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Pathological video-gaming among youth: A prospective study examining dynamic protective factors

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Abstract

The primary aim of the study was to understand the phenomenon of pathological video-gaming by identifying protective factors for its development, and examining the dynamic interplay between protective factors and pathological video-gaming within a framework of change. The study was a 2-year longitudinal study involving 3034 children and adolescents recruited from 6 elementary and 6 secondary schools. Controlling for initial levels of pathological video-gaming, personal strengths and familial factors such as parent–child connectedness, and warm family environment were found to be protective factors for later pathological gaming. Increases in levels of emotional regulation and family environment warmth were related to decreases in pathological video-gaming. Higher initial levels and increases in pathological video-gaming were related to higher levels of later depressive symptoms, controlling for earlier levels of depressive symptoms. The study adds to the growing evidence that pathological video-gaming has potentially serious mental health consequences, in particular, on depression. For health providers who work with pathological video-gamers, the findings suggest that developing self-regulatory skills such as emotional regulation, and improving the family environment are useful strategies.

Keywords

Depression, latent growth modeling, longitudinal study, pathological video-gaming, risk and protective factors

History

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Introduction

Video-gaming has become a pervasive part of the lives of children and adolescents today (Livingstone, Haddon, & Gorzig, 2012; Wang et al., 2013). Although several positive effects of video-games have been documented (Gentile et al., 2009; Rosser et al., 2007), psychologists, parents, and researchers have become concerned about the possible negative effects of such pervasive video-gaming among children and adolescents. In particular, there has been concern about pathological patterns of behaviour with video-games as well as other computer and Internet-related technologies. Recent studies conducted in China (Wang et al., 2013), Singapore (Choo et al., 2010), South Korea (Falola, 2006), Spain (Tejeiro Salguero & Bersabé Moran, 2002) and the U.S. (Gentile, 2009) have reported that 8–14% of their study participants were classified as pathological video-game users.

Initially, research in this area focused on either Internet use in general or on video-gaming, and has used the term addiction (Shaffer, Hall, & Vander Bilt, 2000). More recently, researchers have started using definitions of pathological video-gaming similar to the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria for pathological gambling or gambling disorder as both are considered behavioural addictions (Holden, 2001). In fact, the American Psychiatric Association has created of a new category of ''behavioural addictions'' in the revised diagnostic criteria for the DSM-5 (APA, 2013). Although not recommended for inclusion in this category, internet-related gaming addiction has been included in the manual's appendix as internet gaming disorder with the goal of encouraging further study. The parallel between pathological gambling and video-gaming seems justifiable as both are games that are rewarding to the player, and can stimulate emotional responses and dopamine release (Kuss & Griffiths, 2012). Both gambling and video-gaming are not initially pathological activities, but they can become pathological for some people when the activities become compulsive, and start producing negative consequences to psychosocial adjustment. Nevertheless, there is still considerable debate regarding how best to define such behavioural addictions (Hellman, Schoenmakers, Nordstrom, & van Holst, 2013). For instance, Kardefelt-Winther (2014a) argues that excessive internet use can be better conceptualised as compensatory internet use as this approach highlights motivational factors that are helpful in ''explaining why certain individuals use the internet excessively despite experiencing negative outcome'' (Kardefelt-Winther, 2014b, p.118). Our current understanding of the literature and the APA's position is that a disease model may be useful for understanding

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Internet Gaming Disorder, in that there appear to be several similarities across studies: There appear to be risk factors that can predict who is more likely to become ''addicted,'' once addicted it does not appear to be easy to stop without help, there are predictable outcomes, and certain types of treatment can help. In this it is similar to other addictions (and many other diseases). Nonetheless, it is reasonable to ask whether a disease model is needed, and whether a less restrictive psychological model of maladaptive behaviour patterns might not be equally useful (Kardefelt-Winther, 2014c).

