JKSCI

한국컴퓨터정보학회논문지
Journal of The Korea Society of Computer and Information
Vol. 28 No. 6, pp. 79-88, June 2023
https://doi.org/10.9708/jksci.2023.28.06.079

A Longitudinal Analysis on the Relationship among Internet game Addiction, Peer Relationships, and Self-esteem of Adolescents

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[Abstract]

The purpose of this study is to explore the causal relationships among internet game addiction, peer relationships, and self-esteem of adolescents. For this, total of 625 middle and high school students participated in the survey at three time points, and their responses were analyzed using latent autoregressive cross-lagged modeling. The results are as follows: 1) Peer relationship seemed to be significantly affected by self-esteem and internet game addiction levels from the previous time point. 2) Self-esteem was significantly influenced by internet game addiction but not by peer relationships from the previous time point. 3) Effects of self-esteem and peer relationships from previous points on game addiction were found to be statistically insignificant. These findings are inconsistent with the causal relationships which most previous cross-sectional studies established and provides a new perspective on the causal relationships among the variables.

▸ **Key words**: Online gaming, Game addiction, Internet game addiction, Peer relationships, Self-esteem

[요 약]

본 연구의 목적은 인터넷 게임중독, 친구관계, 자아존중감 사이의 종단적 상호영향 관계를 밝히는 데 있다. 이를 위해 625명의 중고등학생들에게 3차례 설문을 실시하고 이를 자기회귀 교차지연 모델을 통해 분석하였다. 분석결과를 제시하면 다음과 같다. 1) 친구관계는 이전 시점의 자아존중감과 인터넷 중독에 의해 유의하게 영향을 받았다. 2) 자아존중감은 이전 시점의 인터넷 게임중독에 의해 유의한 영향을 받았으나 친구관계에 의해서는 유의한 영향을 받지 않았다. 3) 인터넷 게임중독에 대한 이전 시점의 자아존중감과 친구관계의 영향은 유의하지 않는 것으로 나타났다. 이러한 결과는 대부분의 기존 횡단연구들이 설정한 인과관계에 상반된 것으로, 이러한 결과가 시사하는 바에 대해 논의하였다.

▸ **주제어**: 온라인 게임, 게임중독, 인터넷 게임중독, 친구관계, 자아존중감

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• Received: 2022. 12. 12, Revised: 2023. 05. 24, Accepted: 2023. 05. 24.

http://www.ksci.re.kr pISSN:1598-849X | eISSN:2383-9945

I. Introduction

It is now well established that the Internet, a powerful medium with various convenient functions, can also produce harmful consequences to its users [1,2]. This two-sided characteristic is clearly manifested when it comes to online gaming among adolescents. On one hand, playing online games can bring social and psychological benefits [3,4]. Internet games are an integral element of leisure time activities for today's young people [5]. The Internet users can choose from a variety of games that cater to players' diverse gaming motivations [6]. For instance, Massively Multiplayer Online Role-Playing Games (MMORPGs), the most popular online game genre today [7], allow players to experience achievement, socializing, and immersion [8]. On the other hand, however, excessive internet gaming leads to diverse day-to-day problems for adolescents, in terms of academic performance [9,10], relationship quality [11,10], and physical condition [1,12]. Moreover, pathological gaming has been reported to be related to serious problems such as aggression [11], delinquency [13], and cardiopulmonary-related deaths [14]. As such, Internet game addiction can be a serious threat to adolescents' psychosocial development. Moreover, issues with online gaming are rampant in adolescent lives as access to the Internet became accessible anytime and anywhere with smartphone. In developed countries, the distribution rate of smartphones and the Internet has exceeded 50% [15] and 75% [16], respectively.

Studies on excessive online gaming sought to identify protective and risk factors of internet game addiction and test causality among the related variables [13] in hopes to provide groundwork for effective preventative and treatment interventions. So far, major variables commonly studied can be largely classified into intrapersonal variables and interpersonal variables [17]. Intrapersonal variables include self-control [18,19], sensation seeking [20], self-esteem [21,22], dysfunctional cognition [23,24], and life stress [25]. Interpersonal variables include parent-child relationship [17], social competence [24,10], peer problems [26]. However, whether all these factors act only as precursors to internet game addiction is uncertain, because existing studies on internet game addiction related variables have set and tested casual structures among variables based on logic instead of empirical evidence. Also, existing studies have assumed that findings from internet addiction studies can be applied to the phenomenon of internet game addiction. However, internet addiction is a complex concept, as the causes and results of internet addiction may differ by the main purpose of Internet [27].

