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ORIGINAL ARTICLE

Aggressive Video Games Are Not a Risk Factor for Mental Health Problems in Youth: A Longitudinal Study

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Abstract

Recent preregistered studies and analyses have suggested that links between aggressive video games (AVGs) and aggression-related outcomes may have been exaggerated in previous literature. However, concerns about AVGs remain. Although the impact of aggressive games on aggressive behaviors has been the subject of approximately a dozen preregistered studies, the potential impact of aggressive games on the player's mental health symptoms has not been the subject of similar preregistered analyses. In the current study, a sample of more than 3000 youth from Singapore were examined by using preregistered analyses to determine whether early exposure to aggressive games was predictive of anxiety, depression, somatic symptoms, or attention deficit hyperactivity disorder 2 years later. Analyses suggested that exposure to AVGs is not a risk factor for later mental health symptoms.

AU4 ▶ **Keywords:** video games, aggression, violence, preregistration, depression, anxiety, ADHD

Introduction

THE ISSUE OF the impact of aggressive video games (AVGs) on players' well-being has been of interest for decades, leading to often furious debate among policy makers, scholars, and professional guilds such as the American Psychological Association (APA) and American Academy of Pediatrics (AAP). Despite this, no consensus has been reached regarding whether games do or do not lead to negative outcomes among players.[1] Although groups such as the APA and AAP have often publicly expressed concern about aggressive games, their public statements have themselves been criticized for distorting the scientific evidence.[2] In recent years, the issue of aggressive outcomes has been the subject of nearly a dozen preregistered studies, which limit researcher degrees of freedom that may cause false positive results. Almost all of these preregistered studies or analyses have produced null results,[3–5] with only one high-quality exception.[6]

Comparatively less attention has focused on mental health symptoms as a potential outcome. One study[7] found statistically significant relationships cross-sectionally between AVGs and depression; though the effect sizes were below a level ($r = 0.10$), some scholars suggest interpreting as hypothesis supportive.[8] This concern for false positive results among effect sizes below $r = 0.10$ occurs because in large datasets (more than 5000 youth in the cited study) many ''nonsense'' results may become ''statistically significant'' due to a combination of greatly increased power and systematic methodological limitations such as single responder bias, demand characteristics, and common methods variance (for a demonstration of nonsense false positives see[4]). Some studies suggest a small role for AVGs in particular mental health outcomes such as attention deficit hyperactivity disorder (ADHD).[9] However, overall, meta-analyses of such studies suggest limited impact for AVGs on mental health once other factors are controlled.[10] However, to date, to our knowledge no preregistered studies have considered this issue.

The current study

The current study involves a large dataset from Singapore (henceforth simply ''Singapore dataset'') that has been used by other authors in considering AVG effects [see[3] for full listing and discussion,(pp2–3)]. Continued concerns exist regarding the validity of previous studies using the Singapore dataset as critical constructs (particularly violent game exposure) were assessed differently between publications without explanation, and there is significant evidence of researcher degrees of freedom that may have caused some false positive results.[3] This does not mean the dataset is of poor quality, but rather that the AVG variable, possibly among others, had been calculated differently across studies rather than in a consistent

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manner, raising the possibility of researcher degrees of freedom and false positive results.

Employing a standardized (by which we mean employing a uniform set of questions and rules for assessing the outcome) measure of AVGs from this dataset and using it consistently can reduce false positive results. One recent study proposed just such a measure.[4] The current study adds to the literature by employing this standardized AVG measure as well as standardized versions of all outcome measures. Second, theoretically relevant control variables will be employed, such as earlier outcome symptoms, family environment, and impulse control. Lastly, the study is preregistered (https://osf.io/xbzgp), making it, to our knowledge, the first preregistered study in the realm of violent game impacts on mental health (though there have been prior preregistered studies of aggression). This study tests the hypotheses that AVG exposure in early youth will predict outcomes related to depression, ADHD, anxiety, social phobia, and somatic complaints 2 years later.

AU5 ► **Methods**

Participants

Participants in the current study were 3034 youth from Singapore. For this sample 72.8 percent reported male gender. The sample's mean age at time 1 (T1) was 11.21 ($SD = 2.06$). The mean age at time 3 (T3) was 13.12 ($SD = 2.13$). Most of the sample comprised ethnic Chinese (72.6 percent), with fewer Malay (14.2 percent), Indian (8.7 percent), and other youth. Participants were surveyed three times at 1-year intervals, with T2 occurring 1 year after T1, and T3 at 2 years.

Materials

All measures involved used Likert-scale items unless otherwise described. Full-scale scores were averaged across individual items. All control or predictor variables were assessed at T1 unless otherwise noted, whereas all outcome variables were assessed at T3 unless otherwise noted.

