

How Does Neighborhood Quality Moderate the Association Between Online Video Game Play and Depression? A Population-Level Analysis of Korean Students

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Abstract

The main objective of our study is to assess the relationship between playing online video games and mental wellbeing of adolescents based on a nationally representative sample. Data come from the Korean Children and Youth Panel Survey (KCYPs), a government-funded multiyear research project. Through a secondary analysis of W2 and W3 of data collected in 2011 and 2012, we examine the extent to which time spent playing online games is related to depression, as measured by a battery of items modeled after the abridged version of Center for Epidemiologic Studies Depression Scale Revised (CESD-R). For proper temporal ordering, the outcome variable is drawn from the latter wave (W3), whereas all time-lagged covariates are taken from the earlier wave (W2). Multilevel regression models show that more game playing is associated with greater depression. Findings also indicate that, net of individual-level variables (e.g., gender, health, family background), living in a community with more divorced families adds to adolescent depression. Finally, a cross-level interaction is observed: the positive association between game playing and depression is more pronounced in an area characterized by a lower aggregate divorce rate.

Keywords: video game play, depression, neighborhood effect, Korea

Introduction

UNTIL NOW, THE MAJORITY of research on video game play has focused on aggression as a result of exposure to violent video game content.^{1–5} With most of the academic attention invested in aggression research, relatively little work has investigated the mental health consequences of playing video games. The few studies on adolescent health have largely concentrated on pathological playing, or video game addiction.^{6–10} While video game addiction is indeed a serious social issue with grave health outcomes, it only affects a small subgroup of video gamers⁷ and fails to yield insights into the health status of the general gaming populations in adolescence. One study, for example, looked at health correlates of adolescents who play video games, but focused on problematic health behaviors specific to addictions, including smoking, marijuana, alcohol, and drugs.¹¹ Consequently, the relationship between video game playing and mental health in youth remains a vastly underexplored and fragmented area of research despite the fact that the majority of today's adolescents engage in some form of video game play.

Similar to other media effects, the impact of video game play on an adolescent's mental health is driven by multidimensional factors¹² that involve interactions between individual elements as well as variables within his or her environment. But most video game research to date has dealt mainly with individual-level variables such as the amount of game play^{6,7} or the content of game play.^{1,5} Not all video game play is the same, however, two individuals that engage in the same number of hours in video game play may experience starkly different outcomes depending on the interaction between individual- and environmental-level characteristics.⁸ The current study builds on and extends prior research by investigating the combined impact of individual video game play and the environmental context (neighborhood quality). Figure 1 graphically illustrates the explanatory scheme.

Emerging research has provided, although fragmented if not contradictory, evidence on the associations between video game play and adolescent mental health, specifically depression and suicidal tendencies, for both violent¹³ and nonviolent game content.^{14,15} In addition, it has been shown that the negative effects of video game play on mental health increases

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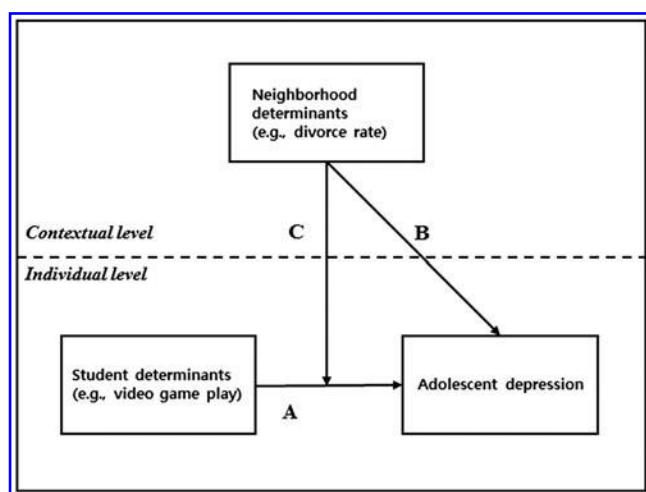


FIG. 1. Multilevel explanatory scheme.

with playing time.¹⁶ Building on these earlier findings, we anticipate a positive linear relationship between online video game play and depression among young users (H1).

