Visit any school playground, and much of the discussion and play will be about media characters, movies, TV shows, and video games. Partly because video games are so popular and motivating (Bryant & Vorderer, 2006), skill in such games is an important social currency for popularity among children (especially among boys).

Hypotheses

Note that each of the educational aspects described above provides testable hypotheses about how to create effective educational software. Although these learning principles are well-established in the classroom, few of these hypotheses have yet to be tested with regard to video games or other media. Nevertheless, there is a large and growing body of evidence showing that the more exposure consumers have to media, the more likely they are to learn from those media – including areas as diverse as product recognition, specific knowledge, skill development, attitude formation and change, stereotypes, brand purchasing and loyalty, and aggressive beliefs and behaviors. Some of these lessons are intentional, such as educational software or television programs designed to teach reading skills, and some are unintentional, such as violent games or television programs training aggressive behavior.

Two of the testable hypotheses from the educational principles described above were addressed here. First, the seventh principle above states that curricula that teach the same underlying concepts across contexts and domains have the best likelihood of transfer. Therefore, students who play multiple violent video games are more likely to learn aggressive cognitions and behaviors than students who generally play fewer violent video games. Second, the sixth principle above states that learning is more likely to be long-term if practice is

distributed across time, in contrast to massed practice (our students know this as “cramming”). Therefore, students who play violent video games more regularly are more likely to learn aggressive cognitions and behaviors than students who play less regularly even if they play for equal amounts of time.

Methods

Participants

Three sets of data were collected, one with elementary school children in grades 3 to 5, one with young adolescents in grades 8 and 9, and one with late adolescents enrolled in a large Midwestern university. For the elementary school sample, 430 3rd ($N = 119$), 4th ($N = 119$), and 5th grade ($N = 192$) students participated in the study. Students were recruited from five Minnesota schools, including one suburban private school ($N = 138$), three suburban public schools ($N = 265$), and one rural public school ($N = 27$). The sample was almost evenly divided between boys and girls, with 51% of the children being male. Participants ranged in age from 7 to 11 years of age ($M = 9.65$; $SD = 1.03$). Eighty-six percent of the respondents classified their ethnic background as Caucasian, which is representative of the region (other ethnicities included 2% African American, 2% Latino/Hispanic, 1% Native American, 4% Asian, 2% Multi-Racial, 2% other). All participants provided parental consent and assent.

For the young adolescent sample, 607 8th-grade ($N = 496$) and 9th-grade ($N = 111$) students participated in the study. Students were recruited from four Minnesota schools, including one urban private school ($N = 61$), two suburban public schools ($N = 350$), and one rural public school ($N = 196$). Students were recruited from mandatory classes within their schools. The mean age of respondents was 14 years ($SD = 0.64$). Fifty-two percent of respondents were male. Eighty-seven percent of the respondents classified themselves as Caucasian (other ethnicities included 1% African American, 2% Latino/Hispanic, 1% Native American, 3% Asian, 5% Multi-Racial, 1% other). All participants provided parental consent and assent.

For the late adolescent college sample, 1,441 students participated in the study. Students voluntarily participated in mass testing sessions, and earned extra credit points for their introductory psychology classes. The mean age of respondents was 19.4 years ($SD = 1.73$). Forty-five percent of respondents were male. Eighty-nine percent of the respondents classified themselves as Caucasian, which is representative of the region and

university populations (other ethnicities included 3% African American/Black, 2% Latino/Hispanic, 0% Native American, 4% Asian, 1% Multi-Racial, 1% other). All participants provided informed consent. All samples were treated in accordance with the “Ethical Principles of Psychologists and Code of Conduct” (APA, 1992).

Elementary Longitudinal Sample Procedure

Participants completed three confidential surveys, and teachers completed one survey for each participating child (described below). Each participant (including teachers) completed each of these surveys at two points in time during the school year. The first administration (Time 1) occurred between November and February of the academic year. The second administration (Time 2) occurred between April and May of the year. The average time lag between the two administrations was five months. Consent levels were at least 70% for all classrooms, each of which was a mandatory class to reduce the likelihood of selection bias. Additional details of the procedure and instruments are available in Anderson et al. (2007). It is worth noting that all of the data gathered here were guided by the theoretical framework of the General Aggression Model (see Anderson & Carnagey, 2003; Anderson & Huesmann, 2003 for details).

