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Not so doomed: computer game play and positive adolescent development

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Abstract

It has been speculated that computer game play by young people has negative correlates or consequences, although little evidence has emerged to support these fears. An alternative possibility is that game play may be associated with positive features of development, as the games reflect and contribute to participation in a challenging and stimulating voluntary leisure environment. This study examined the relationship between game play and several measures of adjustment or risk taking in a sample of 16-year-old high school students. No evidence was obtained of negative outcomes among game players. On several measures—including family closeness, activity involvement, positive school engagement, positive mental health, substance use, self-concept, friendship network, and disobedience to parents—game players scored more favorably than did peers who never played computer games. It is concluded that computer games can be a positive feature of a healthy adolescence.

Keywords: Computer game; Adolescent; Development

1. Introduction

Computer games have become well established as a popular form of electronic entertainment among contemporary children and adolescents (Funk, 1993; Greenfield, 1994; Kubey & Larson, 1990; Phillips, Rolls, Rouse, & Griffiths, 1995; Roberts, Foehr, Rideout, & Brodie, 1999). As has traditionally been the case with the advent of any new mass medium, the

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games' popularity among young people has been the focus of considerable lay and professional concern. Game playing can divert time from other activities, including schoolwork and sports, games often appear 'mindless' and repetitive to nonplaying adults, there is the possibility that preoccupation with activities in computer screens could impede social interaction, and many games involve themes of violence.

Although the amount of empirical research addressing these issues is not as extensive as work on children and television, there is a growing body of evidence on young people's uses of computer games. In summarizing this literature, it should be noted that, unless otherwise specified, the term 'computer games' will be used here generically to include games played on computers (PCs, laptops) as well as games played on purpose-designed games equipment, such as video game consoles, video arcade equipment, and hand-held machines. There are variations in the experiences and activities that particular formats afford, and also in their availability (for example, children from lower income households tend to have less access to computers than do peers from better-off households, but greater access to video games; Roberts et al., 1999). However, relatively little research exists to document the consequences or psychological correlates of playing different formats, and many researchers do not distinguish between them. In the specific data analyses to be reported here, 'computer games' will be used more literally to denote games played on computers.

The available evidence helps to allay some concerns about the effects of computer games but provides inconsistent or minimal evidence in respect of others. In relation to time use, for example, several studies reveal that computer games—although certainly popular—account for only a relatively small proportion of most children's leisure activities, much lower than television viewing (Cupitt & Stockbridge, 1996; Funk, 1993; Kubey & Larson, 1990; Roberts et al., 1999). Short-scale longitudinal studies indicate that a typical pattern of usage is that players invest a burst of initial enthusiasm in the activity, and the amount of time spent on it gradually reduces thereafter (Creasey & Myers, 1986; Mitchell, 1985). Even among the age and gender group fondest of electronic games (8- to 18-year-old boys), only 21% report playing more than an hour per day (Roberts et al., 1999). Only very small ($<1.0\%$) proportions of children are rated by teachers or self as game dependent or 'addicted' (Shotton, 1989).

Analyses of the cognitive and perceptual–motor aspects of the activity indicate that, rather than being an intellectually lazy pursuit, computer game play requires high levels of skill and players elect to meet increasing challenges (Greenfield, 1984, 1994; Turkle, 1984). Contrary to images of game play as the pursuit of isolated computer nerds, several studies have reported that a high proportion of time spent with the games is spent with peers or family members (Cupitt & Stockbridge, 1996; Kubey & Larson, 1990; Phillips et al., 1995). Phillips et al. found that frequent game players met friends out of school hours more often than did less frequent players. The fact that children often have greater computer and computer game expertise than their parents can also prompt a role reversal in terms of help giving within the family (Subrahmanyam, Greenfield, Kraut, & Gross, 2001), though little empirical evidence is available to date of the broader consequences, if any, for social development. Children certainly do spend time alone playing computer games, but this often reflects the fact that they are the sole player in the household and that playing in a bedroom avoids conflict over

the use of leisure space and equipment (Roberts et al., 1999); given the opportunity, most children indicate that they would prefer to play with peers (Cupitt & Stockbridge, 1996). In short, computer game play is not necessarily a monolithic, moronic, or antisocial imposition on children's lives.

Nonetheless, many computer games do contain violent images. Analyses of domestic and arcade games indicate that around 70–85% involve some type of violence (Braun & Giroux, 1989; Dietz, 1998; Funk, Flores, Buchman, & Germann, 1999). Variability among these estimates probably reflects sampling techniques, time of study, and coding criteria, and it is important to note that the frequency of content types is not a perfect guide to the proportion of young people's play that is devoted to this kind of game. Even so, the overall conclusion that simulated violence is a prominent feature of many games is indisputable. Not surprisingly, this has led to lay speculation and scientific investigation into possible effects on young players.