In this light, the present study sought to reconsider the associations of one major intrapersonal factor, self-esteem, and one interpersonal factor, peer relationships, in relation to internet game addiction. Self-esteem and peer relationships are potential protective factors that may help adolescents even in at-risk contexts [28]. The purpose of the present study is to understand better the phenomenon of adolescent Internet game addiction by investigating the longitudinal causal relationships among Internet game addiction, self-esteem, and peer relationship via latent autoregressive cross-lagged analysis (Figure 1). The research questions are as follows:

1) What is the effect of self-esteem on peer relationships and Internet game addiction? How does this manifest itself over time?

2) What is the effect of peer relationships on self-esteem and Internet game addiction? How does this manifest itself over time?

3) What is the effect of Internet game addiction on self-esteem and peer relationships? How does this manifest itself over time?

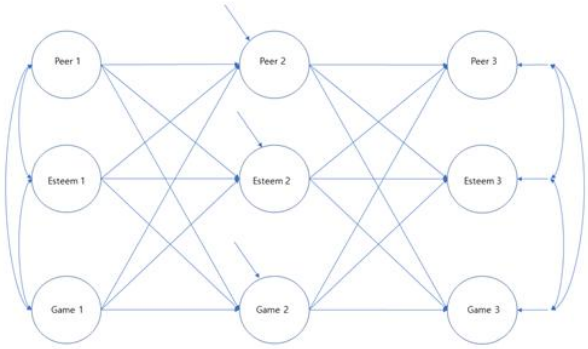

Fig. 1. Autoregressive cross-lagged model for the relationships among peer relationships, self-esteem, and Internet game addiction

II. Preliminaries

1. Association between Internet Game Addiction and Peer Relationships

Compared to any other developmental stage, adolescence is a transitional period in which peer relationships emerge as the greatest source of social support [29]. Peer relationship is a factor known to have significant relationship with adolescent internet game addiction. Park et al. [30] asserted that adolescents with unsatisfactory peer relationships tend to seek acknowledgement and acceptance from others on the Internet. Yoon & Song [31] suggested that adolescents with quality peer relationships are less likely to become addicted to internet gaming even when they have high levels of impulsivity. However, they noted that excessive internet gaming can gradually make adolescents socially isolated, suggesting that poor peer relationship may not just be an antecedent to problematic internet gaming. Also indicating the complexity of the association between peer relationship and internet gaming, Willoughby [32] found that greater frequency of computer gaming in both early and late high school was associated with less positive friendship quality, but higher friendship quality predicted higher frequency of Internet use. Some studies have suggested poor peer relationships as the result, not the cause, of problematic internet gaming. Allison, Wahlde, Shockley, & Gabbard [33] stated that Internet gaming addiction can lead to no real-life social interaction. Kim and Boo [34] explained that adolescents who are addicted to internet gaming enjoy playing games alone and experience serious impairment in their relationship with peers. As such, findings from previous studies suggest that further study is warranted to reexamine the relationship between peer relationships and internet game addiction.

2. Association between Internet Game Addiction and Self-esteem

Low self-esteem has also frequently been examined as a major cause for Internet addiction. Park and colleagues [30] asserted that adolescents strive to redeem their low self-esteem in the virtual world. The tendency for escape from real life often appears in online gamers [17]. Many studies that have examined the relationship between self-esteem and internet game addiction have assumed the causal relationship where self-esteem influences internet game addiction [21,35]. However, a reverse relationship is also likely considering the entertaining and stimulating feature of internet games. For instance, Kim [36) asserted that low self-esteem should be seen as the consequence, not the cause, of internet game addiction. She explained that the recreational characteristic of internet games can lead to deficits in school performance or interpersonal relationships, and ultimately diminishes one's self-esteem. Thus, it is necessary to empirically examine whether Internet game addiction affects self-esteem via peer relationships.