Assessment of Social Adjustment

Peer Assessment of Social Adjustment. A peer nomination instrument was used to assess children’s social adjustment, and was adapted from a peer nomination instrument that has been used in several previous studies of children’s social behavior (e.g. Crick, 1995; Crick & Grotpeter, 1995). Only the physical aggression scale (2 items) is reported here. Children were asked to nominate three children who hit or kick others or who push and shove others around. Coefficient alpha was computed and was found to be satisfactory ($\alpha = .92$).

Teacher Ratings of Aggressive Behavior. Teachers completed a survey assessing children’s aggression and prosocial behavior (Gentile et al., 2004). For the purposes of this study, only the physical aggression subscale was used. This subscale asks teachers to rate on a five-point scale whether the target child hits or kicks peers, initiates or gets into physical fights, threatens to hit or beat up peers, and pushes or shoves peers (anchored “never true” and “almost always true”). Coefficient alpha was satisfactory ($\alpha = .92$).

Self-Report of Fights. One item asked children whether they had been involved in a physical fight in the school year.

Assessment of Media Habits

Violent video game exposure. Similar to Anderson and Dill's (2000) approach, participants were asked to name their three favorite video or computer games. For each named video game, participants were asked to rate how frequently they played on a 5-point scale (1 = "Almost never," 5 = "Almost every day"). Participants were also asked to rate how violent they consider each media product to be on a 4-point scale (1 = "Not at all violent," 4 = "Very violent").

Weekly amount of video game play. Participants reported the amount of time they spent playing video games during different time periods (from when they wake up until lunch, lunch until dinner, and dinner until bedtime), separately for weekdays and weekends. Weekly amounts were calculated from these responses.

Assessment of hostile attribution bias/social information processing.

The final survey was an adapted version of a hostile attribution survey that has been reliably used in past research (e.g., Crick, 1995; Nelson & Crick, 1999). This instrument comprises 10 stories, each describing an instance of provocation in which the intent of the provocateur is ambiguous. Participants answer two questions following each story. The first presents four possible reasons for the peer's behavior, two of which indicate hostile intent and two reflect benign intent. The second question asks whether the provocateur(s) intended to be mean or not. This survey assesses the participant's perception of hostility from the outside world. Based on procedures delineated by Fitzgerald and Asher (1987), the children's responses to the attribution assessments were summed across the stories. Coefficient alpha was satisfactory ($\alpha = .85$).

Composite measures. A composite measure of physical aggression was created because we had multiple informants. Peer ratings of physical aggression, teacher ratings of physical aggression, and self-reports of physical fights were standardized and averaged to create a physical aggression composite. Coefficient alpha was computed and found to be satisfactory at both points in time (Time 1 $\alpha = .87$, Time 2 $\alpha = .89$).

Young Adolescent Sample Procedure

Each participant completed an anonymous survey packet. Consent levels were greater than 90% for all classrooms, each of which was a mandatory class. Additional details of the procedure and instruments are available in Gentile et al. (2004).

Variables

Violent video game exposure. Similar to the approach described for elementary school students, participants were asked to name their three favorite video games. For each named game, participants were asked to rate how frequently they played the game on a 7-point Likert scale (1=“rarely”, 7=“often”). Participants were also asked to rate how violent each game is on a 7-point Likert scale (1=“little or no violence”, 7=“extremely violent”).

Participants were also asked to indicate how much violence they prefer to have in their video games on a 10-point scale (1=“no violence”, 10=“extreme violence”), and how much violence they prefer to have in their video games compared to 2–3 years ago on a 5-point scale (1=“a lot less”, 5=“a lot more”).

Amount of video game play. Participants were asked the amount of time they spent playing games during different time periods (6am-noon, noon-6, 6-midnight, midnight-6), separately for weekdays and weekends. Weekly amount of game playing was calculated from these responses.

Trait hostility. Hostility was measured using the Cook & Medley Hostility Scale (Cook & Medley, 1954), a commonly used reliable instrument. Because the items for the Cook & Medley are taken from the MMPI, some were inappropriate for young adolescents. The instrument was modified by deleting seven items and changing the wording of some items to make them easier for 8th graders to understand. These modifications were based on those made by Matthews and colleagues (e.g., Woodall & Matthews, 1993). Coefficient alpha was satisfactory ($\alpha = .84$).