One major, yet relatively understudied, indicator of the general climate of a youth's environment is family instability, that is, aggregate divorce rate. The dissolution of marriage can introduce dramatic changes and challenges in an adolescent's life.¹⁷ In particular, the changes that come with divorce are related to the availability of social capital and support in an adolescent's life, such as less involvement with the noncustodial parent and less availability of the custodial parent.¹⁸ This study advances prior research by examining the impact of family structure (single- vs. dual-headed home) on adolescent mental health measured at the level of "neighborhood," defined as the area wherein the adolescent engages in regular activity on a daily basis.¹⁹ The substantial literature on neighborhood social capital (e.g., "collective efficacy"²⁰) shows that contextual-level characteristics have a powerful and lasting influence on the life chances of youths.²¹ Because social support often serves as a buffer that eases the negative consequences of mental health problems at the individual level, such as depression or anxiety,^{22–24} we hypothesize that adolescents embedded in a neighborhood with more divorced families are less likely to benefit from such protection and, as a result, experience greater levels of depression, net of the marital status of their own parents (H2).

In addition to direct or main effects, the aggregate divorce rate as a proxy measure of social support (or lack thereof) can have an indirect influence (as illustrated by Arrow C in Fig. 1) on adolescent mental wellbeing by moderating the effect of game playing. Earlier studies point to two conflicting views on video game play as it relates to interpersonal interaction and social support. Some scholars have expressed concerns about the isolating qualities of video game play,^{25,26} in ways similar to how excessive Internet and computer use can lead to social isolation and difficulty in managing "offline" relationships.²⁷ Following this logic, the decline of social support in communities and neighborhoods with a high number of divorced families, combined with the socially isolating effects of online video game play, is likely to exacerbate the negative video game effects on adolescent depression (H3A).

In contrast, other studies have demonstrated that video game play is actually a *social* activity that allows players to engage in cooperative tasks.^{28–31} That is, social interaction has always been an important part of it,³² and that interactions within the confines of the game may even be related to social support in the offline world.³³ If youths reside in an environment with limited collective efficacy, then, they may be driven to actively seek social support within video game play. This could result in a paradoxical situation, where high neighborhood divorce rate appears to suppress, not reinforce, the deleterious effects of online video game play on mental health of young users, leading to an opposing hypothesis (H3B).

Because the vast majority of earlier studies were based on cross-sectional data, it has been difficult to determine the direction of causation. The current study minimizes, although not resolves, the endogeneity problem by using population-level longitudinal data, which allows us to draw more conclusive statements concerning causality between online video game play and mental health (depression). Despite our efforts, however, we fully recognize the limitations of our data and methods in demonstrating unequivocal causal linkage between the two. Few studies to date have collected high-quality data on video gaming from a nationally representative sample of adolescents. Moreover, little earlier work, if any, has investigated the interaction between individual and environmental (neighborhood) variables on the effect of video gaming on adolescent health.

The bulk of the data presented on the effects of video game play has focused on Western and English-speaking countries.^{3,5,16,34} The analysis herein presents a more global perspective of the effects of online video game play by investigating adolescents in South Korea. The question of mental health consequences of online video game play is a timely one in South Korea, home to the highest broadband penetration rate on the planet with 95 percent of households having a high-speed Internet connection (vs. the United States with a 60 percent penetration rate).^{35,36} Problematic levels of game play have alarmed national policy makers to a point where governmental intervention is now in place for curfews on online game play and government-funded counseling centers are available for treating Internet addiction.³⁷ As the Internet penetration rate continues to rise in the United States, findings from the Korean population may serve as an informative forecast of the overall mental health status of adolescents in the United States and other countries following a similar trajectory.