AVGs (main predictor). The current study specifically adopted a standardized approach to accessing AVG previously described for this study.[4] Participants rated three video games they currently played and their frequency of play. ESRB (Entertainment Software Ratings Board) ratings for each of the games were used to estimate violent content. For each game, the ordinal value of the ESRB rating (1 = "EC" through 5 = "M") was multiplied by the average daily hours played. A composite score was then averaged from the three games. This measure provides us with an estimate of time spent playing more AVGs. Employment of a standardized assessment for aggressive game play can reduce spuriously high effect sizes due to researcher degrees of freedom, resulting in effect sizes that more approximate population effect sizes.

Demographics (control variables). Sex, age at T1, and mother's reported years of education were used as basic control variables. Time spent gaming at T1 (hours per week) was also used as a control variable as were the prescores (T1 or T2) for each outcome variable as described later. Prescores are essential to control in longitudinal analyses.

For all variables listed later, standardized versions were used. Unless noted later, all question items were used and assessed as mean totals across items.

Family environment (control variable). Given evidence that family environment can influence mental health, a six-item measure of family environment was included ($\alpha = 0.77$[11]). Items asked about whether youth felt it was pleasant living at home, whether they felt accepted, or whether there were too many arguments.

Impulse control problems (control variable). Impulse problems were measured by using a 14-item scale, which assessed inattentiveness, impulsive behaviors, and excitability ($\alpha = 0.67$.[12]). This was included as a control given the relationship between impulsivity and some mental health outcomes such as ADHD.

Somatic complaints (outcome variable). Physical symptoms potentially due to stress were assessed by using a 10-item scale related to issues such as back pain, headaches, etc. ($\alpha = 0.86$ at T1 and 0.88 at T3[13]). Participants were asked how often in the past month they had experienced symptoms such as back pain, trouble sleeping, hand and wrist pain, etc.

Attention deficit/hyperactivity symptoms (ADHD, outcome variable). ADHD symptoms were measured with an 18-item scale (α 0.92 at wave 2 and 0.93 at wave 3[14]). Items asked about fidgeting, blurting out answers, and distractibility. This scale was only administered during waves 2 and 3. As such, the T2 score was used as a control variable.

Depression (outcome variable). Depression was assessed by using the Asian-American Depression Scale,[15] to which the original producers of the Singapore database added two additional items ("My sleep was restless" and "My appetite was poor" from[16]). Questions were asked about hopelessness, thoughts about dying, and persistent sadness. Coefficient alpha for this sample was 0.95 at wave 2 and 0.96 at wave 3. This scale was only administered during waves 2 and 3. As such, the T2 score was used as a control variable.

Anxiety (outcome variable). Anxiety was assessed by using a 20-item scale of child anxiety.[17] Items asked about the degree to which youth experienced nervousness, worrying, and fears. Coefficient alpha was 0.90 at wave 2 and 0.92 at wave 3. This scale was only administered during waves 2 and 3. As such, the T2 score was used as a control variable.

Social phobia (outcome variable). Social phobia was assessed by using a 17-item scale.[18] Questions were asked about shyness around others, fear of interacting with others, or engaging socially in public. Coefficient alpha was 0.93 at wave 2 and 0.92 at wave 3. This scale was only administered during waves 2 and 3. As such, the T2 score was used as a control variable.

Procedures

All analyses were preregistered as described earlier and consisted of OLS regressions using pairwise deletion for ◄AU6 missing data (switching to list-wise deletion did not influence results). All predictors were entered simultaneously, as we

had no theoretical hierarchical model. Five regressions were conducted, one for each of the mental health outcomes. Initially, a sixth regression was planned in the preregistration, examining mental health predictors of AVG exposure at T3. However, on examining the dataset, it became apparent that ESRB ratings were not available for T3 as had initially been expected. Failure to include this analysis was not due to any results obtained. Control variables were consistent in each case and consisted of age, sex, time spent gaming at T1, mother's education, impulse control at T1, family environment at T1 and the T1 (or in some cases for the mental health outcomes where the T1 outcome wasn't available, T2) outcome variable. Consistent with scholarly recommendations,[8] a threshold of $r = 0.10$ was used for interpretation as hypothesis supportive to reduce the potential for false positive outcomes in large samples. Highest collinearity diagnostics were at approximately variable inflation factor of 2.2, which is acceptable. These were for the AVG and time spent gaming variables, not surprisingly.

Results

Construct validity of measures

Two Confirmatory Factor Analyses (CFA) were conducted to examine the factor validity of the measure using EQS6.1. The first CFA combined all the outcome variables of Wave 2 data (Somatic Complaints, Depression, Anxiety, and Social Phobia), and the second CFA combined all the control variable measures (Family Environment, Impulse Control Problems, Attention Deficit/Hyperactivity Symptoms).