III The Proposed Scheme

1. Method

1.1 Participant

700 survey packets were distributed to middle and high schools located in Seoul and Gyeonggi areas. Participants completed the same survey

packets at three different time points with four-month interval. 625 completed surveys were collected from 284 middle school students and 341 high school students. Of them, 345 were males and 280 were females.

1.2 Materials

Internet Game Addiction. The Korean Internet Addiction Proneness Scale (K-Scale) developed by Kim, Kim, Park, and Lee [37] was modified and used to measure the level of Internet game addiction. The K-scale consists of 40 items around seven subdomains: 'Disturbance of Adaptive Functions', 'Withdrawal', 'Virtual Interpersonal Reality', 'Tolerance', 'Deviate Behavior', 'Disturbance of Reality Testing', and 'Addictive Automatic Thought'. Among these seven subscales, the four that are assumed to be the core factors of Internet addiction were used in this study. Those four factors are 'Disturbance of Adaptive Functions' (9 items), 'Withdrawal' (6 items), 'Virtual Interpersonal Reality' (5 items), and 'Tolerance' (5 items). In this study, Cronbach's alphas for the subscales were as follows for the three time points: .80, .81, .82 for Disturbance of Adaptive Functions, .76, .77, .80 for Withdrawal, .72, .73, .71 for Virtual Interpersonal Reality, and .72, .70, .72 for Tolerance.

Peer relationship. The 'Support from Friends' subscale of the Provision of Social Relation Inventory (PSRI) developed by Turner, Frankle, and Levin [38] was used to measure the degree of peer relationships. This subscale has 20 items that assess the quality of respondent's relationship with friends in their daily life. A sample item reads, "My friends would take the time to talk over my problems, should I ever want to". Items are rated on a 5-point Likert scale, ranging from 'strongly disagree (1)' to 'strongly agree (5).' For the current sample, Cronbach's alphas for the subscale were .87, .85, .86 for the three time points.

Self-esteem. The Rosenberg Self-Esteem Scale [39] is comprised of 10 items that measure respondents' attitude and beliefs about self on a 5-point Likert scale, ranging from 'strongly disagree (1)' to 'strongly agree (5).' The Cronbach's alphas from the current sample were .81, .82, .79 for the three time points.

1.3 Data Analysis

To explore the longitudinal causal relationships among Internet game addiction, peer relationships, and self-esteem, autoregressive cross-lagged panel analysis was performed using Mplus 7. Prior to analyzing the study model, we conducted item parceling. Items from RSE and PSRI's Support from Friends subscale were assigned into three parcels based on factor loadings in a preliminary exploratory factor analysis. For Internet game addiction, each subscale formed an individual parcel.

Parameters were estimated using MLR, a rescaling-based robust estimator which offers standard errors (Huber-White sandwich estimator) and x2 statistics that are robust to non-normality. Estimation of standard errors for indirect effects was obtained using the delta method.

2. Result

The descriptive statistics of internet game addiction, peer relationship, and self-esteem are presented in Table 1. As seen from the table, the changes in the means are quite stable for each variable, with only a slight reduction for Internet game addiction at 3rd measurement point.

Table 1. Descriptive statistics of Internet game addiction, peer relationship, self-esteem

Variables	1st measure		2nd measure		3rd measure	
	M	*SD*	*M*	*SD*	*M*	*SD*
Peer relationship	81.59	10.78	81.51	10.88	80.81	11.12
Self-esteem	28.93	6.79	29.22	6.66	29.81	6.40
Internet game addiction	38.41	11.73	39.07	11.73	36.67	11.81

To investigate the causal relationships among the three variables, we analyzed the autoregressive cross-lagged model shown in Figure 1. First, we set the following models to find the optimal model in terms of correlations among measurement errors and the stability of measure.

Model 1: The model in which measurement errors were uncorrelated with each other.