The available evidence is controversial (see reviews by Anderson & Bushman, 2001; Durkin, 1995; Emes, 1997; Griffiths, 1999; Gunter, 1998; Wiegman & van Schie, 1998). A number of experimental studies have been reported, mostly designed to test predictions derived from social learning theory, that exposure to violent games should lead to greater postgame aggressiveness (e.g., Cooper & Mackie, 1986; Fleming & Rickwood, 2001; Graybill, Kirsch, & Esselman, 1985; Graybill, Strawniak, Hunter, & O'Leary, 1987; Silvern & Williamson, 1987). Typically, these studies have compared experimental participants (children or adolescents) who were exposed to aggressive games with controls who played no games or nonviolent games; the extent to which these provide evidence of effects of game type on subsequent aggressiveness is open to dispute. Most of the studies above found no effects on measures of aggressiveness. Indeed, some experimenters (Graybill et al., 1985, 1987; Silvern & Williamson, 1987) obtained evidence of modest reductions in aggression in experimental participants. Other experimental studies have reported higher levels of aggression against inanimate objects (such as a 'Bobo' doll) among young children who had played violent games compared to peers who played nonviolent games (Irwin & Gross, 1995; Schutte, Malouf, Post-Gorden, & Rodasta, 1988). Some experimental studies have also reported indicators of greater aggressiveness among adult participants playing violent computer games (Anderson & Dill, 2000; Study 2) or virtual reality games (Calvert & Tan, 1994). However, Anderson and Dill (2000) have pointed out that most of these studies are vulnerable to the objection that aggressiveness and arousal were confounded (see also Fleming & Rickwood, 2001). Other critics have noted other design limitations, such as the absence of no play control groups, and the fact that in several cases multiple dependent measures yielded only weak effects (Durkin, 1995).

Researchers have also employed survey and correlational techniques to measure the relation between game playing and aggressiveness in more naturalistic settings. Correlational evidence is always open to a variety of interpretations, but it would certainly be important to obtain information on any association between game play and aggressiveness. Again, few of the available studies have found strong relationships (Dominick, 1984; Fling et al., 1992; Lin & Lepper, 1987; van Schie & Wiegman, 1997; Wiegman & van Schie, 1998). For example, van Schie and Wiegman (1997), in one of the largest studies, involving a sample of 346

schoolchildren in The Netherlands, found no correlation between amount of play and aggressiveness. They did find a slight negative relation between amount of play and a measure of prosocial behavior ($r = -.12$). Similarly, in their 1998 study of 278 children, Wiegman and van Schie obtained no differences on measures of aggression between groups of nonplayers, moderate players, and heavy players, but did find a slight difference with respect to prosocial behavior (heavy players scoring lower than the other groups). Where positive correlations between play and aggressiveness have been obtained, they are low and they tend to concern play in arcades rather than at home (Dominick, 1984; Lin & Lepper, 1987). At the very least, the confound with location makes it inappropriate to attribute causality to the games alone. It may be that other factors associated with arcades (lack of adult supervision, exposure to delinquent peers, inner city settings) are influential. It may be that young people with higher levels of aggressiveness (and related antisocial or 'at risk' characteristics) are more likely to frequent out-of-home environments such as video game arcades.

One recent correlational study did find evidence of associations among time spent playing violent computer games, self-reported aggressive behavior, and aggressive personality (Anderson & Dill, 2000; Study 1). In this study, the zero-order correlation between playing violent games and aggressive delinquent behavior was .46, and that between time spent playing any type of game and aggressive delinquency was .20. Although aggressive personality was also related to both aggressive delinquent behavior and to time spent playing violent games, on the basis of a series of regression analyses Anderson and Dill argue that violent video game play accounts for a major portion of aggressive behavior.

Anderson and Dill's (2000) study was concerned with young adult participants (college students, with a mean age of 18.5 years) rather than children or high school students. The investigators reasoned that participants of college age would be old enough for the long-term effects of playing violent video games to have had measurable effects (p. 776). Hence, we cannot readily assume that the relationships obtained by Anderson and Dill would necessarily hold for younger participants. As noted, van Schie and Wiegman (1997) and Wiegman and van Schie (1998), with larger samples of younger participants did, in fact, fail to obtain evidence of associations between computer game play and aggressiveness. Anderson and Dill are careful also to stress that correlational findings alone cannot provide a strong test of any causal hypothesis, and they emphasize the need for further research with younger participants.

In short, despite much debate about the consequences of playing games with aggressive content, the evidence available to date to support claims of harmful effects upon children is modest. Several studies report weak or no effects of violent content, and some of these are vulnerable to criticisms that they confound aggressive content with arousal or have other design limitations. Correlational studies have led to mixed outcomes, with some evidence to suggest relationships among 18-year-olds but not among younger adolescents.

The relation between game play and other aspects of adjustment has also been subject to more speculation than research (see Greenfield, 1984, for a review of early concerns). Again, where research is available, it tends to be somewhat inconsistent with respect to social adjustment and educational performance. Egli and Meyers (1984) interviewed 151 adoles-

cents in video game arcades in California. The participants reported that they perceived very little interference with family life due to video game play, indicated that they participated regularly in sports, and disagreed quite strongly with the proposition that computer games promoted the use of drugs. van Schie and Wiegman (1997) examined the relations between amount of play and social isolation, loneliness, popularity, general school performance, language skills and arithmetic skills; they found none. Roberts et al. (1999) found that participants who scored lower on a measure of 'contentedness' (combining items measuring friendship networks, relations with parents, affect, attitudes to school, getting into trouble) devoted more time per day to video game play but did not differ from medium and high contentedness groups in amount of time spent on computers; the authors point out that even the lower contentedness participants were not *dis*contented and in fact were broadly positive about their lives. In a study that compared academic records of players and nonplayers (aged 9 to 16 years), Creasey and Myers (1986) found no differences. In contrast, Anderson and Dill (2000), in their study of university students, did find that video game play in general, though not violent video play alone, correlated negatively with academic performance (grade point average [GPA]). The inconsistent and sometimes unexpected findings that are available should make us wary of attributing negative associations or consequences to computer game play. Nevertheless, it has been stressed that the amount of relevant research is limited. There is still less research addressed to an alternative possible account, namely, that computer game play could have positive correlates.