Physical fights. Participants were asked if they had been in a physical fight in the last year. This question yielded a dichotomous response (yes/no).

Late Adolescent Sample Procedure

Each participant completed an anonymous survey that gathered descriptive data about students' video game habits, demographic data, self-reported aggressive behaviors, and the Buss-Perry measure of aggression.

Variables

Violent video game exposure. Identical to the approach described for young adolescents.

Amount of video game play. Participants were asked the amount of time they spent playing games during different time periods separately for weekdays and weekends. Weekly amount of game playing was calculated from these responses.

Trait anger, trait hostility, and overall physical aggression. Students completed the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992), a commonly used reliable instrument. Agreement with statements such as, “I get into fights a little more than the average person,” “I have trouble controlling my temper,” and “I wonder why I sometimes feel so bitter about things,” indicate higher physical aggression anger and hostility, respectively. Three subscales are reported here: the trait anger, trait hostility, and overall physical aggression subscales (reliability coefficients, $\alpha = .80, .84, \& .84$, respectively).

Proactive and reactive physical aggression. Students completed the Social Interaction Survey (Linder, Crick, & Collins, 2002), which measures self-reported use of physical aggression on a 7-point Likert scale (verbally-anchored “not at all true” to “very true”). It measures both proactive use of aggression (e.g., “I have threatened to physically harm other people in order to control them,” $\alpha = .68$) and reactive aggression (e.g., “When someone has angered or provoked me in some way, I have reacted by hitting that person,” $\alpha = .80$).

Results

Because multiple datasets are discussed here, the results are organized by hypothesis.

Hypothesis 1: Playing multiple violent video games will transfer better to aggressive cognitions and behaviors than playing fewer.

In all samples, participants reported their three favorite video games, how often they play each, and how violent each is. Under the logic of Hypothesis 1, if students play multiple violent games (which have different contexts, but share the underlying lesson that violence is an optimal solution to challenges), then those students should show more aggressive cognitions and behaviors, regardless of how much they play. The sample was

restricted to only those participants who named three games. Because participants rated each game on the amount of violent content, the three violence ratings were averaged; thus, participants who play three violent games would have higher means than participants who play non-violent games or a mix of violent and non-violent games. Table 1 shows the raw correlations between the average violence scores and several measures of aggressive cognitions, personality, and behavior. The pattern of correlations show that students who play several violent games are more likely than students who play no violent games or a mix of violent and non-violent games (1) to have a hostile attribution bias, (2) to have a hostile personality, and (3) to be physically aggressive.

Because of multicollinearity among hostility, sex, video game violence exposure, and aggressive behavior, simple correlations are not the best statistics to test this hypothesis. In order to provide a stricter test, logistic regressions were conducted on physical fights in which several variables were controlled. Because boys tend to be more likely both to consume violent media and to be more aggressive (e.g., Anderson et al., 2007), it is important to control for sex. Furthermore, because minorities in America tend to consume greater amounts of electronic media (Gentile & Walsh, 2002; Roberts, Foehr, Rideout, & Brody, 1999), it is important to control for minority status. The small number of minorities in these samples made it impossible to keep race coded by each discrete group, and therefore race was recoded to be dichotomous (white/minority).² Finally, age was statistically controlled because older children may be allowed to have access to different media.

For the 8th/9th graders, logistic regressions were conducted in which sex, race, age, hostile attribution bias, and total weekly amount of time playing video games were statistically controlled. Even controlling for each of those variables, the amount of rated violence in the games explained a significant amount of variance in physical fights ($B = .229$, $Wald = 7.7$, $df = 1$, $p = .006$). This is important because it separates the *content* of the games played from the *amount* of games played. Similar results were found with college students. Controlling

² Because coding minority status in a dichotomous manner is not ideal, the analyses were run without controlling for race. The overall pattern of results does not change if one does not control for race, and sometimes becomes stronger.

for sex, race, and total amount of time playing games, the amount of violence in the games played explained a significant amount of variance in overall physical aggression ($\beta = .094$, $t = 2.5$, $p = .012$).