The purpose of this study was not to resolve these debates, but to utilise data from a prospective study to help us to better understand this phenomenon. One of the arguments for its inclusion in the appendix of the DSM-5 was to encourage more research on the etiology, comorbidities, course and treatments of pathological video-gaming. This study seeks to gain a better understanding of this phenomenon by identifying protective factors for the development of pathological video-gaming, and examining the dynamic interplay between protective factors and pathological video-gaming within a framework of change; in other words, how is change in a protective factor related to change in pathological video-gaming. In addition, as pathological video-gaming is often comorbid with other problem behaviours, in particular, depression (Ha, Kim, & Choi, 2007; Morrison & Gore, 2010), this study hopes to understand how changes in the protective factors and pathological video-gaming are related to depression. Examining this issue is important as it helps to shed light on whether mental health problems such as depression are causes or consequences of pathological video-gaming. For instance, while Ko, Yen, Chen, Yen, & Yen (2009) found that depression is a predictor of later pathological internet use, Lam and Peng (2010) found that pathological internet use was a predictor of later depression.

Research from the field of developmental psychopathology has informed us that risk and protective factors do not function in a static manner. Rather, there is an ''ongoing dynamic progression among the various risk processes involved in shaping the developmental course of the individual and contributing to maladaptive and psychopathological processes'' (Cicchetti, 2006, p.10). The present study focused on protective factors rather than risk factors as there has been a great deal of research on the latter but not the former (Kardefelt-Winther, 2014a).

Research in the area of resilience has suggested that a cascade effects model is useful in conceptualising protective factors. Dynamic systems theory posits that small changes in one area of functioning can trigger a chain of consequences that can snowball into large developmental effects (Sameroff, 2000). Cascade effects can spread over time, across domains, levels, persons, and generations (Masten & Narayan, 2012). Prot and Gentile (2014) have discussed how a cascade effects model is useful in conceptualising the findings of research on the effects of media violence on development; the effects of media violence can trigger cascading effects in different domains over time. They also pointed out that protective factors can also lead to cascading effects with regards to positive development in various domains over time. For example, in the resilience research, there is evidence that having a caring relationship with an adult can be a vital protective factor that can lead to positive outcomes in the future for at-risk youths (Werner & Smith, 2001). Research into children living in high-risk environments has indicated that there are three sets of factors that are important in the development of resilience: (1) personal strengths, (2) characteristics of the family, and (3) characteristics of the wider community (e.g. schools) that are related to healthy adjustment in school and society (Luthar, Cicchetti, & Becker, 2000). The present study focused on personal strengths and characteristics of the family as protective factors.

Personal strengths are the individual characteristics of children associated with healthy development and life success (Benard, 2004). These personal strengths have been synthesised from decades of research on risk and protective factors associated with well-adjusted development. In the framework developed by Liau, Tan, Li, and Khoo (2012), personal strengths consist of five components: emotional awareness, emotional regulation, goal setting, empathy and social competence. The various components of personal strengths have been found to be related to externalising and internalising behaviours, including depression (Liau, Chow, Tan, & Senf, 2011a), as well as pathological video-gaming (Liau, Neo et al., 2011b). As these personal strengths are self-regulatory in nature, Seay and Kraut (2007) have argued that such competencies are essential in allowing video-gaming to be a harmless and enjoyable pastime rather than a destructive preoccupation. It is hypothesised that the various components of personal strengths would be protective factors against pathological video-gaming and depressive symptoms.

In addition, familial protective factors, such as parent-child connectedness, parental involvement in the child gaming and family environment are also investigated. In the area of addiction, numerous studies have found significant associations between family factors and various addictive behaviours, including substance abuse (Walters, 1999) and gaming or Internet addiction (Chiu, Lee, & Huang, 2004; Yen, Yen, Chen, Chen, & Ko, 2007) with some of the studies based on various theoretical models for addiction, such as theory of co-dependency (Loughead, 1991), social control theory (Yen et al., 2007) and interpersonal theory (Liu & Kuo, 2007), and the like. Furthermore, those prior studies, regardless of which theoretical model the study is based on, have accumulated consistent empirical evidence for the protective effect of healthy family functioning or positive family environment against addiction. Depending on which theoretical angle a study takes, however, ''how'' healthy family functioning or positive family environment protects one from being addicted is explained differently. In the theory of co-dependency proposed by Loughead (1991), for example, it can be hypothesised that pathological video-gaming, similarly to other types of addiction, can be developed as the result of long-term exposure to highly stressful family relationships, which may be the present living situation, or the dysfunctional family of origin in the past. On the other hand, the protective effect of family functioning/environment on pathological video-gaming can also be explained from social control theory: when adolescents experience higher conflicts with parents due to poor family functioning, they would be less likely to conform to their parents' request, including rules set for video-game play or Internet use, which can contribute