The results of the CFA for outcome variable measures (Scaled $\chi^2 = 6331.87$, degrees of freedom [df] = 2217, comparative fit index [CFI] = 0.935, NNFI = 0.931, root-mean-squared error of approximation [RMSEA] = 0.028, 90 percent confidence interval [CI] of RMSEA = 0.027–0.028) and the control variable measures (Scaled $\chi^2 = 5901.42$, df = 2213, CFI = 0.942, NNFI = 0.938, RMSEA = 0.026, 90 percent CI of RMSEA = 0.025–0.027) revealed acceptable fit indices, supporting the factor validity of these measures.

Main results

Results from the regression equations are presented in Table 1. All regression models were significant at $p < 0.001$ for the full model. As can be seen from the results, the most consistent predictors of later mental health symptoms are earlier mental health symptoms. Neither time spent gaming nor AVG use specifically predicted later mental health symptoms. Early problems with impulse control predicted later ADHD, and early issues with family environment predicted later depression.

Discussion

The issue of whether AVGs impact player behavior continues to be controversial. Recent preregistered studies have generally found little evidence to link AVGs to aggressive or violent behavior. The current study sought to expand on this work by conducting a preregistered analysis of the longitudinal impact of AVGs on later mental health symptoms. Results from this study suggest that playing AVGs has little impact on later youth mental health problems. Likewise, time spent gaming in general was not predictive of mental health outcomes, with all effect sizes below our threshold of evidence.

Current results fit with increasing data to suggest that the impact of AVGs is less than had been previously thought. Indeed, using such games may be typical for normal adolescent development.[19] This also suggests that society's fascination with the impact of video games may be particularly well conceptualized via moral panic theory, wherein presumed effects are exaggerated and stakeholders incentivized to promote the idea of such impacts.[20] Evidence suggests that older adults tend to be most concerned about the impact of games, consistent with moral panic theory.[21]

These results also suggest that, clinically, a focus on AVGs is unlikely to be productive in understanding the development of youth mental health issues, including ADHD. This does not mean that other gaming issues such as pathological gaming might not be involved in mental health.[22] However, this does suggest caution in regards to how professional guilds such as the APA and AAP discuss the impact of games on mental health. Current results suggest that professional guilds may wish to revise their public statements on games to be more cautious in asserting either correlational or causal links.

As with all studies, this one has several limitations. As noted earlier, data on T3 AVG use were not available as been

Table 1. Main Hypotheses Regression Outcomes at T3

Predictor	*Somatic*	*ADHD*	*Depression*	*Anxiety*	*Social phobia*
Female sex	0.060	–0.030	0.046	0.041	0.026
Age	0.082	**0.130**	0.053	0.053	0.024
T1 gaming time	0.093	0.024	0.061	–0.050	0.010
Mother's Ed	–0.035	0.021	–0.018	0.000	–0.032
T1 family Env.	–0.063	–0.082	**–0.102**	–0.045	–0.032
T1 impulse control	0.055	**0.159**	0.078	0.059	0.055
T1 (or T2) outcome variable	**0.276**	**0.383**	**0.477**	**0.444**	**0.413**
AVG exposure T1	–0.057	0.004	–0.054	0.043	–0.025
Full model statistics	$R^2 = 0.132$ $F(8, 1846) = 35.14$	$R^2 = 0.286$ $F(8, 1833) = 91.57$	$R^2 = 0.312$ $F(8, 1821) = 104.60$	$R^2 = 0.227$ $F(8, 1834) = 66.96$	$R^2 = 0.190$ $F(8, 1805) = 52.81$

Bolded values are statistically significant with a Bonferroni corrected alpha value of 0.008 adjusted for the six regressions and also meeting the $r = 0.10$ threshold for interpretation. All effect sizes reported are standardized regression coefficients. T2 outcome scores were used as controls for Depression, ADHD, Anxiety and Social Phobia.

ADHD, attention deficit hyperactivity disorder; AVG, aggressive video game.

originally expected during the preregistration. All data are correlational, despite the longitudinal design, so causal claims cannot be made. The data come from a particular sample of Singapore youth, and thus they cannot be generalized to other cultures. And data in the current survey are limited by their self-report nature. Nonetheless, the addition of a preregistered analysis using standardized measurements is a significant potential contribution to the field. Not all control data for T1 were available for each outcome, and thus T2 was used for some. This may create some inconsistencies in the strength of control between analyses given changes in adolescent development across that year.