The basis for such a proposition is twofold. First, there is experimental evidence of cognitive and/or perceptual skill gains through computer game play (Greenfield, Brannon, & Lohr, 1994; Greenfield et al., 1994; Greenfield, deWistanley, Kilpatrick, & Kaye, 1994; Subrahmanyam & Greenfield, 1994). This does not confirm that all computer game play is invariably beneficial in all respects for all players (Greenfield, 1994), but it does indicate that positive outcomes are possible in at least some domains. Importantly, cognitive and spatial skills, involvement in technologies increasingly pivotal to contemporary educational and occupational demands, interaction with the products of artificial intelligence and positive self-concepts of computer-related skills are all facilitated through computer game play (Cassell & Jenkins, 1998; Greenfield, 1994). It has also been speculated that young people's exposure to the imagery and task demands of computer games may help explain the increases in recent decades on some tests of nonverbal intelligence (Greenfield, 1998; Subrahmanyam et al., 2001; Subrahmanyam, Kraut, Greenfield, & Gross, 2000).

Second, there is extensive evidence that participation in leisure activities has personal and social benefits (Ajzen, 1991; Larson, 2000; Tinseley & Eldredge, 1995). Leisure engagement can promote personal wellbeing (Kleiber, Larson, & Csikszentmihalyi, 1986), social cohesion in peer and family relations (Fine, Mortimer, & Roberts, 1990; Orthner & Mancini, 1992), self-identity affirmation (Eccles & Barber, 1999; Fine et al., 1990; Haggard & Williams, 1992), motivation and goal setting (Ajzen, 1991; Kleiber et al., 1986; Munson & Savickas, 1998), cognitive stimulation and creativity (Tinsley & Eldredge, 1995), anticipatory socialization, educational and career development (Barber, Eccles, & Stone, 2001; Fine et al., 1990; Hong, Milgram, & Whiston, 1993; Munson & Savickas, 1998). Pervasive features of adolescent leisure are that it is usually enjoyed and that the participants elect to do it (Fine

et al., 1990)—in fact, another favorable correlate of leisure is that young people report more positive mood during the times they are engaged in it (Larson & Richards, 1998).

Again, not all of these benefits are associated with all leisure pursuits and for all individuals, and leisure choices are themselves likely to reflect individual differences in needs and interests (Tinsley & Elderedge, 1995). However, accumulating evidence supports the conclusion that activities which are motivating, structured, and challenging do contribute to positive youth development (Larson, 2000). Larson notes that among adolescents' common activities, some—in particular, school-based activities and homework—can provide structure and challenge, but often fail to nurture intrinsic motivation because they are 'other-directed' (i.e., under the control of adults). Other activities, such as television watching and listening to music, may be self-selected and gratifying but do not invariably demand high levels of concentration or provide serious challenge. In contrast, Larson proposes that voluntary, structured youth activities—such as sports and hobbies—may provide contexts that combine intrinsic motivation with high levels of concentration and challenge. Consistent with this view, research shows that involvement in extracurricular activities of this type is associated with positive academic trajectories (Eccles & Barber, 1999).

Can computer game play furnish sufficient levels of motivation, concentration, and challenge to serve a positive function in young people's lives? In one view, this is unlikely. If the games are banal commercial distractions, exposing children to repetitive, typically trivial and often destructive activity, then their use should be associated with less favorable developmental circumstances including poorer school attainment, maladjustment (e.g., depressed mood), risky behavior (e.g., alcohol consumption, drug use, truancy), greater aggressiveness, and poorer social relations. As discussed above, exactly these fears have been aired by many critics of computer game play. However, as also discussed above, young players themselves usually perceive the games quite differently. Clearly, they find computer games enjoyable, but they also claim that principal attractions include gaining greater skill and attaining higher performance (Durkin & Aisbett, 1999). In other words, computer game play is reported, by participants, to meet at least some of the criteria proposed by Larson as supportive of positive youth development. Hence, in this view, computer game play should be associated with more favorable developmental circumstances, including better academic performance, better personal adjustment and self-concept, less risky behavior, lower levels of aggressiveness, and better social relations. The present study was conducted to test these competing accounts. Drawing on data from a large-scale survey of adolescents in Grade 10, we investigate here the relationships between computer game usage and several measures of adjustment and risk behaviors.

2. Method

2.1. Sample

The data used in this study come from Wave 5 of the Michigan Study of Adolescent Life Transitions (MSALT), an ongoing longitudinal investigation designed to examine partic-

ipants' normative and nonnormative life transitions from early adolescence through adulthood. Participants were recruited from 10 predominantly white middle- and lower-middle-class school districts in Southeastern Michigan through letters sent home in their sixth grade math classes in 1983 (see Eccles et al., 1989, for full sample details). MSALT began in 1983 when the respondents were in sixth grade in 10 school districts in southeastern Michigan. Wave 5 data were collected from 1304 participants in 1988 when the respondents were in 10th grade and approximately 16 years old.

2.2. Procedure

Surveys were administered at the schools; students were excused from their regularly scheduled classes to complete the survey in their school cafeteria or auditorium. Students were allotted 90 min to respond to questionnaires with researchers present to answer questions. In addition, information about course work and grades was gathered from participants' school records.

