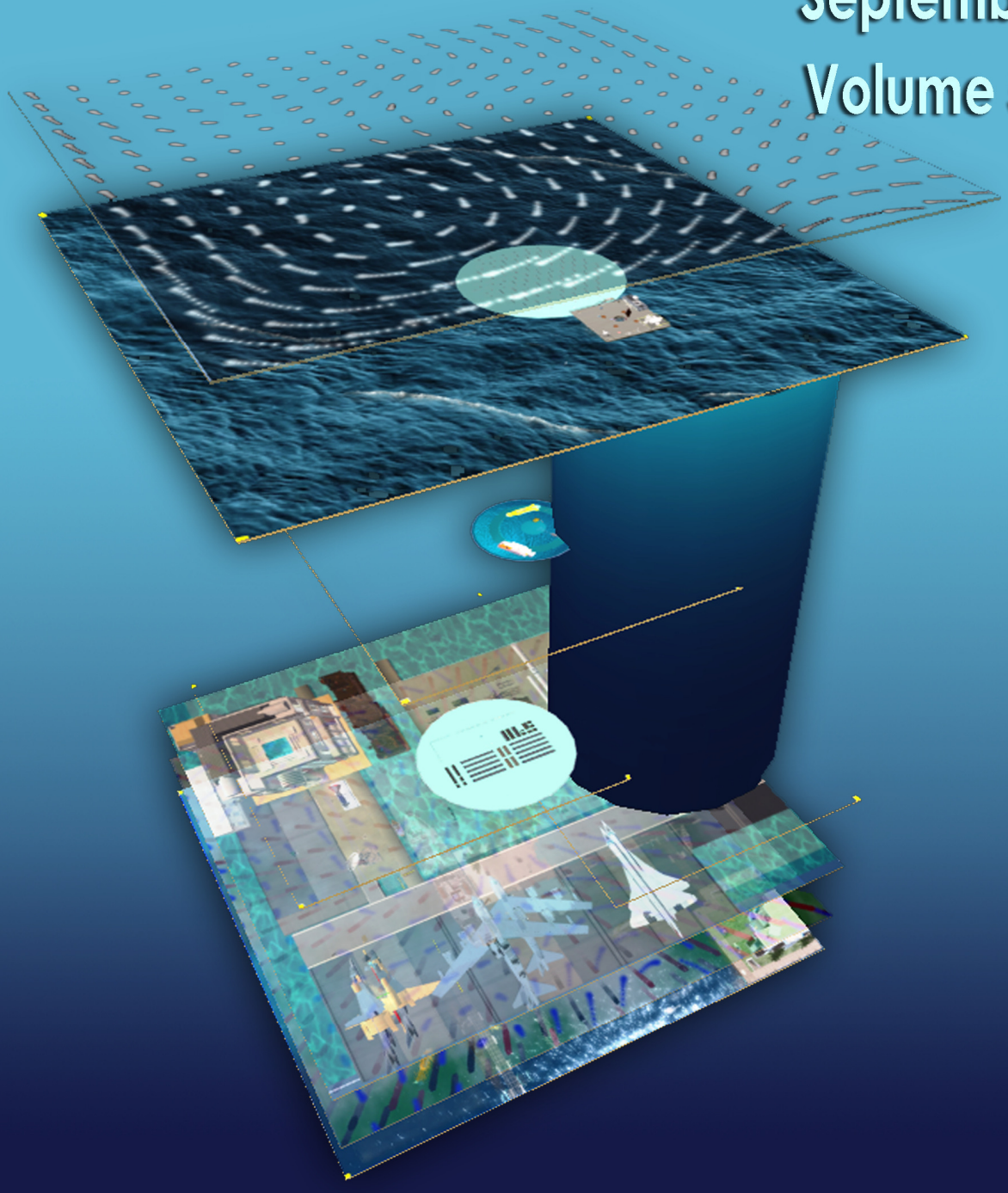
Journal of
Virtual Worlds Research
jvwresearch.org ISSN: 1941-8477

Asian Perspectives

September 2012
Volume 5, No. 2



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Volume 5, Number 2
Asian Perspectives
September 2012

Journal of Virtual Worlds Research
jvwresearch.org ISSN: 1941-8477

Volume 5, Number 2
Asian Perspectives
September 2012

Effects of Digital Game Play Among Young Singaporean Gamers: A Two-Wave Longitudinal Study

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Acknowledgement

This study includes an analysis of longitudinal data and the first wave of data was published previously. An early version of this manuscript was presented at the 2010 Joint World Conference on Social Work and Social Development: The Agenda in Hong Kong, China. The authors would like to thank the Ministry of Education, Singapore and the Media Development Authority for jointly funding the research project (Project EP 1/06 AK). No competing financial interests exist.