to excessive playing of video-games, increasing the risk of addiction to it (Yen et al., 2007). Also, healthy family functioning or environment may represent the family's capacity to provide a wider variety of education and leisure opportunities for children, which facilitates not only those children's healthy social adjustment, but also can prevent them from being easily addicted to a single leisure activity such as video-gaming (Chiu, Lee, & Huang, 2004). All these empirical findings and theoretical explanations converge to indicate the significance of healthy family functioning and environment as a protective factor against addiction, and suggest that how it acts as the protective factor is probably a mixture of all of the above explanations: it is probably the overall dynamic of less stressful and less harsh family relationships and environment, and the positive parent-child interactions and conducive education and leisure activities experienced within that reduces the risk of being addicted to gaming. In line with this integrative perspective about the protective role of family, family-based treatments, combined with other therapeutic approaches, such as cognitive-behaviour therapy, for addiction in general and gaming or Internet addiction have been widely advocated and performed (Liddle & Hogue, 2001; Liu, Liao, & Smith, 2012). However, despite the robust empirical evidence for the protective effect of healthy family functioning and environment, a caution must be exercised not to equate the lack of the protective factor to a cause of gaming addiction as there is little scientific research that can establish the causal relationship of family functioning with pathological video-gaming due to its theoretical and methodological limitations: the significant negative association between healthy family functioning and pathological video-gaming that have been found so far only suggests that people are likely to present fewer pathological symptoms of video-gaming when their family functioning and environment are healthy and positive for the above-explained reasons, than when they are not. As such, it is hypothesised that family factors such as parent–child relationship and the quality of the family environment would be protective factors against pathological video-gaming (Choo, Sim, Liau, Gentile, & Khoo, 2014).

In order to identify the protective factors associated with pathological video-gaming, longitudinal data are needed. With the exception of a few studies (Gentile et al., 2011; Lam & Peng, 2010), almost all of the studies that have been conducted have relied on correlational data at a single point in time or case studies. Gentile et al. (2011) utilised latent class analyses to create four groups of gamers – those who were never pathological, those who became pathological, those, who stopped being pathological, and those who stayed pathological over a two-year period. The study indicated that youth who were more impulsive, had lower social competence, empathy and poorer emotional regulation skills were more likely to become pathological gamers.

The present study adds to Gentile et al.'s (2011) findings in the following ways. First, a variable-oriented approach was utilised to identify protective factors for pathological video-gaming instead of the person-oriented approach utilised in Gentile and colleagues. Both approaches have its advantages and disadvantages. A strength of the person-oriented focus is the ability to structure variables in naturally occurring configurations whereas an advantage of the variable-oriented approach is that is often maximises statistical power, and is well suited for identifying factors that have implications for intervention (Masten, 2001). Second, the present study sought to provide a more comprehensive analysis by examining an array of personal and family factors as relevant protective factors. Family factors were not examined in the earlier study. Third, the present study examined the dynamic interplay between protective factors and pathological video-gaming by using dual trajectory latent growth models within a framework of change. Most studies identifying risk and protective factors tend to examine how one variable is correlated (e.g. the risk factor) to the outcome variable. Fewer studies utilise a framework of change to examine how change in the risk or protective factor is related to changes in the outcome variable (Henry, 2010). Latent growth analysis has become an important approach in studying change as it models both the intercept (i.e. initial level), and the slope (i.e. the rate of change over time) for a construct. Dual trajectory growth modeling examines the growth of two constructs, and thus allows us to investigate how changes in a protective factor are related to changes in pathological video-gaming (Bollen & Curran, 2006). Although this approach has not been used in the study of pathological video-gaming, researchers have started using dual trajectory growth models in examining the dynamic relationships between risk factors of drug addiction and drug use (Henry, 2010; Wills, Sandy, Yaeger, & Shinar, 2001). For instance, Henry (2010) examined the correlated growth trajectories between academic achievement and drug use. In our study, a framework of change using the dual trajectory growth models was utilised to address the primary objective of this study which was to examine the dynamic interplay between various protective factors (personal and familial) with pathological video-gaming.