Concluding thoughts

For nearly four decades, speculation has swirled about the potential impact of AVGs. This study, as well as many other recent studies, suggests that the harmful impact of such games on youth well-being may have been greatly exaggerated. Increasingly, it appears that fictional media have little impact on youth well-being.

AU9 ▶ **Author Disclosure Statement**

No competing financial interests exist.

AU10 ▶ **Funding Information**

References

1. Quandt T, Van Looy J, Vogelgesang J, et al. Digital games research: a survey study on an emerging field and its prevalent debates. Journal of Communication 2015; 65:975–996.
2. Elson M, Ferguson CJ, Gregerson M, et al. Do policy statements on media effects faithfully represent the science? Advances in Methods and Practices in Psychological Science 2019; 2:12–25.
3. Przybylski A, Weinstein N. Violent video game engagement is not associated with adolescents' aggressive behaviour: evidence from a registered report. Royal Society Open Science 2019; 6:171474.
4. Ferguson CJ, Wang JCK. Aggressive video games are not a risk factor for future aggression in youth: a longitudinal study. Journal of Youth and Adolescence 2019; 48:1439–1451.
5. McCarthy RJ, Coley SL, Wagner MF, et al. Does playing video games with violent content temporarily increase aggressive inclinations? A pre-registered experimental study. Journal of Experimental Social Psychology 2016; 67:13–19.
6. Ivory AH, Ivory JD, Lanier M. Video game use as risk exposure, protective incapacitation, or inconsequential activity among university students: comparing approaches in a unique risk environment. Journal of Media Psychology: Theories, Methods, and Applications 2017; 29:42–53.
7. Tortolero SR, Peskin MF, Baumler ER, et al. Daily violent video game playing and depression in preadolescent youth. Cyberpsychology, Behavior, and Social Networking 2014; 17:609–615.
8. Orben A, Przybylski AK. Screens, teens, and psychological well-being: evidence from three time-use-diary studies. Psychological Science 2019; 30:682–696.
9. Nikkelen S, Vossen H, Piotrowski J, et al. Media violence and adolescents' ADHD-related behaviors: the role of parental mediation. Journal of Broadcasting and Electronic Media 2016; 60:657–675.
10. Ferguson CJ. Do angry birds make for angry children? A meta-analysis of video game influences on children's and adolescents' aggression, mental health, prosocial behavior, and academic performance. Perspectives on Psychological Science 2015; 10:646–666.
11. Glezer H. Antecedents and correlates of marriage and family attitudes in young Australian men and women. (1984) *In Social Change and Family Policies. Proceedings of the XXth International Committee on Family Research Seminar Conference* (Vol. 1, pp. 201–255). Melbourne: Australian Institute if Family Studies.
12. Liau AK, Chow D, Tan TK, et al. Development and validation of the personal strengths inventory using exploratory and confirmatory factor analyses. Journal of Psychoeducational Assessment 2011; 29:14–26.
13. Crystal D, Chen C, Fuligni A, et al. Psychological maladjustment and academic achievement: a cross-cultural study of Japanese, Chinese, and American high school students. Child Development 1994; 65:738–753.
14. DuPaul GJ, Power TJ, Anastopoulos AD, et al. (1998) *ADHD Rating Scale-IV: checklists, norms, and clinical interpretation*. New York: Guilford.
15. Woo BSC, Chang WC, Fung DSS, et al. Development and validation of a depression scale for Asian adolescents. Journal of Adolescence 2004; 27:677–689.
16. Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. Applied Psychological Measurement 1977; 1:385–401.
17. Birmaher B, Khetarpal S, Brent D, et al. The screen for child anxiety related emotional disorders (SCARED): scale construction and psychometric characteristics. Journal of American Academic Child Adolescence Psychiatry 1997; 36:545–553.
18. Connor KM, Davidson JR, Churchill LE, et al. Psychometric properties of the Social Phobia Inventory (SPIN). New self-rating scale. The British Journal of Psychiatry 2000; 176:379–386.
19. Olson CK. Children's motivations for video game play in the context of normal development. Review of General Psychology 2010; 14:180–187.
20. Bowman ND. The rise (and refinement) of moral panic. (2016) In: Kowert R, Quandt T, eds. *The video game debate: unravelling the physical, social, and psychological effects of digital games*. New York, NY: Routledge/Taylor & Francis Group, pp. 22–38.
21. Przybylski AK. Who believes electronic games cause real world aggression? Cyberpsychology, Behavior, and Social Networking 2014; 17:228–234.
22. Colder Carras M, Kardefelt-Winther D. When addiction symptoms and life problems diverge: a latent class analysis of problematic gaming in a representative multinational sample of European adolescents. European Child and Adolescent Psychiatry 2018; 27:513–525.

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