Methods

Data source

This study is based on the secondary analysis of Korean Children and Youth Panel Survey (KCYPS), a large-scale multiyear research project funded by the Korean government (Ministry of Gender Equality & Family). KCYPS contains waves of data on probability samples of middle and high school students in Korea. The questionnaire was designed and administered by the National Youth Policy Institute (more details can be found at <http://archive.nypi.re.kr>). The first wave of data collection (W1) sampled 2,351 first-year middle schoolers (1997 birth cohort), who were subsequently tracked and reinterviewed based on a prospective panel

survey design. The current study uses W2 (2011) and W3 (2012) of KCYPs consisting of second- and last-year middle school students with valid person weights to account for attrition and probability of selection. The sample size for W2 is 2,280 (retention rate of 97 percent of the first wave); for W3, it is 2,259 (96 percent).

School dropout rate is the highest in Korea during the transition from middle to high school, hence leading to a significant loss of cases comprising high school freshmen in W4 (2013). Analyzing the fourth wave of data also introduces unobserved heterogeneity due to additional “school effects” that are unaccounted for. In addition, a full version of W5 (2014), including the information on the outcome measure (depression), is not publicly available. Thus, to minimize attrition rate and omitted variable bias, we limit our analysis to the chosen two waves of data. With the listwise deletion of cases with missing information on the selected survey items used, the reduced sample size is 2,051. Multiple imputation method^{38,39} is used to generate roughly nine percent of the original sample with missing values, resulting in 2,219 cases with unique school and regional IDs. To establish proper temporal ordering, the depression variable is measured from W3 (2012), whereas all the time-lagged covariates are drawn from the wave collected a year before (W2).

Measures

Depression. The outcome measure is based on the (10-item) abridged version of the Center for Epidemiologic Studies

Depression Scale Revised (CESD-R), designed to gauge symptoms defined by the American Psychiatric Association’s Diagnostic and Statistical Manual (DSM-V) for depressive disorder, which has been used to gauge depression in adolescents.^{40–43} Due to the right-tailed skewed distribution, individual responses are log transformed.

Video game. The student respondents were asked how many hours a day they played online video games, which varied from 0 to 9. The data distribution is skewed to the left, with about 27 percent of the sample saying they do not play at all, about 35 percent who play 1 hour a day, and another 24 percent who spend 2 hours a day on online video games. These original responses are also converted to log-transformed values. Similar measures were used to assess video game play in earlier studies.^{44,45}

Confounding variables. A number of student-level control variables, including risk and protective factors, are taken into account: age, gender, household income, peer relations, delinquent behavior, self-rated health, etc. To test for direct and moderating effects of neighborhood characteristics, three additional variables are measured, namely population size, aggregate educational level, and divorce rate across regional clusters. Precise survey items and coding schemes used for all the variables used are provided in Table 1. Table 2 summarizes the basic descriptive statistics.

TABLE 1. SURVEY ITEMS AND CODING SCHEMES

Depression	Log-transformed scores based on items modeled after the Center for Epidemiologic Studies Short Depression Scale (CES-D 10)
Student-level covariates	
Girl	Respondent’s (R’s) gender (girl=1)
SRH	R’s self-rated health coded on a 4-point scale (e.g., 4=“very healthy,” 1=“very unhealthy”)
Income	Household monthly income in KRW (Korean currency)
Both parents	Coded 1 if R lives with both biological parents; 0 otherwise.
Academics	“How satisfied are you with your own academic performance at school?” Reverse coded so that 4=“very satisfied,” 3=“satisfied,” 2=“not satisfied,” and 1=“very dissatisfied.”
Delinquency	R’s answers to six behavioral questions about the experiences of smoking, drinking, bullying, fighting, skipping school, and running away from home (1=yes; 0=otherwise). Responses are added to form a single scale ranging in value from 0 to 6 ($\alpha=0.61$).
Peer relations	Averaged score based on R’s responses to six survey items ($\alpha=0.77$) concerning the quality of communication (“my friends respect my thoughts and feelings during conversation”; “my friends pay attention to what I have to say”; “I tend to verbally express my personal problems to my friends”) and the level of mutual understanding (“my friends understand me well”; “I can confide in my friends whenever I need to”; “I trust my friends”).
Parental care	Averaged score based on R’s responses to questions ($\alpha=0.88$) measuring the subjective perception of parental care (“my parents/guardians care for me more than their professional work and other responsibilities”; “my parents/guardians have a genuine interest in my school work and life”; “my parents/guardians make sure that I am healthy and clean”; “my parents/guardians provide appropriate medical care when I am sick”).
Computer use	Logged number of daily hours spent using the computer
Video game	“How many hours do you spend during school days playing online or video games?” R’s answers log-transformed due to (right-tailed) skewed distribution
Neighborhood-level effects	
Population	Log-transformed values of community-based population size
College	Proportion of residents who graduated from a 4-year college
Divorce	Aggregate divorce rate