Abstract

Using a large sample of Singaporean children and adolescents from primary and secondary schools, this study provides important results on changes in amount of time spent on gaming and violent content exposure, and the effects of such changes on academic performance, pathological gaming, aggressive cognitions and empathic attitudes. This study provided support for the hypothesis that excessive gaming was related to poorer academic performance and more pathological symptoms. For example, Stable-Hardcore students reported the lowest academic performance in both waves with a decreasing trend, and Stable-Casual students reported the highest academic performance. There was also a link between high violent game content exposure and greater approval of aggression as well as lower empathic attitudes. Students with constantly low violence exposure reported higher empathic attitudes, and lower acceptability of aggression. Implications of the study were discussed in relation to the treatment of excessive gaming.

1. Introduction

Digital gaming has become one of the most popular activities among children and adolescents today. In fact, the National Public Radio in the US reported that 3 billion hours are spent in video game play (National Public Radio, 2011). The amount of time that children and adolescents are playing videogames has been steadily increasing over the years (Colwell & Payne, 1997; Subrahmanyam, Kraut, Greenfield, & Gross, 2000; Anderson, Gentile & Buckley, 2007), the fastest increase being among children between the ages of 2 and 5 years (NDP Group, 2011).

Similar changes can be observed in Singapore. In 2004, a study conducted by Parents Advisory Group for the internet (PAGi) reported that 73% of adolescents in Singapore between the age of 13 and 17 years played digital games (Liau, Khoo, & Ang, 2005). Almost 6 years later, a study in 2010 found that 83% of children and adolescents played video games. Boys played 22.1 hours per week, compared to 18.2 hours for girls, averaging 20.2 hours per week (Choo, et al., 2010). Anecdotal accounts from teachers, counsellors and social workers have also reported more cases of students being late for school and being truant in order to devote themselves to video gaming. One counselling centre in Singapore reported an increase of 40% of gaming addiction cases from 2009 to 2010 (Musfirah, 2011). There is also the realization of a growing gap in parental awareness of children and adolescents' Internet use in Singapore (Liau, Khoo & Ang, 2005). Not surprisingly, these trends in the gaming habits are matched by increasing concerns about the negative effects of gaming on the young.

2. Literature Review

2.1 Academic Grades

Although patterns of results has differed across previous studies, there is a preponderance of studies showing that digital game play can have negative effects such as pathological video gaming or addiction, aggressive tendencies and decreasing school grades (Harris, & Wiliams, 1985; Anand, 2007; Anderson, Gentile & Buckley, 2007; Gentile et al., 2011). The "displacement hypothesis" suggests that digital game play may displace time spent in academic activities and thus negatively affect school results (Huston, et al., 1992). Gentile and his colleagues (2004) found that adolescents who had greater exposure to video game violence were not only more hostile and more likely to get into physical fights; they also had more arguments with teachers and had poorer academic grades. Chan and Rabinowitz's (2006) study provides further support for the relationship between excessive game play and poorer grades. Their study showed that students who play videogames for more than one hour a day had lower Grade Point Average scores compared to those who played less than an hour a day.

On the other hand, it has been argued that videogames can promote learning, and several books have been written to support this (for example, Gee, 2003; Prensky, 2006; Shaffer, 2006). Gee (2003) believed that the game world provides ample opportunities for creative solutions and problem-solving skills, which is reflected in 36 learning principles described in his book. Squire's (2003) study of the game *Civilization III* found that students gained a better conceptualization of history, geography and politics and have deeper appreciation of different perspectives. Similarly, Steinkuehler and Chmiel's (2006) analyses of game forums in *World of Warcraft* found evidence of players' scientific literacy demonstrated in their understanding of mathematical models, construction of social knowledge and use of counter arguments. A more recent study by Jackson and her colleagues (2011) found that 12 year-old students who played video games were more creative in drawing pictures and writing stories than their counterparts.

If students who play video games are engaged in learning, to what extent does learning that takes place in the virtual game world transferable to the real world and learning in schools? This study aims to examine if changes in the amount of time spent on video gaming have any effect on academic grades among children and teenagers in Singapore schools. On one hand, it is possible that over a year, students' grades could have improved if they have transferred the skills learned in the games to their studies. On the other hand, time that should have been spent on studies could have been replaced by time spent on gaming, as explained by the "displacement hypothesis".