Longitudinal research has shown that pathological video-gaming can lead to negative mental health consequences such as depression, anxiety and social phobia (Gentile et al., 2011); pathological Internet use has been linked to later depression (Lam & Peng, 2010). However, these studies did not examine how changes in pathological video-game or Internet use were related to changes in depression. Utilising the framework of change described above, a secondary purpose of the study was to examine how changes in protective factors and pathological video-gaming would be associated with later depressive symptoms, controlling for an earlier level of depressive symptoms. Consistent with a cascade effects model where protective factors can lead to positive development across domains, it is expected that positive changes in protective factors would be related to positive changes in pathological video-gaming and depressive symptoms.

In summary, we were interested at whether the following protective factors predicted pathological video-gaming and depressive symptoms: personal strengths including emotional awareness, emotional regulation, goal setting, empathy, and competence, and familial factors including parent-child connectedness, parental involvement in media, and family environment. Finally, we examined depressive symptoms as a possible negative mental health outcome of pathological video-gaming.

Method

Participants and procedure

Data for this study were drawn from a large scale research project entitled ''Effects of Digital Gaming on Children and Teenagers in Singapore (EDGCTS)''. The EDGCTS study is a four-wave longitudinal survey examining the positive and negative effects of digital games on children and adolescents in Singapore. The current study utilised Wave 1, Wave 2 and Wave 3 data involving personal strengths, parental variables, depressive symptoms, and pathological symptoms of video-gaming to test the study hypotheses formulated.

Totally 3034 children and adolescents from grades 3 ($N = 743$), 4 ($N = 711$), 7 ($N = 916$), and 8 ($N = 664$) were recruited from 6 elementary and 6 secondary schools, 5 of which were boys' schools. These students were surveyed annually between 2007 and 2009. Parental consent was gathered by schools. Overall participation was 99%. Surveys were conducted in classrooms by teachers who had been trained by the research team.

Of the consented participants, 2998 completed a survey at Time 1 (2179 males and 819 females; 72.6% Chinese, 14.2% Malay, 8.8% Indian, and 4.3% other races). 60 students did not provide identifying information and were lost to follow-up (leaving 2974). 2605 and 2532 questionnaires were collected in years 2 and 3, respectively, yielding attrition rates of 12.3% by Time 2 and 14.7% by Time 3. Comparisons of dropouts with remaining participants at T3 showed no difference in their T1 and T2 levels of pathological gaming symptoms. Attrition was due mainly to administrative reasons rather than students' refusal to participate. At Time 1, four classes at each educational level were selected to participate. The students were re-assigned to different classes each year, making tracking and surveying of students difficult. Most students, however, stayed within the same schools across all three years.

Measures

Personal strengths were measured using the Personal Strengths Inventory-2 (PSI-2; Liau et al., 2012). It contains 21 items and covers the following five subscales: emotional awareness, emotional regulation, goal setting, empathy and social competence. Respondents answered based on a four-point Likert scale ranging from strongly disagree (1) to strongly agree (4). The higher the score, the greater the level of strength.

Familial factors included parent–child closeness which was measured with six items from a parent-family connectedness scale, originally developed by Resnick et al. (1997). Respondents were asked to indicate their agreement level from strongly disagree (1) to strongly agree (4) on three statements for each parent – mother and father respectively, e.g. ''I feel close to my mother/father''. Adult involvement in media was a 10-item scale to measure parental involvement in their children's game playing. The scale was adapted from the Adult Involvement in Media Scale (Anderson, Gentile & Buckley, 2007) and a parent supervision scale (Abelman & Petty, 1989). A sample item includes ''My parents restrict or ban me from playing certain videogames they consider undesirable''. Respondents were asked to indicate the frequency of their parents' involvement on a 4-point scale from never (0), one or two times a month (1), one or two times a week (2), to every day or almost every day (3). Family environment was based on a 6-item scale adapted from Glezer (1984) to measure students' perceptions of the home living environment, e.g. ''It is pleasant living with my parents and family'' on rated from strongly disagree (1) to strongly agree (4).