2.3. Measures

Measures were obtained from student questionnaires and school record data. Computer game use, adjustment, and self-concept, risk behaviors, and social context were measured by students' responses to a series of items. Grades in school and absences were gathered from official school record data.

2.3.1. Computer game use

Computer game use was measured with two questions about computer use. The first asked whether the participant ever used a computer. If they responded yes, they were then asked how often they used a computer to play computer games. The responses ranged from 1 (*never*) to 7 (*daily*).

2.3.2. Adjustment

Depressed mood was measured with a four-item scale (α=.70). A sample item was "how often do you feel unhappy, sad, or depressed?" Responses ranged from 1 (*never*) to 7 (*daily*). Self-esteem was measured with three items (α=.78). A sample item was "how often do you feel satisfied with yourself the way you are?" Responses ranged from 1 (*never*) to 7 (*daily*). For both items, a mean score was computed.

2.3.3. Self-concept

A section of the survey dealt with self-concept in a range of skills and abilities. All skills were assessed with the following question: "Compared to others, how good are you at each of the following" and were rated on a seven-point scale from 1 (*a lot worse*) to 7 (*a lot better*). The five domains included intelligence, leadership, interpersonal skills, mechanical ability, and computer skills. Intelligence included two items: logical, analytic thinking, and intelligence (α=.71). Leadership included supervising others and being a leader (α=.72).

Interpersonal skills included listening to and understanding others, and teaching and explaining to others (α=.68). Mechanical and computer skills were single items: "repairing mechanical equipment" and "computer skills."

2.3.4. Risk behavior

The surveys included information on the adolescents' involvement in risky/problematic activities in 10th grade like drinking, using drugs, and being aggressive. The risk behavior measures used the following categories to indicate frequency of engaging in the activity in the previous 6 months: 1 (*none*), 2 (*once*), 3 (*2–3 times*), 4 (*4–6 times*), 5 (*7–10 times*), 6 (*11–20 times*), and 7 (*21 or more times*). The four constructs were aggression, disobedience, substance use, and truancy. The aggression item asked about the frequency of punching and pushing around other students, and the disobedience item asked about disobeying parents on an important issue. The substance use scale included three items about bringing alcohol or drugs to school, drinking outside of school, and using illegal drugs outside of school (α=.68). The two-item truancy scale was a self-report about the number of classes and days the student had skipped at school (α=.73).

2.3.5. School records

Student transcripts were used to obtain the number of days of school that were missed in the 10th grade. In addition, information on academic performance was obtained for all participants from their files. For these analyses, we used school records of the participants' cumulative GPAs at the 11th grade. For those schools that did not record a cumulative GPA for the 11th grade, the 12th grade GPA was imputed.

The *family closeness* scale consisted of three items about perceived emotional support from family members and frequency of joint family activities (α=.80). Items, adapted from the Family Environment Scale (Moos & Moos, 1981), were: "Our family enjoys doing things together," "Members of my family are very close and get along very well," and "Family members are supportive of each other during difficult times." The seven-point range of the items was from "Never" to "A lot" or "Strongly Disagree" to "Strongly Agree." Higher scores indicated closer family relationships.

2.3.6. Friend characteristics

Composition of the friendship network was measured with a series of questions asking "what percentage of your friends are each of the following?" *Academic friends* includes the items "planning to go to college" and doing very well in school" (α=.68). *Risky friends* includes "regularly drink alcohol," regularly use drugs" and "likely to skip class" (α=.76). The response scale ranged from 1 (*none*) to 5 (*all*), with 3 (*half*).

2.3.7. Participation

Sports involvement was measured with a checklist about which school teams the student competed on. The number of teams checked was summed for each participant. Activity involvement was the sum of affirmative responses from two checklists, covering activities and clubs at school, as well as outside of school.

2.3.8. Academic attachment

We collected the students' attachment to school using one seven-point item about how much they liked school.

2.3.9. Mother's education

Mothers were asked about their education level at Wave 1 in 1983, but not all mothers participated in the survey. Adolescents were also asked about their mothers' education at Wave 5. To maximize the number of respondents with data, these two variables were averaged to create a mother education variable. The categories are 1 (grade school), 2 (some high school), 3 (high school graduate), 4 (some college or technical school), 5 (college graduate), 6 (some graduate school).

3. Results

The results are presented in three sections. First, descriptive information on the three categories of computer game users is provided. Second, we present group differences in adjustment, risk behavior, and school records. Finally, we examine the differences in engagement in multiple social contexts (family, peer group, sports, and school).

3.1. Computer game use

The participants were categorized into three groups based on their frequency of play: "None" included participants who did not use computers at all, as well as those who used computers, but never for computer games; "Low" included participants who checked 2, 3, 4, or 5 for frequency of computer use to play computer games; and "High" included participants who checked 6 or 7 for frequency of computer game play. A chi-square test indicated that males and females were not evenly distributed across these three categories [$\chi^2(2, N=1043)=62.39$, $p<.001$]. Girls were overrepresented among the nonusers, with a majority never playing computer games (50.6%), compared to 29.4% of boys who never played. Boys were more than twice as likely (23.8%) as girls (9.9%) to be in the high use group. A substantial number of both girls (39.4%) and boys (46.8%) were in the low use group. An ANOVA indicated that the differences between the three groups in the level of education their mothers had attained approached significance [$F(2,1032)=2.82$, $p<.07$], with those who never played having mothers with less education ($M=3.60$) than those in the low use group ($M=3.76$). The high use group did not differ significantly from the other two groups ($M=3.73$). Previous research has found that the availability of computers tends to be lower in lower-income neighborhoods/families with lower parental education, although the availability of video game players is broadly comparable across income/education groups (Roberts et al., 1999). Because there was a marginal difference in mother's education between game play groups, and mother's education was expected to be related to many of the dependent variables, mother's education was included as a covariate in all analyses, and adjusted means are reported.