SRH, self-reported health.

Data source: Korean Children and Youth Panel Survey (2011, 2012).

TABLE 2. (UNWEIGHTED) DESCRIPTIVE STATISTICS

Variable names	Mean/proportion	SD	Min.	Max.
Level-1 (<i>N</i> =2,198)				
Depression (ln)	1.97	0.63	0.08	4.15
Girl	49%	—	0	1
SRH	3.20	0.62	1	4
Income	4,514.34	2,481.00	0	30,000.00
Both parents	82%	—	0	1
Academics	3.14	0.59	1	4
Delinquency	0.29	0.75	0	6
Peer relations	3.11	0.51	1	4
Parental care	3.13	0.59	1	4
Computer use (ln)	1.19	0.63	0	2.94
Video game (ln)	0.71	0.51	0	2.30
Level-2 (<i>N</i> =81)				
Population (ln)	7.43	1.77	3.83	10.26
College	20.75	8.54	6.60	56.00
Divorce	2.23	0.35	1.50	3.20

SD, standard deviation.

Data source: Korean Children and Youth Panel Survey (2011, 2012).

Analytic method

Data analyzed in this study are hierarchically nested, that is, individual respondents (Level-1 *N*=2,219) are sampled across different regions or neighborhood clusters (Level-2 *N*=80). To correct for the methodological problem associated with data clustering,^{46,47} two-level hierarchical regression models are fitted using HLM 7.⁴⁸ Following a standard procedure to avoid collinearity problems, all nondichotomous student-level variables were group-mean centered; all neighborhood-level variables were grand-mean centered. Four nested models were estimated to empirically test the association between depression and online game playing. Model 1 includes only the level-1 control variables. Model 2 introduces the main predictor variable (video game). Model 3 incorporates the three level-2 covariates. Finally, Model 4 includes cross-level interaction terms, where the slope for video game is allowed to vary across regions, while other covariates remain fixed. The estimated multilevel regression models are expressed as follows.

Individual-level model:

$$Y_{ij} = \beta_{0j} + \beta_1(\text{Female}) + \beta_2(\text{SRH}) + \beta_3(\text{Income}) \\ + \beta_4(\text{Both parents}) + \beta_5(\text{Academics}) + \beta_6(\text{Delinquency}) \\ + \beta_7(\text{Peer relations}) + \beta_8(\text{Parental care}) \\ + \beta_9(\text{Computer use}) + \beta_{10}(\text{Video game}) + r_{ij},$$

where Y_{ij} is the depression level for student i in neighborhood j , β_{0j} represents the intercept, β_{ij} are the parameter estimates, and r_{ij} is the student-level random error term.

Neighborhood-level direct effects model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Population}) + \gamma_{02}(\text{College}) \\ + \gamma_{03}(\text{Divorce}) + u_{0j},$$

where γ_{00} is the intercept, γ_{01} , γ_{02} , and γ_{03} are the coefficients for the three covariates on student-level depression, and u_{0j} is the neighborhood-level error term.