2.2 Pathological Video Gaming

As seen in studies conducted in the US, Spain, South Korea and China, 8% to 14% of the participating game players manifested pathological gaming symptoms (Choo et al., 2010; Gentile, 2009; Kim, Namkoong, Ku & Kim, 2008; Tejeiro Salguero & Morán, 2002). In Singapore, about 8.7% of children and teenagers who show 5 or more out of 10 symptoms of damage to family, social, school or psychological functioning, can be classified as "pathological players" (Choo et al., 2010).

Pathological video gaming or gaming addiction is not listed in the latest version of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision commonly known as the DSM-IV-TR. This manual is published by the American Psychiatric Association (APA) and covers all mental health disorders for both children and adults. However, the APA has announced the possibility of creating a new category of "behavioral addictions" in the draft diagnostic criteria for the DSM-V. Although not recommended for inclusion in this category, internet-related addiction has been included in the manual's appendix with the goal of encouraging further study (APA, 2010). Some researchers agree that pathological video gaming is similar to pathological gambling as both are considered "behavioural addictions" since both activities are forms of entertainment that can stimulate emotional responses and dopamine release (Koepp, et al., 1998; Holden, 2001). Hence, pathological video gaming has been measured by modifying the criteria in the DSM-IV-TR for pathological gambling. A gamer is classified as being pathological when he or she indicates having at least 5 out of a list of 10 symptoms of damage to family, social, school, and psychological functioning.

Many studies point to the fact that excessive gaming is related to what may be called game "addiction" (Fisher, 1994; Gentile et al., 2011; Griffiths, 2000; Lemmens, Valkenburg & Peter, 2009). Research evidence indicates that pathological gamers spend more time playing than non-pathological gamers (Grusser, et al., 2007; Gentile, 2009). Wood and his colleagues (2007) interviewed 280 gamers about their gaming experiences. Positive effects include temporary escape from reality and relief from stress. They also reported negative effects such as missing important events like meals, school and appointments and sacrificing sleep as a result of losing track of time.

The relationship between excessive gaming and pathological symptoms suggest that if pathological gamers were to decrease the time they spend on gaming, their pathological problems could be alleviated. Hence, this study explores if changes in time spent on gaming are related to changes in pathological gaming. In other words, we hypothesized that gamers who spend lesser amount time over a period of one year would show a decrease in pathological symptoms. Correspondingly, those who increased in their gaming time would show an increase in these symptoms.

2.3 Aggressive Cognitions and Empathetic Attitudes

Studies demonstrating the relationship between video games and aggressive behavior are often criticized, the results as well as the methodology of these studies are often challenged (e.g., Goldstein, 2005, Williams & Skoric, 2005; Ferguson, 2008). However, there is also ample evidence that playing

violent digital games can increase aggressive cognitions as well as aggressive behavior (Anderson & Bushman, 2001; Dill & Dill, 1999; Silvern & Williamson, 1987). Anderson, Gentile, and Buckley (2007) report experimental, correlational, and longitudinal studies demonstrating that children and adolescents who play violent digital games become more aggressive, both immediately after playing and also over long periods of time. Meta-analyses and review studies on the effect of violent games demonstrate increasingly robust effects on increased aggressive thoughts, feelings, and behaviors, and also on decreased pro-social behaviors (Anderson et al., 2010; Anderson & Carnagey, 2004; Griffiths, 1999).

Other studies provide evidence that exposure to violent games is related to decreased empathy in children (Funk, et al., 2002, Bartholow, Sestir & Davis, 2005). On the other hand, playing prosocial games have been found to help increase empathy (Greitemeyer, Osswald & Brauer, 2010). A study on Singapore teenagers also found that playing prosocial games predicted prosocial behaviours in terms of helping others, cooperation and sharing, and empathy (Gentile et al., 2009).

Hence, gamers who play more violent games can be expected to show increased levels of aggression and lower levels of empathy. Conversely, those who play less violent games would show lower levels of aggression and higher levels of empathy. This study also aims to test out this hypothesis by investigating changes in students' violent game content exposure and their aggressive cognitions and empathy with measures collected in 2 waves over a period of one year.

2.4 Purpose of the Study

Digital games can have both positive and negative effects at the same time, and the effects are likely to be dependent on how much time is spent on gaming, what types of games are played, and in what contexts (Gentile & Gentile, 2007; Gentile & Stone, 2005; Khoo & Gentile, 2007). Although there are many international studies on effects of digital gaming, there are not many studies involving longitudinal data with a major focus in an Asian context. This paper is thus an attempt to reveal the effects of Singapore children and adolescents' digital game play based on a two-year short term longitudinal study. This paper focuses mainly on the changes in children and adolescents' amount of time spent on gaming and the relationships of such changes to school performance and the number of pathological symptoms. Besides, the study also explored the relationship between changes of violent content exposure with aggressive cognition and empathic attitudes. This paper aims to provide timely information on digital game effects for parents, educators, policy makers and fellow researchers to make meaningful interpretation of the results and application in real life settings.