For the 3rd – 5th graders, regressions were conducted predicting Time 2 variables from Time 1 variables, demonstrating changes across time. Controlling for sex, race, age, lag, weekly amount of video game play, and Time 1 hostile attribution bias, Time 1 amount of violence in the three top games played explains a significant amount of variance in Time 2 hostile attribution bias ($\beta = .156$, $p = .003$). Similar results are obtained looking at changes in overall aggressive behavior (self-reported, peer-nominated, and teacher-nominated). Figure 1 displays a path analysis testing a model of causality (the model also includes race, age, and school lag as exogenous variables). It is hypothesized that children who play multiple violent video games are more likely to learn the underlying concepts of aggression as normative, and will therefore begin to see the world more in aggressive terms (hostile attribution bias), which will then result in more aggressive behaviors. As can be seen in Figure 1, both prior aggression and playing multiple violent games at Time 1 predict hostile attribution bias (here shown as a mean of Time 1 and Time 2), which in turn predicts aggressive behavior at Time 2. In addition to this mediated pathway, both prior aggression and playing multiple violent games *directly* influence Time 2 aggressive behavior (and being a boy marginally increases the risk for Time 2 aggressive behavior). These results are particularly significant. They show that students who played several violent video games *changed* to become more aggressive across a school year.

Hypothesis 2: More regular and distributed practice with violent video games will increase learning of aggressive cognitions and behaviors.

In the 8th/9th grade and the college samples, participants reported how often they play video games on a scale ranging from “less than once a month” to “almost every day.” Participants also reported for how many years they had been playing video games. A distributed practice variable was created by multiplying the frequency of play by the number of years of play. Under the logic of Hypothesis 2, if students play violent games (but not non-violent games) repeatedly over long periods of time, then those students should show more aggressive cognitions and behaviors. Again, the sample was restricted to only those participants who named three games, and the sample was split at the violence exposure scale midpoint (forming a low violence gaming

group and a high violence gaming group). It was expected that students who played games more regularly for more years would have more aggressive cognitions and behaviors, but only for the high violence gaming group. That is, among gamers who play equal amounts of violent games, those who split their play into more regular and frequent intervals during would be more likely to become more aggressive than those who play similarly violent games but who distribute their play less.

For the young adolescent sample, multiple regressions were conducted on hostile attribution bias, trait hostility, arguments with teachers, and physical fights. Distributed practice significantly predicted hostile attribution bias for the high violence gaming group, but not for the low violence gaming group, even controlling for sex, grade, and race (see Table 2). Distributed practice also significantly predicted arguments with teachers for both the high and low violence gaming groups, after controlling for sex, grade, and race. There were trends toward distributed practice predicting trait hostility and physical fights for the high violence gaming group, but they were non-significant.

For the college sample, multiple regressions were conducted on self-reported proactive and reactive physical aggression, and the anger, hostility, and physical aggression subscales of the Buss-Perry Hostility Inventory. Distributed practice significantly predicted trait anger, proactive physical aggression, reactive physical aggression, and general physical aggression for the high violence gaming group, but not for the low violence gaming group, even controlling for sex and race (see Table 3). There was a trend toward distributed practice predicting trait hostility ($\beta = .14, p = .12$) for the high violence gaming group, but it was non-significant.

Discussion

When considered in the light of what is known to be the “best practices” of education, violent video games appear to be exemplary teachers of aggression. Our hypotheses were supported. Playing multiple violent video games, even after controlling for total amount of time playing all video games, appears to lead to better transfer of aggressive cognitions and behaviors than playing a mix of violent and non-violent games (or obviously playing only non-violent games). Because we had longitudinal data, we were able to show that students who play multiple violent games actually changed to have a greater hostile attribution bias, which also

increased their aggressive behaviors over prior levels (Figure 1). Playing multiple violent games also increased aggressive behaviors directly, in addition to the mediated pathway through hostile attribution bias.

The second hypothesis, that distributed practice over time playing violent video games will lead to greater aggressive cognitions and behaviors was largely supported. Controlling for the amount of violence in video games played by 8th/9th graders, playing more frequently during a given week over multiple years was correlated with greater hostile attribution bias and arguments with teachers. This held true after controlling for sex, race, and grade. There were trends in the hypothesized direction for hostile personality and physical fights, but these were non-significant. Among the college sample, after controlling for sex, race, and the amount of violence in video games played, distributed practice significantly predicted trait anger, proactive physical aggression, reactive physical aggression, and general physical aggression (Table 3). There was also a non-significant trend toward distributed practice predicting trait hostility.