Pathological video-gaming was measured with a 10-item instrument derived from the pathological gambling items of the DSM-IV. This scale had been used previously in a national study of American youth (Gentile, 2009), and has been validated with Singaporean youth (Choo et al., 2010). Participants could respond ''no'', ''sometimes'', or ''yes'' to each of the 10 symptoms, and each item was scored 0, 0.5, or 1, respectively. A sample item is ''In the past year, has your schoolwork suffered because you spent too much time playing computer/video-games?''

Depressive symptoms was measured based on the 22-item scale that consisted of the 20-item Asian Adolescent Depression scale (Woo et al., 2004) and 2 items from the Center for Epidemiological Studies – Depression scale (Radloff, 1977). Items were rated on a 5-point scale from strongly disagree (1) to strongly agree (5). The Cronbach's α for all the measures are reported in Table 1.

Table 1. Cronbach's α for the measures.

	Time 1	Time 2	Time 3
Personal Strengths			
Emotional Awareness	0.73	0.81	0.80
Emotional Regulation	0.62	0.71	0.73
Goal Setting	0.71	0.76	0.76
Empathy	0.86	0.87	0.86
Social Competence	0.73	0.77	0.80
Familial Factors			
Parent-family connectedness	0.90	NA	0.89
Adult involvement in media	0.83	0.85	0.88
Family environment	0.77	0.81	0.83
Pathological video-gaming	0.71	0.77	0.79
Depressive symptoms	NA	0.95	0.96

Data analysis

In order to examine whether the protective factors predicted pathological video-gaming, both linear and logistic regression analyses were run with pathological video-gaming at T3 as the outcome variable; pathological video-gaming at T1 and the protective factor were predictors. In the linear regression analyses, pathological video-gaming was analysed as a continuous variable representing the number of pathological symptoms. In the logistic regression analysis, pathological video-gaming was analysed as a dichotomous variable based on the 5-criteria cutoff (Gentile, 2009). Both linear and logistic regression analyses were used to determine whether there would be any differences in the results if pathological video-gaming was treated as a continuous or dichotomous variable.

A dual trajectory growth model, estimated in a structural equation modeling framework (Henry, 2010), was used to