3. Materials and Methods

3.1 Participants

The sample comprised a total of 2,998 children and adolescents from Primary schools (N = 1438) and Secondary schools (N = 1260). In this sample, 2,179 were males and 819 were females. The overall average age of participants was 11.2 (*Standard Deviation* (*SD)* = 2.06; primary students *Mean* (*M*) = 9.2, *SD* = 0.7; secondary students *M* = 13.0, *SD* = 0.8). The racial composition was 72.6% Chinese, 14.2% Malay, 8.8% Indian, and 4.3% other races.

3.2 Procedures

Informed consent was sought from the parents through the schools. A liaison teacher from each school collated the information and excluded students from the study whose parents refused consent. Assent was obtained from the students by informing them that participation in the survey was voluntary

and they could withdraw at any time. Confidentiality of the students' responses was assured by requiring the teachers to seal the collected questionnaires in the envelopes provided in the presence of the students.

Paper and pencil surveys were conducted in classrooms with the help of school teachers. The same individual students were followed one year (Wave 2) after the baseline survey at Wave 1. The data used in this study was drawn from a larger scale study. Due to the length of the questionnaire, it was administered in four different orders over a period of four days. The order of these questionnaires was counterbalanced so that they wouldn't be done in the same sequence in the same day for different classes. Part of the data was reported before and the procedures were described elsewhere (Choo et al., 2010).

3.3 Measures

Academic performance. The students reported the results of their last examination on a six point scale as follows: (1) Below 50; (2) 50-59; (3) 60-69; (4) 70-79; (5) 80-89 and; (6) Over 90. An average score of English, Mathematics, Science and Second Language was used to represent students' school performance. Standardized scores for each year were used in the analysis.

Gaming habits. The survey included items assessing children's video game habits adapted from the General Media Habits Questionnaire and the Adult Involvement in Media Scale (Anderson et al., 2007; Gentile, Lynch, Linder, & Walsh, 2004). These items measured weekly amount of video game play and frequency of violent or pro-social content exposure. A sample item for violent or pro-social content exposure is "How often do you shoot or kill creatures /other players in this game?" answered from never to almost always on a four-point scale.

Pathological game use. Pathological gaming was measured with a 10-item scale modified from DSM-IV criteria for pathological gambling (Choo et al., 2010; Gentile, 2009). The scale includes items such as "In the past year, have you become restless or irritable when trying to cut down or stop playing computer/video games?" Participants could respond "no," "sometimes," or "yes" to each of the 10 symptoms. A sum score was used to represent the level of pathological gaming. This scale yielded acceptable reliability (Cronbach α = .71 and .77 for two waves respectively). There is a positive correlation between the two waves ($r=.46$, $p<.001$).

Normative beliefs about aggression scale. This scale from Huesmann and Guerra (1997) was used to measure the students' perception of acceptable aggressive behavior under a general condition or under different types of provocations. The students rated each item on a four-point scale, ranging from 1 "it's really wrong" to 4 "it's perfectly OK". The scale included items such as "in general, it's OK to hit other people" and "suppose a boy says something bad to another boy, John. Do you think it's wrong for John to hit him?" Mean scores were used for all items as a total approval of aggression score, with higher scores indicating higher levels of tolerance of aggressive behaviors. The scale has a reliability of .94 and .95 for two waves.

Children's Empathic Attitudes Questionnaire (CEAQ). There is a total of 15 items measuring the students' empathic attitudes (Funk, Fox, Chan, & Curtiss, 2008). The items were answered on a three-point scale, where 1 is for "no", 2 for "maybe" and 3 for "yes". A total score was used in the analysis. A sample item is "I understand how other students feel". The reliability for this scale is .86 and .87 respectively for two waves.

4. Data Analysis

The students were first divided into different groups based on their changes in frequency of gaming or violent content exposure. A repeated measures ANOVA was then conducted to examine the effects of between-group factor (categories of gamers) and within-group variable (wave) on academic performance, pathological gaming, aggressive cognitions and empathic attitudes. SPSS 16 was used for the data analyses. All analysis were done while controlling for gender, educational level, race and socio-economic status. There were 2641 students who reported gaming time in Wave 1 and 2360 in Wave 2. As there were attrition cases and non-responses in both waves, a missing values analysis was conducted to test the difference in their weekly hours spent on gaming. T-tests showed no significant statistical differences. In other words, the average gaming time for those who dropped out of the project and those who participated in both surveys were essentially the same. A listwise deletion was thus used in each analysis.