3.2. Differences among computer game play groups

The next analyses are presented in several steps. First, when constructs are related, they are included together in multivariate analyses of variance. After multivariate tests are reported, the between-subjects effects are reported for each scale separately. Because cell sizes were unequal, Type III sums of squares were used in all analyses. To compare adjusted means, parameter estimates for simple contrasts were computed to determine the differences between computer game use groups [examined pairs were (1) none and low, (2) none and high, and (3) low and high]. All contrasts reported were significant at the .05 level.

3.3. Psychological adjustment

A 3 × 2 (Computer game use × Adolescent gender) multivariate analysis of variance (MANOVA) was performed to assess potential main effects of gender and computer game use, as well as for interactions between computer game use and gender, on depressed mood and self-esteem. MANOVA results indicated that the adjustment scales were significantly related to computer game use [Wilks' criterion = 0.99, $F(4,2026) = 3.39$, $p < .01$] and gender [Wilks' criterion = 0.90, $F(2,1013) = 55.53$, $p < .001$]. The multivariate interaction of gender and computer game use was not significant for adjustment.

Between-subjects tests revealed significant main effects of both computer game play and gender for both depressed mood and self-esteem. The group means and pairwise comparisons for adjustment by computer game use are presented in Table 1. Depressed mood varied significantly by computer game use [$F(2,1014) = 4.19$, $p < .05$], with the low use group reporting significantly less depressed mood than the high use group and their peers who did not use computer games. Self-esteem differences by computer game use favored the low play group over the nonplayers [$F(2,1014) = 4.00$, $p < .05$]; neither of these groups differed significantly from the high players. Concerning the main effects of gender, girls reported significantly more depressed mood [$M = 4.54$ for girls, $M = 3.65$ for boys, $F(1,1014) = 111.16$, $p < .001$], and lower self-esteem than boys [$M = 4.43$ for girls and $M = 4.77$ for boys, $F(1,1014) = 14.45$, $p < .001$].

3.4. Self-concept

A 3 × 2 MANOVA for the five self-concept domains revealed significant multivariate main effects of computer game play [Wilks' criterion = 0.90, $F(10,2016) = 11.31$, $p < .001$] and gender [Wilks' criterion = 0.81, $F(5,1008) = 47.05$, $p < .001$]. Computer game play was a significant predictor of three of the five self-concept scales: intelligence [$F(2,1012) = 6.36$, $p < .01$], mechanical repairs [$F(2,1012) = 3.14$, $p < .05$], and computer skills [$F(2,1012) = 56.30$, $p < .001$]. Those who never played computer games reported lower self-concepts in intelligence and computer skills than low- or high-level players, and less mechanical ability than high-frequency players. High-frequency players also rated their computer skills more highly than low-frequency players. The gender main effect was significant for four of the five self-concept scales. Girls rated their interpersonal skills

Table 1
Adjusted means (and standard deviations) of adjustment, self-concept, risk behavior, and school records by frequency of computer game use, with mothers' education as a covariate

	Never use	Low use	High use	*F* statistic
Adjustment				
Depressed mood	4.16 (1.30)[a]	3.95 (1.17)[b]	4.18 (1.21)[a]	4.19 *
Self esteem	4.46 (1.28)[a]	4.70 (1.23)[b]	4.65 (1.23)	4.00 *
Self-concept				
Intelligence	4.95 (1.36)[a]	5.25 (1.28)[b]	5.27 (1.24)[b]	6.36* *
Leadership	4.79 (1.38)	4.89 (1.22)	4.96 (1.33)	1.01
Interpersonal	5.22 (1.24)	5.38 (1.15)	5.39 (1.21)	2.10
Mechanical	3.10 (1.73)[a]	3.33 (1.80)	3.46 (1.94)[b]	3.14 *
Computer skills	3.23 (1.70)[a]	4.25 (1.58)[b]	4.69 (1.73)[c]	56.30* *
Risk behavior				
Aggression	1.94 (1.30)	1.85 (1.29)[a]	2.14 (1.64)[b]	2.76 +
Disobedience	3.33 (1.85)[a]	2.90 (1.59)[b]	3.15 (1.94)	5.83* *
Substance use	1.86 (1.13)[a]	1.70 (1.05)[b]	1.58 (0.87)[b]	6.57* *
Truancy	1.70 (0.83)[a]	1.61 (0.87)	1.53 (0.72)[b]	2.32 +
School records				
Absences	9.05 (7.83)	8.18 (6.94)	8.45 (6.19)	1.27
GPA	2.53 (0.68)[a]	2.79 (0.70)[b]	2.61 (0.62)[a]	14.11* *

Groups with different superscript letters are significantly different from each other.
* $p < .05$.
** $p < .01$.
+ $p < .10$.