It is likely that there is a great deal of measurement error when attempting to retroactively measure distributed practice. Furthermore, the analyses conducted here also assume that the current levels of violent video game exposure has also remained constant over time, which is likely to be an incorrect assumption. However, both of these measurement problems would serve to make it unlikely to find any significant effects, but significant effects were found for both aggressive cognition variables and antisocial/aggressive behavior variables. In addition, all gamers actually distributed their practice, just that some distributed more. Again, this should only serve to lessen the ability to find effects.

It is important to remember that the data presented here are correlational, and we cannot conclude that playing violent video games *caused* the changes in aggressive cognition and behavior. However, because we also have longitudinal data, it is clear that our data are not solely showing that aggressive kids play violent video games. Even controlling for prior aggressive cognition and behavior, playing multiple violent video games adds a significant amount of power for predicting which children will become *more* aggressive (e.g., Figure 1). Violent video games appear to be excellent teachers of aggression.

This study adds to the literature primarily by bridging disciplines. Educational psychologists have decades of research documenting what makes for excellent instruction, but this knowledge has rarely been cited

by social, developmental, and experimental psychologists who study media effects on children. We hope that this cross-disciplinary conceptual approach provides a richer understanding of the psychological mechanisms underlying the effects of video games, as well as generating several testable hypotheses for researchers. This study contributes a replication of well-known findings on the educational power of distributed practice and overlearning, but with a focus on children's and adolescents' experience with video games rather than in a classroom setting. In addition, it is hoped that this conceptual approach provides a richer understanding for educators, as it suggests that one *can* hook children and adolescents into learning by using good instructional methods.

Implications for Teaching

The schools begin with several disadvantages in comparison with the media. For example, it is difficult to imagine a lesson on multiplication of fractions being so vivid or arousing to create widespread excitement about math or to be a means to widespread popularity. If math induces conditioned emotions, they are more likely to be anxiety or learned helplessness than euphoria (Dweck & Licht, 1980; Gentile & Monaco, 1986). Moreover, it is socially acceptable to admit or feign incompetence in math (“I was never good with math” or “I hate math”), while their opposites (“I love math”) have little currency for popularity. In contrast, saying “I love this song” or “I am good at this video game” is likely to increase one's popularity, while admitting dislike for pop songs or incompetence at video games may carry a social penalty (e.g., Christenson & Roberts, 1999).

Schools are charged with teaching and modeling such prosocial values as sharing, tolerance, modesty, and peaceful conflict resolution. These goals compete with the popular media, and especially video games, in which such values as competition, aggression, acquisitiveness, lust, gender bias, pride, and winning at all costs through whatever means are often vividly portrayed and celebrated (e.g., Gee, 2003; Poole, 2000). Furthermore, schools do not have the capital to invent or purchase state of the art technology to make their lessons in history, science, math, or English as sexy and vivid as the lessons being taught (explicitly or implicitly) in video games.

Given that the schools cannot – and should not – adopt all of the titillating tactics of the popular media, what can educators learn from the successful *instructional* practices of violent video games? Some answers, based on the above discussion, are: (1) Teach fewer concepts, but require that students master and then

overlearn them; (2) connect those concepts (via a spiral curriculum) to past and future learnings via continual review and practice, as well as reminders of the connections; (3) reinforce (extrinsically with grades and intrinsically with perceived self-efficacy) increasing levels of competence or automaticity, depth of understanding, and analytic or creative applications of these concepts; (4) invent more ways for students to experiment with identities relevant to their studies; and (5) use technology where appropriate to provide practice toward automaticity in a game-like atmosphere. This is not to imply that teachers should become automatic robots, responding to each action of each student immediately as a computer can. In fact, much of the burden for the instructional practices we endorse here should be taken up by curriculum designers and textbook producers. Effective teachers and curriculum developers already implement many of these ideas much of the time, but in general these ideas are not widely practiced. We conclude by expanding and clarifying these points.

Most teachers feel that they have too little time to cover too much material. The movement toward higher standards, ironically, only exacerbates the problem by list after list of mostly unrelated objectives. Mastery of an objective – that is, achieving a benchmark – means you are done with that objective when it should instead be considered the beginning (Gentile & Lalley, 2003). Initial learnings, after all, will be forgotten even when a high standard of 80% to 100% correct is required if for no other reason than interference from previous and subsequent learning objectives (Hulse, Egeth, & Deese, 1980). Lower passing standards assure even less recall. Therefore, what is necessary is an instructional plan to require that knowledge and skills initially mastered will be overlearned to the point of automaticity, optimally in a variety of new applications and while adding new skills or knowledge incrementally (Gentile & Lalley, 2003; Willingham, 2004). There are many successful ways to do this, of course, but “covering the curriculum” to survey all of the concepts, historical periods, or formulas in a standard curriculum is not one of them.