Cross-level moderating effects model:

$$\beta_{10j} = \gamma_{100} + \gamma_{101}(\text{Population}) + \gamma_{102}(\text{College}) \\ + \gamma_{103}(\text{Divorce}) + u_{10j}$$

Results

Initially, a null model without any of the covariates, akin to a one-way analysis of variance, was estimated to see how much unexplained variance stemmed from the contextual or neighborhood level. The between-region variance component indicated a significant variation in adolescent depression ($\tau_{00}=0.035$; $\chi^2=1,034.59$, $df=80$; $p<0.001$). The intraclass correlation showed that roughly nine percent of the variation is due to the contextual-level effect. Results from running hierarchical regression models to predict adolescent depression based on the latter wave (W3) are presented in Table 3. Model 1 consists of only the control variables. Aside from household income and overall time spent on the computer, many of them were found to be significant factors at the conventional level ($p<0.05$). Girls are more depressed than boys ($\beta=0.254$; $p<0.001$), students with better self-reported health (SRH) are less depressed ($\beta=-0.140$; $p<0.001$), and those living with both biological parents are also mentally healthier ($\beta=-0.055$; $p<0.001$). In addition to sociodemographic factors, academic satisfaction from the previous year has a negative effect on depression in the following year ($\beta=-0.059$; $p<0.001$). In contrast, an index of delinquent behaviors (smoking, drinking, bullying, running away from home, etc.) is positively related to depression ($\beta=0.022$; $p<0.01$). Better peer relations (-0.267 ; $p<0.001$) and quality parental supervision (-0.070 ; $p<0.001$), on the other hand, emerge as strong protective factors. Model 2 introduces the main predictor, video game.

Consistent with our hypothesis (H1), video game is significantly associated with the main outcome of depression ($\beta=0.026$; $p<0.05$), that is, more time spent playing online video games is related to greater depression, while adjusting

TABLE 3. MULTILEVEL MODELS ESTIMATING THE EFFECTS OF GAME PLAY ON DEPRESSION

<i>Student-level (N=2,198)</i>	<i>Region-level (N=81)</i>	<i>Model 1 β (SE)</i>	<i>Model 2 β (SE)</i>	<i>Model 3 β (SE)</i>	<i>Model 4 β (SE)</i>
Intercept β_0	γ_{00}	1.892 (0.029)***	1.892 (0.029)***	1.897 (0.027)***	1.903 (0.027)***
Level 1					
Girl, β_1	γ_{10}	0.254 (0.015)***	0.251 (0.015)***	0.250 (0.015)***	0.252 (0.015)***
SRH, β_2	γ_{20}	-0.140 (0.010)***	-0.140 (0.010)***	-0.140 (0.010)***	-0.137 (0.010)***
Income, β_3	γ_{30}	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Both parents, β_4	γ_{40}	-0.055 (0.016)***	-0.052 (0.016)**	-0.051 (0.016)**	-0.060 (0.016)***
Academics, β_5	γ_{50}	-0.059 (0.007)***	-0.058 (0.007)***	-0.058 (0.007)***	-0.058 (0.007)***
Delinquency, β_6	γ_{60}	0.022 (0.008)**	0.021 (0.008)**	0.021 (0.008)**	0.018 (0.008)*
Peer relations, β_7	γ_{70}	-0.267 (0.012)***	-0.267 (0.012)***	-0.267 (0.012)***	-0.270 (0.012)***
Parental care, β_8	γ_{80}	-0.070 (0.011)***	-0.070 (0.011)***	-0.070 (0.011)***	-0.069 (0.011)***
Computer use, β_9	γ_{90}	0.002 (0.009)	-0.004 (0.009)	-0.004 (0.009)	-0.002 (0.009)
Video game, β_{10}	γ_{100}		0.026 (0.012)*	0.026 (0.012)*	0.043 (0.026)
Level 2					
Population	γ_{01}			-0.001 (0.015)	-0.000 (0.000)
College	γ_{02}			0.001 (0.003)	0.001 (0.003)
Divorce	γ_{03}			0.188 (0.074)*	0.175 (0.072)*
Cross-level interaction					
Video game \times population	γ_{101}				0.003 (0.018)
Video game \times college	γ_{102}				-0.006 (0.004)
Video game \times divorce	γ_{103}				-0.171 (0.085)*
Within-region variance (σ^2)		0.319	0.319	0.319	0.311
Between-region variance (τ_{00})		0.035***	0.035***	0.030***	0.030***
Deviance (-2 LL)		21,982.29	21,976.42	21,966.91	21,784.64