5. Results

5.1 Changes in Amount of Time Spent on Gaming

A descriptive analysis was conducted on the number of weekly hours spent on gaming for both waves. Table 1 shows the quartile cut-off points for both waves. The distribution of the time spent on gaming was relatively stable across two waves. On average, primary boys spent 10.5 hours per week on gaming in Wave 1 and 11 hours in Wave 2; primary girls spent 7 and 9 hours respectively. For secondary schools, boys spent 18.5 and 20.3 hours while girls spent 18 and 15.8 hours for Wave 1 and Wave 2 respectively[1].

Table 1: Quartile of gaming hours per week

	Wave 1			Wave 2			
Gender	25%	50%	75%	25%	50%	75%	N
Primary school							
Male	3.5	10.5	27.5	4.0	11.0	26.0	741
Female	2.0	7.0	18.5	3.0	9.0	21.5	316
Total	3.0	9.5	24.5	4.0	10.5	24.5	1057
Secondary school							
Male	8.5	18.5	38.5	9.0	20.3	35.0	886
Female	7.0	18.0	37.1	7.0	15.8	31.6	341
Total	8.0	19.0	39.0	8.0	19.0	34.5	1227

Students' gaming time was categorized as low, medium or high based on 25% and 75% cut-off score for both waves. For example, gaming time below the 25% quartile is deemed as low and the corresponding students are thus labelled "casual" gamers. Those whose gaming time is above the 75% quartile are labelled "hardcore" gamers. The rest who are "medium" with regards to their gaming time are labelled "average" gamers.

Combining both Wave 1 and Wave 2 gaming time, the students were categorized into 9 groups. There are three groups with stable gaming hours, three groups with increased gaming hours and three groups with reduced gaming hours. For example, a student with high gaming hours in Wave 1 and low

[1] Median is used to represent the average number of gaming hours (refer to Table 1)

gaming hours in Wave 2 is categorized as a "hardcore-casual" gamer, indicating that the student who was hardcore in Wave 1, has become a casual gamer in Wave 2. Table 2 shows the mean gaming hours for each group based on 2086 students who reported gaming times for both waves.

Table 2: Gaming hours per week by educational level and gamer category

	Primary School			Secondary School		
Gamer category	Wave 1 M(SD)	Wave 2 M(SD)	N	Wave 1 M(SD)	Wave 2 M(SD)	N
Stable casual	1.0 (1.1)	1.8(1.4)	121	3.0(2.8)	3.2(2.8)	121
Stable Average	10.5(5.4)	11.9(5.2)	290	19.5(7.9)	19.5(7.2)	339
Stable Hardcore	54.9(25.0)	56.0(25.2)	124	69.2(22.2)	64.2(21.7)	141
Casual-Average	1.1(1.1)	10.2(5.1)	108	4.2(2.9)	17.4(6.9)	97
Casual-Hardcore	0.9(1.0)	44.1(21.4)	36	1.7(2.6)	57.2(23.1)	27
Average-Hardcore	13.7(5.6)	49.0(22.9)	107	24.0(8.8)	55.7(21.7)	90
Average-Casual	8.2(4.8)	2.0(1.3)	123	18.4(8.3)	3.4(2.8)	100
Hardcore-Average	53.8(25.6)	13.9(5.9)	108	64.3(19.8)	23.2(7.6)	82
Hardcore-Casual	54.6(26.6)	1.4(1.5)	39	71.3(23.5)	2.5(3.0)	33

5.2 Effects on Academic Results

Table 3 presents changes in students' gaming time and academic performance over a year. There is a significant wave and category interaction, $F(8, 1675) = 4.47$, $p<0.01$, partial eta squared $= .02$.

Stable gaming hours. Students who play longer hours in both waves reported consistently lower scores in their grades compared to those who play shorter hours in both waves, $F(2, 1033) = 38.19$, $p < 0.01$, partial eta squared $= .069$.[2] To be more specific, Stable-Hardcore gamers reported significantly lower academic performance in both waves with a decreasing trend. Stable-Casual gamers reported the highest academic performance in both waves, and Stable-Average gamers in the middle with an increasing trend (Table 3).