($M = 5.59$) higher than boys did ($M = 5.07$), $F(1,1012) = 38.03$, $p < .001$. Boys' self-concept scores were higher than girls' on three measures, namely leadership [Ms = 4.98 vs. 4.78, $F(1,1012) = 4.50$, $p < .05$], mechanical ability [Ms = 4.04 vs. 2.55, $F(1,1012) = 156.92$, $p < .001$], and computer skills [Ms = 4.20 vs. 3.91, $F(1,1012) = 5.90$, $p < .05$].

3.5. Risk behavior

Differences in reports of risk behavior were examined. A 3×2 MANOVA was used to examine differences based on computer game use and gender in the four risk behavior constructs. MANOVA results indicated that the risk behavior scales were significantly related to computer game play [Wilks' criterion = 0.97, $F(8,2002) = 3.65$, $p < .001$] and gender [Wilks' criterion = 0.91, $F(4,1001) = 24.39$, $p < .001$]. The interaction of gender and computer game use was not significant. Between-subjects effects were considered for substance use, aggression, disobedience, and truancy. Computer game use was a significant predictor of both substance use [$F(2,1004) = 6.57$, $p < .01$], and disobeying parents on an important issue [$F(2,1004) = 5.83$, $p < .001$]. Contrasts indicated that compared to those who did not play computer games, both low and high play adolescents reported less substance use (see Table 1). Low levels of play

were also related to lower levels of disobedience compared to no play. Computer game play approached significance as a predictor of aggression [$F(2,1004) = 2.76$, $p < .07$], with high use players tending to report greater frequency of punching or pushing around others than low use players. Game play also approached significance as a predictor of truancy [$F(2,1004) = 2.32$, $p < .10$]; the high play group tended to report lower levels of truancy than those who never played. Gender was significantly related only to aggression [$F(1,1004) = 89.15$, $p < .001$], with girls ($M = 1.53$) reporting less aggression than boys ($M = 2.42$).

3.6. School records

The 3 × 2 MANOVA for absences and GPA indicated significant multivariate effects of computer game play [Wilks' criterion = 0.97, $F(4,1740) = 7.15$, $p < .001$] and gender [Wilks' criterion = 0.97, $F(2,870) = 15.29$, $p < .001$]. There was no significant multivariate interaction of game play and gender. The between-subjects effect of computer game use on GPA [$F(2,871) = 14.11$, $p < .001$] demonstrated that those who reported low use of computer games had higher grades than both those who never played and those who played at high levels (see Table 1). There was a main effect of gender on GPA [$F(1,871) = 10.72$, $p < .01$], and on school absences [$F(1,871) = 7.88$, $p < .01$], with girls having higher grades ($M = 2.73$) than boys ($M = 2.56$) and more absences ($M = 9.35$ for girls and $M = 7.77$ for boys).

3.7. Social contexts

The 3 × 2 (Computer game use × Gender) ANOVAs were performed to assess main effects of gender and computer game use, as well as for interactions between computer game use and gender, on family relationships, and attachment to school (see Table 2). For

Table 2
Adjusted means (and standard deviations) of social context involvement by frequency of computer game use, with mothers' education as a covariate

	Never use	Low use	High use	*F* statistic
Family closeness	4.54 (1.56)[a]	4.84 (1.35)[b]	5.03 (1.44)[b]	7.40**
Attachment to school	4.29 (1.79)[a]	4.55 (1.59)[b]	4.81 (1.66)[b]	5.61**
Friendship network				
Academic	3.54 (0.88)[a]	3.69 (0.81)[b]	3.68 (0.94)	2.93+
Risky	2.48 (1.03)[a]	2.24 (0.87)[b]	2.25 (0.92)[b]	6.56**
Participation				
Sports teams	1.35 (1.58)[a]	1.59 (1.80)[b]	1.64 (1.95)	2.44+
Activities and clubs	1.76 (1.64)[a]	2.05 (1.76)[b]	2.16 (1.90)[b]	4.08*

Groups with different superscript letters are significantly different from each other.
* $p < .05$.
** $p < .01$.
+ $p < .10$.

family closeness, computer game use was a significant predictor [$F(2,1034) = 7.40$, $p < .01$]. Adolescents who played computer games either at low or high rates reported having closer family relationships than those who did not play. There was no gender difference in family closeness.

For attachment to school, there was a significant main effect of computer game play [$F(2,1032) = 5.61$, $p < .01$]. Those participants who reported never playing computer games were less attached to school than those who reported playing computer games at either low or high levels. There was no gender effect, or interaction of gender with computer game use.

3.8. Friendship network

A 3 × 2 MANOVA indicated that characteristics of friendship network were significantly related to computer game play [Wilks' criterion = 0.98, $F(4,1822) = 3.77$, $p < .01$]. Level of computer game play was a significant predictor of having more risky friends [$F(2,912) = 6.56$, $p < .01$]. Adolescents who never played computer games reported having more risky friends than those who played either low or high levels. The computer game play effect approached significance with respect to academic friends [$F(2,912) = 2.93$, $p < .06$], with low-level players tending to have more academic friends than nonplayers (see Table 2).