Parameter estimates are weighted using the W2 KCYPS person-weights (adjusted for attrition and selection at W3). The slope for the variable video game is allowed to vary randomly across the contextual unit in Model 4; the effects of all other covariates are fixed.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed test).

KCYPS, Korean Children and Youth Panel Survey; LL, log-likelihood; SE, standard error.

Source: Korean Children and Youth Panel Survey (2011, 2012).

for a host of control variables. To check for contextual-level effects, three aggregate measures were entered in Model 3, among which only the variable divorce was significant ($\beta = 0.188$; $p < 0.05$). That is, as we hypothesized (H2), living in a community with a higher divorce rate increases adolescent depression, net of student-level characteristics (e.g., gender, health, delinquency, peer relations, and family background including parental marital status). According to the last model (M4), neighborhood-level divorce rate significantly moderates the effect of game playing on depression ($\beta = -0.171$; $p < 0.05$). Specifically, it is weaker (stronger) in a community characterized by a higher (lower) divorce rate, providing empirical support for H3B.

Discussion

By employing a multiwave panel design, which measured the outcome variable of depression in 2012, while all time-lagged covariates were taken from 2011, the current study offers one of the most comprehensive empirical analyses on the relationship between online video game play and adolescent depression by minimizing the endogeneity issue. Findings from multilevel models suggest that after holding constant both individual (e.g., sex, delinquency, academic performance) and social (e.g., family relationship, peer relationship, parental care) variables, more time spent playing online video game indicates higher depression in the following year. These results advance earlier findings of correlations between online video game play and adolescent

health based on cross-sectional data. In addition, net of a host of background variables (including parental marriage status), living in a neighborhood with higher divorce rates leads to poorer mental health among adolescents. This adds further empirical evidence to the importance of neighborhood-level social capital: even if an adolescent's own parents are not divorced, the youth may be adversely affected by living in a neighborhood with more divorced families.

Based on the findings reported above, it may seem that online video game play yields influences on adolescent depression that are similar to the detrimental effects of parental divorce, which is often characterized by a lack of social support.^{17,18} However, the interaction between online video game play and the neighborhood-level divorce rates delivers a more complicated story. The cross-level interaction between online video game play (individual determinant) and divorce rate (contextual determinant) indicates that the latter operates as a critical moderator. In other words, neighborhood quality matters. Specifically, adolescents who live in communities with more divorced families, irrespective of the marital status of their own parents, experience lower rates of depression with more video game engagement than those in communities with fewer divorced families.

With respect to the two competing hypotheses, current findings imply that video gaming could be a social (rather than an isolating) activity, particularly for youths who live in a neighborhood where social support might not be readily available. Social support within online video games was not directly measured in the current study and we note that

alternate reasons may be driving the interaction between online video game play and neighborhood-level divorce rate. However, with all of the discussed variables held constant, if adolescents who live in these neighborhoods experience lower depression with more online video game play, it is plausible that they are actively seeking and receiving the social support they need to serve as a buffer against depression, even though they reside in a neighborhood with low collective efficacy. These findings seem to support the emerging literature which demonstrates that online video game play is a social activity, despite the common stereotype of the “lone gamer.”^{28–31} The findings further contribute to the current literature by highlighting the role of ecological context, which has not received much scholarly attention.

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