As implied above, students must be encouraged – indeed, required – to find connections between previous and current concepts. This must be explicit because teaching for understanding and transfer requires that such connections be made (via a spiral curriculum or scaffolding; e.g., Bruner, 1960 or Glaser, 1984, respectively). It is also necessary because our current practices do not engender trust. Consider that when students ask us “Why do we have to learn this stuff?” we usually answer “Because you’ll need it for something

coming later,” but when later comes, we often say, “Well, forget what you learned before; we don’t do it that way here.” Gentile and Lalley (2003) give the example of addition and subtraction of fractions, which is often illustrated using pies and cakes. When it comes to multiplication and division of fractions, and students ask how dividing Joe’s three-quarters of a pie by Mary’s fifth of a pie leads to more pie, most teachers give a “Well, forget about pies” answer. The teachers say this because they don’t know how to use pies to demonstrate the solution, but notice the message about trust that the students are receiving. Of course, our favorite example is teachers themselves, who upon taking their first job hear from their new colleagues, “Forget all that stuff they taught you in that ivory tower – we do it differently here in the real world of schools.”

Although the current zeitgeist disparages behaviorists and extrinsic motivation, schools are almost all about extrinsic reinforcement and punishment. Consider the gushy praise that many elementary students receive for mediocre work or for finally paying attention (after much inattention), or the points that are docked for work that is correct but a day late. What the students learn is that they can get by with little effort and that schedules are more important than competence. These are violations of learning principles (e.g., reinforcement contingencies) that the designers of video games do not make. As noted earlier, self-esteem or self-efficacy is something that students must earn by increasing competence on a task that is perceived by them as important and that is beyond their previous level of competence. Sustained effort on fewer, more difficult and complex tasks is preferable to quick, isolated and easy assignments if we want students to develop persistence and frustration tolerance, and to understand that success is contingent upon focused effort. Rewarding (through points or grades) for such achievements, then, helps the learner reflect and self-monitor and does not undermine intrinsic motivation (e.g., Gee, 2003; Schön, 1987). Rather, the extrinsic reinforcement (points) is used in service of intrinsic motivation (competence and perceived self-efficacy). Recently a computer game designed to classically condition positive feedback has been shown to increase implicit self-esteem and lower aggression (Baccus, Baldwin, & Packer, 2004). In the current literature, there are philosophical differences between behavioral and traditional learning approaches on the one hand, and situated cognition approaches on the other. Yet, it is likely that the conceptual issues described here (and most of the existing empirical evidence) can be

incorporated into either position, as the arguments above describe general principles that hopefully apply beyond specific theoretical approaches.

For all of the talk about technology in schools, we have not begun to tap its potential broadly and systematically. We have increasingly smarter technology that “thinks” along with the student, adapting instruction to each student’s current skills, strategies, or mistakes. We now have software sophisticated enough to provide knowledge and skill building: requiring learning to a high level, distributed practice with feedback, overlearning to automaticity, reflection and practicing inquiry skills. Most importantly, we could use the kind of identity experimentation technology described above to allow our students to be a virtual Marie Curie or Christopher Columbus for a few days, instead of just learning about their discoveries. As an unintended consequence, this also could return drama and excitement (and perhaps associated arts such as music and design) to the classroom. Some educational programming of this sort has been achieved, but is not widely used; neither are schools integrating the arts with the core curricula to achieve these same goals without computer technology. Conceptually, the issues seem similar, so we do not need to wait for more advances to begin to use the insights technology has afforded us.

Conclusion

We have attempted to argue that video games use at least seven of the pedagogical techniques that educational psychologists know make for excellent learning. It should therefore be no surprise that video games are excellent teachers, both of educational content (e.g., Murphy et al., 2001) and of violent content (e.g., Anderson et al., 2007). We tested two of the educational principles with cross-sectional samples of younger and older adolescents, and a longitudinal sample of elementary school children, and found support for both. We hope that the conceptual framework we have provided will encourage additional research on the other principles. The fact that learning occurs regardless of whether the effects are intentional or unintentional is irrelevant, and should make us more thoughtful about designing games and choosing games for children and adolescents to play.