Increased gaming hours. The three groups with increased gaming hours also have different academic results, $F(2, 411) = 30.49$, $p < .05$, partial eta squared $= .017$. Consistent with expectations, the Average-Hardcore reported lower academic performance than Casual-Average students. The three groups with the lowest Wave 1 academic performance are the Casual-Hardcore, Average-Hardcore and Stable Hardcore, two of which are the groups with increased time of gaming.

Decreased gaming hours. The three groups with reduced time of gaming also have different academic results, $F(2, 432) = 7.53$, $p < 0.01$, partial eta squared $= .034$. Students in Average-Casual group reported higher academic performance than the other two groups. Students who showed the largest decrease in academic performance belong to the Hardcore-Casual groups ($t(134) = 2.38$, $p < 0.05$).

[2] Mean difference between "stable hardcore" and "stable casual" is - 0.73, $p<0.001$; mean difference between "stable hardcore" and "stable Average" is -0.5, $p <0.001$; mean difference between "stable Average" and "stable casual" is -0.23, $p<0.05$.

Table 3: Changes in gaming time and academic performance

	Wave 1		Wave 2		
	M	SD	M	SD	N
Stable Casual	0.32	0.88	0.38	0.96	216
Stable Average	0.07[1]	0.97	0.16[1]	0.91	585
Stable Hardcore	-0.31[2]	0.95	-0.45[2]	0.96	243
Casual-Average	0.14	0.92	0.11	0.96	186
Casual-Hardcore	-0.13	0.98	-0.02	1.10	57
Average-hardcore	-0.16	1.08	-0.18	1.05	179
Average-Casual	0.21	0.93	0.30	0.93	203
Hardcore-Average	-0.03	1.14	-0.17	1.03	177
Hardcore-Casual	-0.03[3]	0.93	-0.41[3]	1.14	65

Note. [1, 3] $p < 0.01$, [2] $p < 0.05$

5.3 Effects on Pathological Gaming

Stable gaming hours. The Stable-Casual group reported the least pathological symptoms in both waves, and the Stable-Hardcore group reported the most symptoms, with Stable-Average group in between. Post hoc analysis revealed a significant mean difference between all the three groups, $F(2, 1033) = 37.20$, $p < 0.01$, partial eta squared = .067.

Increased gaming hours. The three groups with increased time of gaming also showed significant differences in pathological symptoms, $F(2, 411) = 4.53$, $p < 0.05$, partial eta squared = .022. Casual-Average group reported fewer symptoms than Average-Hardcore groups for both waves ($p < 0.01$). Among the three groups, the Casual-Hardcore group showed the highest increase of pathological symptoms from 1.53 to 2.77 ($t(113) = -2.88$, $p < 0.01$) while the other two groups remained relatively stable.

Decreased gaming hours. The three groups with reduced time of gaming also showed significant differences in pathological symptoms, with the Average-Casual group reporting significantly fewer symptoms than the other two groups ($F(2, 432) = 7.91$, $p < 0.01$, partial eta squared = .035). The three groups showed a consistent pattern of decreased pathological gaming symptoms. Not surprisingly, the Hardcore-Casual groups on average reduced pathological symptoms from 3 to 2, which is the largest decrease among the three groups ($t(133) = 3.03$, $p < 0.01$). Table 4 presents the average pathological symptoms reported by each group in both waves.

Table 4: Changes in gaming time and pathological symptoms

	Wave 1		Wave 2		
	M	SD	M	SD	N
Stable Casual	1.22	1.31	1.15	1.45	218
Stable Average	2.30[1]	1.65	2.00[1]	1.69	564
Stable Hardcore	3.39	1.88	3.21	2.03	243
Casual-Average	1.79	1.55	1.92	1.63	182
Casual-Hardcore	1.53[2]	1.32	2.77[2]	2.30	52
Average-hardcore	2.84	1.82	2.85	2.02	179
Average-Casual	2.18[3]	1.63	1.54[3]	1.55	201
Hardcore-Average	3.12[4]	2.01	2.56[4]	1.97	170
Hardcore-Casual	3.03[5]	2.08	1.96[5]	1.78	64

Note.[1-5] $p < 0.01$

5.4 Effects on Aggressive Cognition and Empathic Attitudes

Violent game exposure is measured by multiplying the level of violence experienced in each game by the weekly hours of gaming. A mean score was used across three games listed by the students. The violent game content exposure was further categorized as either high or low, based on median split for both waves. As a result, the students with high exposure in both waves were labelled "constantly high exposure" group. Similarly, the other three groups were "constantly low exposure", "increased exposure" and "decreased exposure".