3.9. Activity participation

The 3 × 2 MANOVA for activity participation indicated that there was a multivariate effect of computer game play [Wilks' criterion = 0.99, $F(4,2042) = 2.52$, $p < .05$], and of gender [Wilks' criterion = 0.96, $F(2,1021) = 23.12$, $p < .001$]. For club participation, there was a significant main effect of computer game play [$F(2,1022) = 4.08$, $p < .05$], and gender approached significance [$F(1,1022) = 3.71$, $p < .06$]. Compared to those who did not play computer games, those who played at both low and high rates reported participation in more clubs (see Table 2). Girls ($M = 2.11$) tended to be in more clubs than boys ($M = 1.87$). For number of sports teams, there was a significant gender effect [$F(1,1022) = 31.28$, $p < .001$], and the effect of computer game use approached significance [$F(2,1022) = 2.44$, $p < .09$]. Boys ($M = 1.87$) reported playing on more competitive sports teams than girls ($M = 1.18$). Those who played computer games at lower levels tended to participate on more teams than those who never played computer games.

4. Discussion

In a large sample of 16-year-olds, we identified individuals whose involvement in computer game play was 'never', 'low', or 'high'. On measures of adjustment, self-concept, risk behavior, school records, and social involvement, there were several differences among these groups. In general, and contrary to common speculation, there

was little evidence that computer game play is associated with negative outcomes—indeed, most of the findings suggest advantages to adolescents in the low or high play groups compared to the young people who report that they never play games. In general, the low play group obtained the most positive scores on most measures, though the high play group also scored positively on several measures and in some cases obtained the most positive score.

More specifically, depressed mood was significantly lower in the low use group, and the two other groups did not differ from each other. Self-esteem was higher in the low use group. With respect to self-concept, players regarded themselves higher in intelligence, mechanical skills, and computer skills than did nonplayers; on the latter two measures, the high players scored highest. The groups also differed on measures of risk behavior, including self-reported disobedience (low players significantly lower than the other groups) and substance use (both low and high players reporting significantly lower than the nonplayers). There were marginally significant effects for truancy, where the high play group reported lowest levels, and for aggression, which will be discussed further below. Both groups of players reported higher levels of family closeness and less risky friendship networks than did the nonplayers, and attachment to school was higher in these two groups. Clearly, these findings do not support assertions that computer game play is likely to be harmful, but instead indicate positive correlates. These results extend those of Egli and Meyers (1984) who found that computer game players reported no interference in family life, were regularly active in sports, and rejected a link between drug use and game play.

GPAs were significantly higher in the low play group, and the never play and high play groups did not differ from each other. These findings differ from those of Creasey and Myers (1986) and van Schie and Wiegman (1997), who obtained no difference between players and nonplayers on measures of school performance. This discrepancy among results may be due to the statistical power available because of the large N in the present study. Our findings also differed from those of Anderson and Dill (2000, Study 1) who found a negative correlation between amount of video game play and GPA. In Anderson and Dill's case, their data were based on university students. It is possible that university students are a special case with respect to the balance of time between work and leisure pursuits. These respondents would presumably be toward the higher end of the GPA distribution, and within this elite stratum, relative performance may be disproportionately influenced by how much time the individual is prepared to devote to his or her studies. Again, taking into account the fact that computer game play does not occupy large amounts of most young people's leisure time, there does not seem to be a strong reason to assume that involvement with this activity will invariably impede educational progress. It would certainly be useful in future research to examine more thoroughly the relation between game play and educational attainment. For example, do computer game players do better in particular educational domains? The game players' significantly higher self-concepts in respect of computer skills suggest the possibility that game play is associated with a broader interest and sense of competence in relation to computers.

We did not find strong evidence of differences among the groups in self-reported aggression. In this respect, our findings do not enable us to clarify the inconsistent patterns of results that have been reported in previous studies of links between play and aggression (see Introduction). Nevertheless, it should be acknowledged that the higher use group obtained the highest mean on the aggression measure. Because of the importance of this issue to our understanding of the effects and correlates of computer game play, these results justify closer inspection. Although an overall univariate ANOVA did not indicate a between-groups effect at a conventional level of significance, post hoc pairwise comparisons revealed significant differences between the higher use group and the low play group (although not between the high play group and the never play group). Several points should be borne in mind in interpreting this finding. First, none of the groups scored high on this measure. Participants were asked how often they had punched or pushed around another student; the mean levels indicate that adolescents in all three groups engaged in this level of aggression approximately once within the previous 6 months. Second, the mean differences among groups are magnified by the higher proportion of males in the higher play group and the lower proportion in the low play and never play groups; males were substantially higher than females on aggression and so the means in Table 1 reflect this additive combination of gender and game play. Third, because the measure is concerned with physical aggression, it is not sensitive to possible variations among groups in other forms of aggressive behavior, including verbal aggression and indirect aggression; there is evidence that indirect aggression is more prevalent among females (Oesterman et al., 1998) and a more comprehensive study might include measures that capture different modes of aggression. Fourth, as in all correlational studies of this topic, we cannot infer causal directions even for the weak relationship we did obtain (Anderson & Dill, 2000).

Contrary to the assumption that computer game play is a solitary activity reflecting or exacerbating a lack of social skills, we found that both high and low players report greater family cohesion than those who do not play. In fact, evidence on computer game play indicates that, while it is often undertaken alone, most players prefer to share the activity with friends or parents (Cupitt & Stockbridge, 1996; Durkin & Aisbett, 1999; Kubey & Larson, 1990).

Gender differences were obtained in our findings that were consistent with those of earlier research. Virtually all investigators have found that males report greater involvement in computer game play than do females (e.g., Barnett et al., 1997; Durkin & Aisbett, 1999; Kubey & Larson, 1990; Roberts et al., 1999; Subrahmanyam et al., 2001). Consistent with this pattern, in the present study, girls were overrepresented among the never-users, and underrepresented among the high players. Several other significant gender differences were also consistent with previously well-established patterns: girls scored higher on the measure of depressed mood, higher on GPA, lower on self-reported physical aggression, and lower on sport participation. In general, we obtained no evidence that the patterns of any effects or correlates of computer game play differ between the sexes: the main difference is simply that boys play more.