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Table 1

Correlations between violence of favorite games and aggressive cognitions, personality, and behavior

	3 rd – 5 th Graders	8 th – 9 th Graders	College Students
	Average Violence	Average Violence	Average Violence
	<u>of Games at Time 1</u>	<u>of Games</u>	<u>of Games</u>
Hostile Attribution Bias	.13*	.11*	...
Trait Hostility	...	.17***	.12**
Arguments with Teachers	...	.14*	...
Physical Fights (Time 1)	.21***	.28***	...
Physical Fights (Time 2)	.29***	...	...
Time 1 Peer-Nominated Physical Aggression	.27***	...	...
Time 2 Peer-Nominated Physical Aggression	.33***	...	...
Time 1 Teacher-Nominated Physical Aggression	.29***	...	...
Time 2 Teacher-Nominated Physical Aggression	.36***	...	...
Time 1 Overall Physical Aggression Index	.33***	...	...
Time 2 Overall Physical Aggression Index	.41***	...	...
Buss-Perry Trait Anger	...	...	.10**
Buss-Perry Overall Physical Aggression	...	...	.26***
Proactive Physical Aggression	...	...	.16***
Reactive Physical Aggression	...	...	.24***

Note 1: * $p < .05$, ** $p < .01$, *** $p < .001$,

Note 2: ... = Not measured in this population

Table 2: Regression Coefficients Predicting Hostile Attribution Bias and Arguments with Teachers (8th/9th Grade)

Violence Group	Variable	Beta	t	Significance
Low Violence Gaming Group: Predicting Hostile Attribution Bias				
	Sex	-.041	-.586	.559
	Grade	.059	.884	.378
	Race	-.012	-.182	.855
	Distributed Practice	.016	.227	.821
High Violence Gaming Group: Predicting Hostile Attribution Bias				
	Sex	.025	.376	.708
	Grade	-.031	-.459	.647
	Race	.032	.479	.632
	Distributed Practice	.176	2.566	.011
Low Violence Gaming Group: Predicting Arguments with Teachers				
	Sex	-.124	-1.527	.129
	Grade	.075	.983	.327
	Race	-.038	-.502	.617
	Distributed Practice	.237	2.928	.004
High Violence Gaming Group: Predicting Arguments with Teachers				
	Sex	.014	.198	.843
	Grade	.178	2.489	.014
	Race	.175	2.451	.015
	Distributed Practice	.239	3.299	.001