Table 5 presents the students' changes of violent game content exposure. There were significant gender ($F(1, 1873) = 174.12$, $p < 0.001$) and educational level differences ($F(1, 1873) = 46.06$, $p < 0.001$) across two waves. The result suggests that boys and secondary school students generally reported higher violent game content exposure than girls and primary school students. The wave and gender interaction is also significant, $F(1, 1873) = 5.28$, $p < 0.05$. It suggested that boys' violent game exposure increased while girls' remained relatively stable.

Table 5: Violent game content exposure by gender and educational level

Gender	Wave 1		Wave 2		N
	M	SD	M	SD	
		Primary school			
Male	3.82[1]	4.15	4.16[1]	4.04	713
Female	1.85	2.62	1.72	2.78	291
Total	3.25	3.87	3.45	3.88	1004
		Secondary school			
Male	5.25[2]	4.61	5.83[2]	4.78	702
Female	2.86	3.60	2.72	4.20	171
Total	4.78	4.53	5.22	4.83	873
		Total			
Male	4.53	4.44	4.99	4.50	1415
Female	2.22	3.05	2.09	3.41	462
Total	3.96	4.26	4.27	4.44	1877

Note.[1] $p < 0.05$, [2] $p < 0.01$

Figure 1 and 2 presents the line graphs for total approval of aggression and empathic attitudes by violent game content exposure. For total approval of aggression, there was significant group difference ($F(3, 1717) = 11.07$, $p < 0.01$, partial eta squared = .02). Students in the constantly high exposure group reported higher level of acceptability of aggression in both waves. For students in the constantly low exposure group, their level of approval of aggression was consistently lower. The wave and group interaction was significant ($F(3, 1717) = 5.07$, $p < 0.01$, partial eta squared = .01). It indicates that different groups' approval of aggression changed differently from Wave 1 to Wave 2. More specifically, students in the increased exposure group reported significant increase in the approval of aggression while all the other groups remained relatively stable (Table 5).

Table 6: Total approval of aggression and empathic attitudes by violent game content exposure

Violent game exposure	Wave 1		Wave 2		
	M	SD	M	SD	N
Total approval of aggression					
Constant low	1.72	0.65	1.68	0.61	542
Increased	1.76[1]	0.67	1.91[1]	0.72	287
Decreased	1.80	0.64	1.77	0.66	314
Constant high	1.90	0.68	1.96	0.72	587
Total	1.80	0.66	1.83	0.69	1730
Empathic attitudes					
Constant low	2.40	0.37	2.41	0.36	540
Increased	2.33	0.40	2.33	0.41	281
Decreased	2.33	0.40	2.34	0.37	300
Constant high	2.25	0.41	2.24	0.40	574
Total	2.33	0.40	2.33	0.39	1695

Note.[1] $p < 0.01$

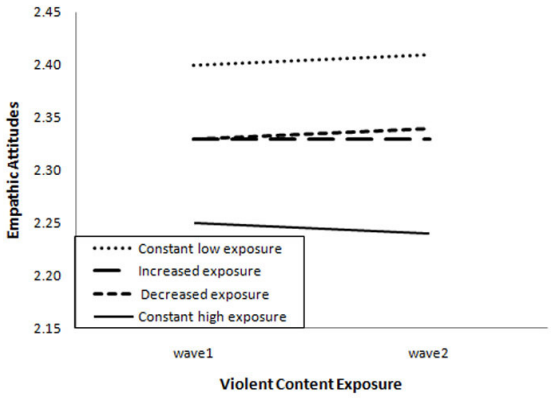

Figure 2. Empathic attitudes by violent game content exposure

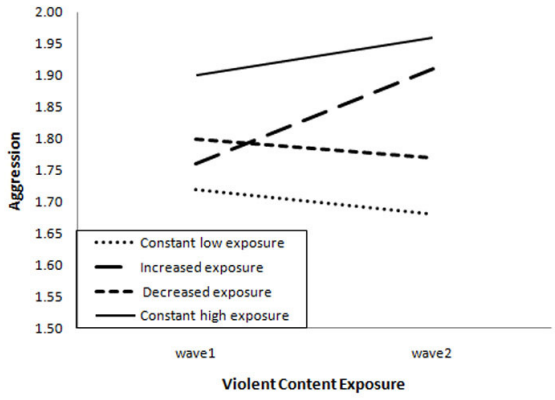

Figure 1. Total approval of aggression by violent game content exposure

For empathic attitudes, the group difference was also significant ($F(3, 1682) = 12.26$, $p < 0.01$, partial eta squared = .021)[3]. Students in the constantly high violence exposure group reported lower levels of empathy in both waves. For students in the constantly low exposure group, their level of empathic attitude was consistently higher. The wave difference as well as the wave and group interaction was non-significant. It indicates that different groups' level of empathic attitudes were relatively stable from Wave 1 to Wave 2.