How are we to interpret the several findings of links between frequency of play and features indicating positive adolescent development, such as family closeness, physical

activity, attachment to school, school attendance, favorable mental health, lower substance use? Although we cannot confirm causal relations, at least two lines of interpretation appear possible. One is that the direction of effect is from player to activity choice. On this account, young people who are psychologically well adjusted could be expected to incorporate some degree of currently popular recreational options, such as computer games, as part of a range of activities because they like to explore and experiment with what the world has to offer; they may enjoy the activity, but it does not necessarily predominate among their leisure choices or prevent them from engaging enthusiastically in many other undertakings.

A second line of interpretation might be that the direction of effect is from the medium to the player: that is, that computer game play itself affects psychological adjustment, family relations, social behavior, school attendance, and so on. Kubey and Larson (1990) found that adolescents in naturalistic environments reported higher arousal and more positive subjective states during computer game play, especially when the activity was undertaken in the company of friends or parents. It is conceivable that playing computer games enhances young people's leisure and promotes positive affect and social interactions. Similarly, computer game play might impact on interests in sports and activities by stimulating interests in action and competition. Computer game play may have cognitive benefits, stimulating spatial skills, decision making, and reaction times (Greenfield, 1998; Subrahmanyam et al., 2000, 2001), enhancing the associated self-concepts, all of which may be conducive to better performance at school.

In general, most of our findings point to the optimal group being the low players. This group most often obtained the most favorable rating on the various dimensions assessed. This is consistent with the interpretation that well-adjusted young people like to sample many of the recreational and skill opportunities that their environments provide and can manage their time to accommodate diverse interests. As noted earlier, computer game play is not the dominant media activity for the majority of young people (Cupitt & Stockbridge, 1996; Funk, 1993; Kubey & Larson, 1990; Roberts et al., 1999). Even so, on several measures, the high play group also scored significantly more positively than the nonplayers, and on some (self-concept of mechanical and computer skills, substance use), it had the most favorable scores. For some enthusiasts, a higher than average level of involvement with computer games may not be problematic. There was little evidence to suggest that being a high player was associated with developmental problems, and in fact, there was no measure on which the high play group recorded a less positive score than the nonplayers. (Indeed, it is striking that the nonplaying group did not record the most positive mean on any measure.) However, it should be borne in mind that our measure of computer game play did not allow us to identify any participants who may play games for very high amounts of time, and we do not address here the issues concerning this possible subset (which previous research indicates would be a very small minority).

It is most likely that any relation between individual differences and game play is bidirectional, with certain types of people attracted to particular levels of play and then particular levels of play fostering certain attributes or experiences, and so on. Adolescents

who have a positive attitude toward school may have more opportunities to learn about computers or to share information about computer games with their school friends. Adolescents who feel close to their families may play computer games more because of opportunities to share with other family members, or because they are in families that provide generously for educational and leisure activities, including computers. It is possible that the subjective experience of playing is different between individuals who are prone to depressed mood symptoms and those who are not, or between children in close families and peers in troubled homes. There is surprisingly little ethnographic research into the everyday contexts of computer game usage, and a dearth of longitudinal investigations of the complex interplay of individual differences and game play.

Limitations of the present study include the fact that our measure of computer game use is concerned with one format and does not include games consoles or hand-held machines. It is certainly the case that different formats and different games provide varied playing experiences (Roberts et al., 1999) and this raises important issues for developmental research that have not yet been very thoroughly addressed. We did not collect detailed information on the participants' particular game preferences and it is very likely that some young people play a lot of violent games. Nevertheless, we have been able to provide evidence on the relationship between game playing in general and physical aggressiveness and, consistent with previous literature, we have found at most a weak link, with causal direction remaining unclear. It should also be noted that these data were collected in 1988, and computer games have developed considerably in terms of form and content since then, as well as becoming still more widely available. However, all of the concerns addressed here have been aired frequently since the very earliest computer games became available (see Greenfield, 1984). While developments in the technologies will inevitably provoke new concerns and lead to many important issues for future research, it remains useful to record that a large sample of American youth exposed to the early generations of computer games did not manifest evidence of social and behavioral correlates of play involvement.

The overall picture that emerges from the present pattern of findings is that computer game play is one manifestation of an active and well-adjusted lifestyle. Rather than disrupting family life, games are played by young people who tend to perceive their family relations as close. Rather than displacing activities such as clubs and sports, games appear to be another leisure pursuit of those who are active social participants. Rather than signifying academic problems, game play is associated with more positive engagement with school. Some of the relative advantages are greatest among high players (self-concepts of mechanical and computer skills, family closeness, attachment to school) and some among low players (lower depressed mood, lower aggression, lower disobedience, higher self-esteem, GPA), but on none of the variables measured here did we find an advantage to the nonplayers. Together, these findings support the thesis that well-balanced young people make active leisure choices to complement and extend their interests and skills. Regular engagement in voluntary, structured activities sustains and challenges them (Eccles & Barber, 1999; Larson, 2000) and is related to academic and personal development. Computer games are one form of voluntary leisure that many contemporary young people enjoy: they are not a miracle ingredient but can be a positive feature of healthy adolescence.

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