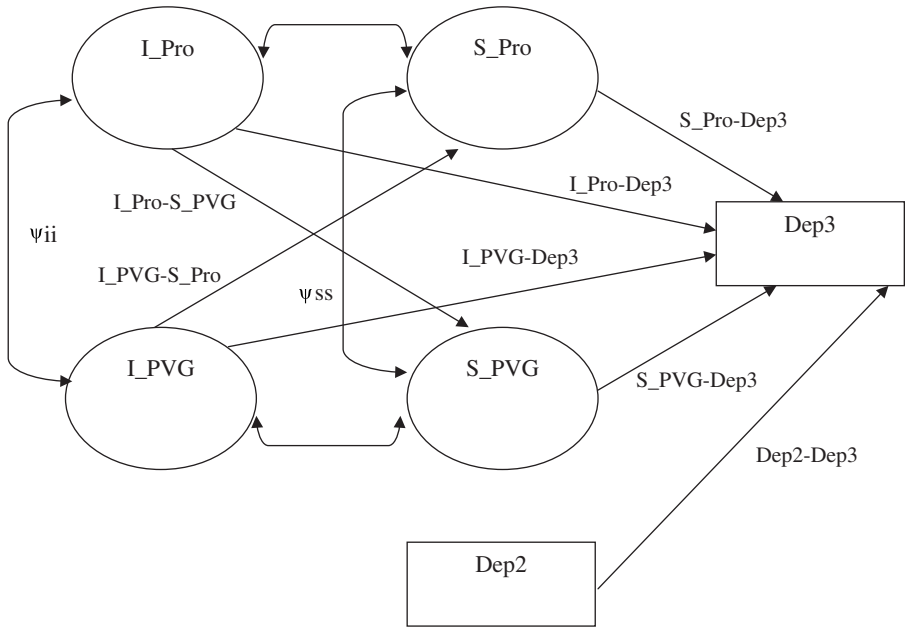

Figure 1. Dual trajectory growth model relating the protective factor, pathological video-gaming, and depressive symptoms. Pro: Protective Factor; PVG: Pathological Video-gaming; Dep2: Depressive symptoms at Time 2; Dep3: Depressive symptoms at Time 3; I_Pro: latent intercept for the Pro; S_Pro: latent slope for the Pro; I_PVG: latent intercept for PVG; S_PVG: latest slope for PVG; S_Pro-Dep3: regression of depressive symptoms at time 3 on slope of the Pro; I_Pro-Dep3: regression of depressive symptoms at time 3 on intercept of the Pro; I_PVT-Dep3: regression of depressive symptoms at time 3 on intercept of PVG; S_PVG-Dep3: regression of depressive symptoms at time 3 on slope of PVG; I_Pro-S_PVG: regression of slope of PVG on intercept of Pro; I_PVG-S_Pro: regression of slope of Pro on intercept of PVG; Dep2-Dep3: regression of depressive symptoms at time 3 on depressive symptoms at time 2; ψii: covariance between intercept for Pro and intercept for PVG; ψss: covariance between slope for Pro and intercept for PVG. Model controls for sex by covarying sex with both latent intercepts. Depressive symptoms2 was also covaried with both latent intercepts.

examine whether changes in the protective factors were related to changes in pathological video-gaming over time (Figure 1). In these models, pathological video-gaming would be analysed as a continuous variable representing the number of pathological symptoms rather than a dichotomous one as such models provide more sensitive tests of the hypotheses. In this framework, two growth models were specified – one for the protective factors of interest, and the other for pathological video-gaming. We examined the protective factors that were significant predictors of pathological video-gaming at T3 (controlling for pathological video-gaming at T1) from the logistic regression analyses.

Across the two growth models (Figure 1), the latent intercepts (ψii; i.e. the protective factor and pathological video-gaming at T1) were covaried, and the latent slopes (ψss; i.e. changes in the protective factor and pathological video-gaming over the 2 years) were covaried. The slope of pathological video-gaming was regressed on the intercept of the protective factor (I_Pro-S_PVG), and the slope of the protective factor was regressed on the intercept of pathological video-gaming (I_PVG-S_Pro). To examine the mental health outcome of pathological video-gaming, depressive symptoms at T3 was regressed on to the intercepts of the protective factor (I_Pro-Dep3) and pathological video-gaming (I_PVG-Dep3), the slopes of the protective factor (S_Pro-Dep3) and pathological video-gaming (S_PVG-Dep3), and on depressive symptoms at T2 (Dep2-Dep3). The models controlled for sex by covarying sex with both latent intercepts.

Where applicable, model fit was assessed through 3 practical fit indices: the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). For CFI and TLI, a value greater than or equal to 0.90 indicates adequate fit. An RMSEA value of 0.05 or less indicates adequate fit (Brown, 2006). All models were estimated using Mplus, Version 6.0 (Muthen & Muthen, 2010).

Table 2. Linear and logistic regression analyses of pathological video-gaming at Time 3 for various protective factors controlling for gender and pathological video-gaming at Time 1.

Predictor	Linear regression B (SE)	Logistic regression Odds ratios (95% CI)
Personal Strengths		
Emotional Awareness	−0.20 (0.07)**	0.53 (0.38, 0.74)**
Emotional Regulation	−0.25 (0.06)**	0.61 (0.45, 0.83)**
Goal Setting	−0.22 (0.07)**	0.59 (0.43, 0.82)**
Empathy	−0.10 (0.06)	0.81 (0.62, 1.07)
Social Competence	−0.29 (0.06)**	0.62 (0.46, 0.83)**
Familial Factors		
Parent-child relationship	−0.19 (0.06)**	0.66 (0.50, 0.87)**
Adult Involvement in Media	0.007 (0.05)	0.92 (0.71, 1.20)
Family Environment	−0.28 (0.06)**	0.68 (0.513, 0.91)**

**$p < 0.01$.

Results

The average number of pathological gaming symptoms reported was small: 2.27 ($SD = 1.78$) at T1, 2.05 (1.86) at T2, and 1.78 (1.80) at T3. Overall, the percentage of students in our sample who would meet the 5-symptom requirement to be considered pathological was 9.9% at T1, 8.8% at T2, and 7.6% at T3. Boys were more likely than girls to reach this criterion at all three times (12.0% and 4.6% at T1, respectively; 11.2% and 2.6% at T2; and 9.2% and 3.3% at T3; all chi-squares $p < 0.001$).