6. Discussion

Using a large sample of Singaporean children and adolescents from primary and secondary schools, this study provides important results on changes in time spent on gaming and violent content exposure over a year and the effects of such changes on academic performance, pathological gaming, aggressive cognitions and empathic attitudes. As mentioned, the students were categorized into 9 groups according to the number of hours spent on gaming per week and whether it increased, decreased or remained stable from Wave 1 to Wave 2. The results showed that majority of the students are Stable-Average gamers over a year.

The study results indicate a positive relationship between longer gaming hours and poorer academic performance. Stable-Hardcore students reported the lowest academic performance in both waves with a decreasing trend in grade, and Stable-Casual students reported the highest academic performance. This is consistent with previous studies in other countries in that the amount of game play is directly related to poorer academic performance (Anderson & Dill, 2000; Gentile et al., 2004). Despite the research showing that games can promote learning (e.g., Gee, 2003; Prensky, 2006; Shaffer, 2006), the kind of learning that takes place in games does not seem to be related to academic performance. Increase in gaming hours does not contribute to any improvement in academic results but may instead lead to a decrease in the grades. It is also possible that students who did badly in their studies may turn to the gaming world to seek solace.

The result also provides further support for the positive relationship between longer gaming hours and more pathological symptoms. Stable-Casual group reported the fewest pathological symptoms in both waves while Stable-Hardcore group consistently reported the most symptoms. All the groups with decrease in weekly hours spent on gaming reported significantly fewer pathological symptoms in Wave 2 than Wave 1. Students with the most drastic increase in gaming time (Casual-Hardcore gamer) also showed significant increase in pathological symptoms over a year. In line with previous study findings (Gentile, 2009, Grusser, et al., 2007, Tejeiro Salguero & Morán, 2002), the results imply that a reduction of gaming hours may alleviate pathological symptoms. Thus, help rendered to children and teenagers with excessive gaming or pathological gaming symptoms should incorporate time management and self-regulatory skills. These skills can be encouraged through peer mentoring and parental supervision.

For violent content exposure, the results are also consistent with previous studies (Anderson & Bushman, 2001; Gentile & Stone, 2005). There was a link between high violent game content exposure and greater approval of aggression as well as lower empathic attitudes. Students with constantly low violence exposure have higher empathic attitudes, and lower acceptability of aggression. In contrast, students with constantly high violence exposure have lower empathic attitudes and higher acceptability of aggression in both waves. The result also supports the General Aggression Model (Anderson et al., 2007) in that violent game play can increase children's hostile attribution biases, and their beliefs about the acceptability of aggression in real life. Specifically, results also reveal a worrying trend of older boys

[3] The results are essentially the same while including prosocial game exposure as covariate.

preferring games that involved more violent game content. This could be due to changes in their preference for more fighting games and game genres like First-person shooter games. Older boys are also more able to access games with higher ratings. Nonetheless, they need to be aware that continuous exposure to violent content can lead to de-sensitization and increased approval of aggression. They need to become more sensitive to their own aggressive cognitions as well as behaviours, and be mindful of how virtual in-game aggression can be transferred to real-life situations. Educational programs that involve social and emotional learning can help increase awareness of violent content of digital games for both youths as well as parents.

In sum, this study provided support for the hypothesis that excessive gaming is related to poorer academic performance, more pathological symptoms and that excessive exposure to violent games is related to higher aggressive cognitions and lower empathy. However, several questions remain to be addressed in future work. This study only used data for two waves. It is unknown whether the relationships identified in this study will remain in the long term. It is also unknown who is at greatest risk of excessive gaming, how long the problem persists, what are the protective factors and what types of help would be most effective. Long-term longitudinal studies are needed to test the above questions, and research using other samples is required to replicate the findings of this study to enhance generalizability.

Nevertheless, this study's primary strength is its large sample size and two-wave longitudinal data. Compared to cross-sectional data, this study provides more revealing results about the changes across time regarding the most debated topic on digital games. Certainly, the results of this study indicate the need for parents, educators and professional practitioners to consider the problem of excessive digital gaming among youth in a more dynamic and comprehensive manner, and highlight that the importance of managing time spent on gaming, cannot be understated for children and teenagers' learning and healthy psychosocial development.

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