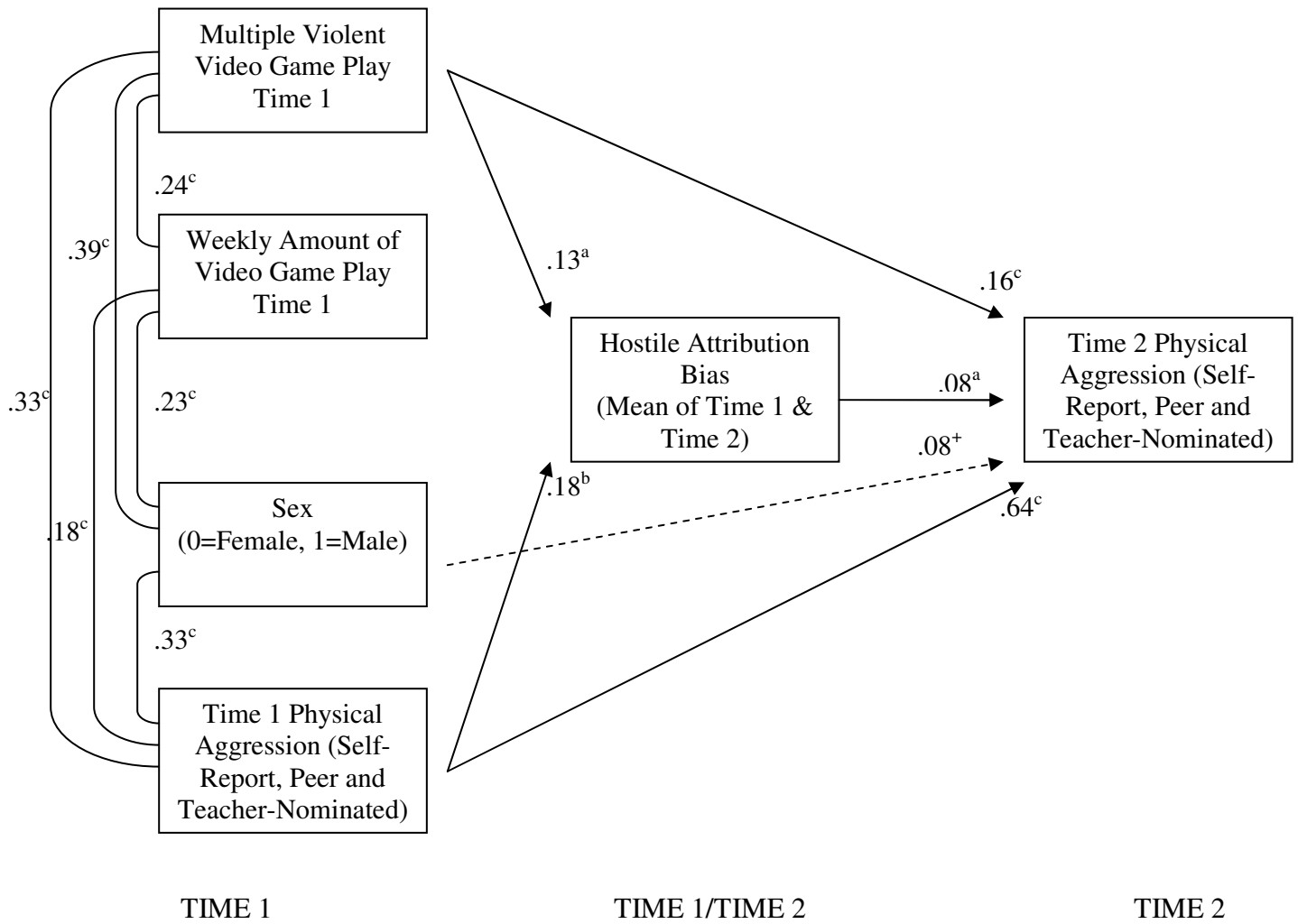
Table 3: Regression Coefficients Predicting Anger and Physical Aggression (College Students)

Violence Group	Variable	Beta	t	Significance
<i>Low Violence Gaming Group: Predicting Trait Anger</i>				
	Sex	.069	1.511	.132
	Race	-.104	-1.905	.057
	Distributed Practice	.098	1.794	.073
<i>High Violence Gaming Group: Predicting Trait Anger</i>				
	Sex	.069	.865	.389
	Race	-.016	-.190	.850
	Distributed Practice	.255	2.985	.003
<i>Low Violence Gaming Group: Predicting Proactive Physical Aggression</i>				
	Sex	.074	1.638	.102
	Race	-.226	-4.149	.000
	Distributed Practice	.023	.426	.670
<i>High Violence Gaming Group: Predicting Proactive Physical Aggression</i>				
	Sex	-.015	-.183	.855
	Race	-.010	-.119	.906
	Distributed Practice	.269	3.160	.002
<i>Low Violence Gaming Group: Predicting Reactive Physical Aggression</i>				
	Sex	.102	2.283	.023
	Race	-.264	-4.954	.000
	Distributed Practice	.074	1.392	.165

<i>High Violence Gaming Group: Predicting Reactive Physical Aggression</i>				
	Sex	.034	.424	.672
	Race	-.130	-1.535	.127
	Distributed Practice	.225	2.650	.009
<i>Low Violence Gaming Group: Predicting Overall Physical Aggression</i>				
	Sex	.139	3.335	.001
	Race	-.372	-7.483	.000
	Distributed Practice	.081	1.636	.103
<i>High Violence Gaming Group: Predicting Overall Physical Aggression</i>				
	Sex	-.022	-.274	.784
	Race	-.162	-1.905	.059
	Distributed Practice	.184	2.163	.032

Figure Captions

Figure 1. Longitudinal Path Model Demonstrating Mediated and Direct Effects of Multiple Violent Game that Playing Multiple Violent Games Leads to Greater Physically Aggressive Behavior, Controlling for Prior Aggressive Behavior, Sex, Race, Age, and Total Amount of Game Play (3rd – 5th Graders)



⁺ $p < .10$, ^a $p < .05$, ^b $p < .01$, ^c $p < .001$

Note: Race, age, and amount of school lag are included as exogenous control variables.