Logistic regression analyses indicated that the following personal strengths were significant protective factors for pathological video-gaming: emotional awareness, emotional regulation, goal setting, and social competence. The following familial factors were significant protective factors: parent–child connectedness, and warm family environment. The linear regression analyses indicated the same significant predictors. The coefficients for the logistic and regression analyses can be found in Table 2.

Table 3. Regression and covariance coefficients from the dual growth trajectory models for the protective factors.

Protective factor	I_Pro-Dep3	I_PVG-Dep3	S_Pro-Dep3	S_PVG-Dep3	I_Pro-S_PVG	I_PVG-S_Pro	ψii	ψss
Emotional awareness	−0.11**	0.16**	−0.15**	0.24**	−0.08	−0.01	−0.24**	−0.03
Emotional regulation	−0.11	0.17**	−0.32**	0.17**	−0.08	0.09	−0.36**	−0.20*
Goal setting	−0.23**	0.14**	−0.26**	0.22**	0.38**	−0.05	−0.01	−0.12+
Social competence	−0.21**	0.15**	−0.33**	0.22**	−0.13*	−0.02	−0.25**	−0.07
Parent-child connectedness	Parent−child connectedness was not administered at T2							
Family environment	−0.19*	0.14**	−0.43**	0.13*	0.03	0.13+	−0.46**	−0.25**

Pro: Risk/Protective factor; PVG: pathological video-gaming; S_Pro-Dep3: regression of depressive symptoms at time 3 on slope of the Pro; I_Pro-Dep3: regression of depressive symptoms at time 3 on intercept of the Pro; I_PVT-Dep3: regression of depressive symptoms at time 3 on intercept of PVG;
S_PVG-Dep3: regression of depressive symptoms at time 3 on slope of PVG; I_Pro-S_PVG: regression of slope of PVG on intercept of Pro; I_PVG-S_Pro: regression of slope of Pro on intercept of PVG; ψii: covariance between intercept for Pro and intercept for PVG; ψss: covariance between slope for Pro and intercept for PVG
+$p<0.10$, *$p<0.05$, **$p<0.01$.

The regression and covariance coefficients for the dual growth trajectory models are presented in Table 3. The fit of the models were good, and the CFI ranged from 0.97 to 0.99, the TLI ranged from 0.93 to 0.97, and the RMSEA ranged from 0.03 to 0.06. As expected, the regression of Depressive symptoms at T3 on Depressive symptoms at T2 (Dep2–Dep3) for the various models were significant at the $p<0.01$ level; the coefficients ranged from 0.39 to 0.46 and are not reported in Table 3. Of greatest interest was the relationship between the latent slopes (ψss) which indicates whether changes in the protective factor were related to changes in pathological video-gaming. The findings indicated that increases in the following protective factors: emotional regulation and family environment, were related to decreases in pathological video-gaming. For all the models, higher initial levels and increases in pathological video-gaming, as well as increases in the protective factors were related to higher levels of depressive symptoms at T3, controlling for depressive symptoms at T2 (ψii). For all models except for emotional regulation, initial levels of the protective factors were related to lower levels of depressive symptoms at T3, controlling for depressive symptoms at T2.

Discussion

The study aimed to gain a better understanding of pathological video-gaming by identifying protective factors for the problem behaviour. While most studies have described correlates of pathological video-gaming, this study has provided longitudinal data in identifying these factors.

Controlling for initial levels of pathological video-gaming, personal strengths such as emotional awareness, emotional regulation, goal setting, and social competence, as well as familial factors such as parent–child connectedness, and a warm family environment were found to be protective factors for pathological gaming two years later. Based on dual growth trajectory models, increases in the following protective factors – emotional regulation and family environment – were related to decreases in pathological video-gaming. This pattern of protective factors is consistent with research in the area of resilience which suggests that individual factors such as emotional regulation (Eisenberg et al., 2001) and familial factors such as a close parent–child relationship (Resnick et al., 1997) often are protective factors against a variety of externalising and internalising problem behaviours. The findings also provide longitudinal evidence for the cascade effects model in that higher initial levels of the protective factors were related to lower levels of pathological video-gaming two year later despite controlling for initial levels of pathological video-gaming.

The findings have important implications for health providers who are working with pathological video-gamers. In particular, these results suggest that developing self-regulatory skills such as emotional regulation, and improving the family environment could be useful strategies for working with pathological gamers. The role of self-regulation had been highlighted by Seay and Kraut (2007) who found that self-regulation was more important than motivational factors in predicting problematic use of online gaming. Hence, self-regulatory processes are essential in allowing video-gaming to be a harmless and enjoyable pastime rather than a destructive preoccupation. Baumeister, Gailliot, DeWall, & Oaten (2006) have argued that it is possible to improve self-regulation through a process akin to exercise.

The research linking family or parental factors to pathological video-gaming or Internet use have been mixed. Some studies have found that parental involvement in child use of media is related to lower problematic Internet use (Sun et al., 2005) while other studies have not found such a relation (Liau, Khoo, & Ang, 2008). Our study indicated that it is the more affective aspect of family factors such as parent–child connectedness and family environment, rather than parental involvement in youths' video-gaming, was a protective factor against pathological video-gaming. The results also suggest improving the family environment as an important approach for helping youths with pathological video-gaming. While very little research has been done on evaluating interventions for pathological video-gaming, an initial study on an intervention for internet addiction indicate that a multi-level treatment program that involved the adoption of a family perspective showed promise in helping youths with Internet addiction (Shek, Tang, & Lo, 2009).

The study adds to the initial growing evidence that pathological video-gaming has potentially serious mental health consequences, in particular, on depression. The results indicated that higher initial levels and increases in pathological

video-gaming were related to higher levels of later depressive symptoms controlling for an earlier level of depressive symptoms. Similarly, Lam and Peng (2010) found that young people who were initially free of mental health problems but used the internet pathologically could develop depression as a consequence. The relationship between pathological video-gaming and depression may not necessarily be linear, and it is possible that the relationship is reciprocal given that mental health disorders tend to be comorbid and mutually reinforcing. Lemmens, Valkenburg, and Peters (2011) found evidence that psychosocial well-being was an antecedent of pathological video-gaming. Longer longitudinal studies are needed to examine the dynamic interplay between pathological video-gaming and depression.

One important issue in video-gaming that was not examined in this study relates to patterns of play associated with different types of gaming. Research has indicated that social game play may have different characteristics and effects compared to solo play (Kaye & Bryce, 2012; Lim & Lee, 2009). One type of social game play that has received a great deal of attention and debate with regards to its potential negative impact on the lives of youth is online gaming. Smahel, Blinka, and Ledabyl (2008) argue that young players when compared to adults have a tendency toward more intensive gaming, which would then create a greater potential risk for addiction. However, others have disagreed with this connection between online gaming and addiction (Ng & Wiemer-Hastings, 2005). Based on analyses of our data reported elsewhere (Liau, 2012), online gaming was a significant predictor of pathological video-gaming at Time 3, controlling for pathological video-gaming at Time 1. Hence, online gaming was found to be a risk factor for pathological video-gaming. Future research can examine the impact of different genres of games on the course of pathological video-gaming.

A number of limitations have been identified in this study. First, information is based on a self-reported questionnaire and the study could have been improved by gathering information from additional sources such as teachers and parents. Nevertheless, research on internet and video-gaming has generally supported the use of self-report measures (Anderson et al., 2007). The present study was conducted in an Asian country, and hence further cross-national research is needed to improve the generalisability of the results. However, the prevalence of pathological gaming is similar to that in other countries (Choo et al., 2010), and the effects of prosocial and violent video-gaming are similar to other countries (Gentile et al., 2009). In this study, individual and familial protective factors were measured in view of a cascade effects model of resilience. However, the concept of resilience is still debated; for instance, it is unclear whether resilience is something a given child ''has'', or whether it is better conceptualised as a collection of protective factors (Luthar et al., 2000). Future research involving more complex measurements of resilience, and how it relates to pathological video-gaming, are needed. In summary, the present study has identified protective factors at the individual and familial level for pathological video-gaming, and has indicated depressive symptoms as a serious mental health consequence of pathological video-gaming.

Declaration of interest

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