Model 2-a: Based on Model 1, the model that additionally allowed for the correlations between adjacent measurement errors for peer relationship

Model 2-b: Based on Model 2-a, the model that additionally allowed for the correlations between non-adjacent measurement errors for peer relationship

Model 3-a; Based on Model 2-b, the model that additionally allowed for the correlations between adjacent measurement errors for self-esteem

Model 3-b: Based on Model 3-a, the model that additionally allowed for the correlations between non-adjacent measurement errors for self-esteem

Model 4-a: Based on Model 3-b, the model that additionally allowed for the correlations between adjacent measurement errors for internet game addiction

Model 4-b: Based on Model 4-a, the model that additionally allowed for the correlations between non-adjacent measurement errors for internet game addiction

Model 5: Based on Model 4-b, the model in which factor loadings for peer relationships were same across time

Model 6: Based on Model 5, the model in which factor loadings for self-esteem are same across time

Model 7: Based on Model 6, the model in which factor loadings for Internet game addiction are same across time

Table 2. Comparisons of models

	χ^2	TRd	RMSEA	CFI	TLI
Model 1	1540.81	NA	.070	.864	.845
Model 2-a	1387.53	152.88***	.066	.881	.862
Model 2-b	1334.47	52.15***	.064	.887	.868
Model 3-a	1297.87	37.24***	.064	.891	.870
Model 3-b	1259.99	35.19***	.063	.895	.874
Model 4-a	975.15	338.25***	.053	.927	.911
Model 4-b	818.92	126.91***	.046	.945	.932
Model 5	820.82	1.56	.046	.945	.933
Model 6	829.59	7.56	.046	.945	.933
Model 7	832.99	7.28	.045	.945	.935

In Table 2, TRd is the scaled difference in χ^2. When TRd is statistically significant, the complex model is chosen. RMSEA (root mean square error of approximation) measures average lack of fit per degree of freedom. The values of RMSEA is usually interpreted as: 0=perfect fit, <.05=close fit; .05-.08= fiar fit; .08-.10=mediocre fit; and >.10=poor fit. Both CFI (comparative fit index) and TLI (Tucker-Lewis index) are the ways of comparing the lack of fit of a specified model to the lack of fit of the null model. Both indexes are usually interpreted as >.90=acceptable.

Comparing the results from the models 1 through 4-b, Model 4-b appeared to be statistically the best fit model considering the model parsimony. Model 4-b's RMSEA, CFI, and TLI values were all within the acceptable range. Moreover, models 5 through 7 had TRd values that were not statistically significant ($p > 0.05$) and △CFI values were negligible (< .001), which indicates that these models met the measurement invariance. Based on these results, Model 7 appeared to be the most fitting and was chosen as the research model.

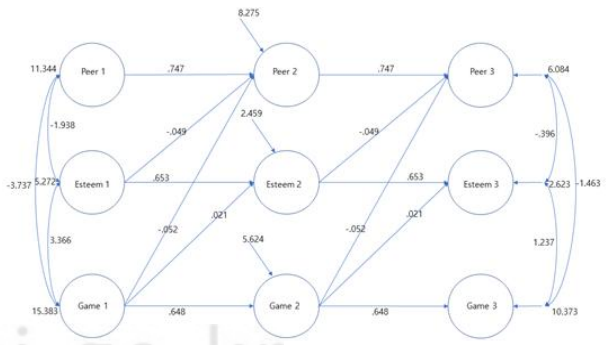

Fig. 2. Structural Coefficients for the Selected Model

Table 3. The path coefficients and test statistics

Path	B	β	SE	t
Peer 2←Peer 1	.59	.60	.05	13.13***
Peer 3←Peer 2				
Peer 2←Esteem 1	.13	.08	.05	2.70**
Peer 3←Esteem 2				
Peer 2←Game 1	-.12	-.10	.04	-3.19**
Peer 3←Game 2				
Esteem 2←Peer 1	.00	.01	.02	.83
Esteem 3←Peer 2				
Esteem 2←Esteem 1	.67	.69	.04	18.40***
Esteem 3←Esteem 2				
Esteem 2←Game 1	-.04	-.07	.02	-2.60**
Esteem 3←Game 2				
Game 2←Peer 1	-.04	-.04	.03	-1.25
Game 3←Peer 2				
Game 2←Esteem 1	-.06	-.04	.04	-1.38
Game 3←Esteem 2				
Game 2←Game 1	.76	.72	.04	18.43***
Game 3←Game 2				

B: unstandardized coefficient
β: standardized coefficient
SE: standard error

Structural coefficients for Model 7 were presented in Table 3 and Figure 1. Note that self-esteem and internet game addiction significantly influenced peer relationship at subsequent time point (p <.01 each). In other words, adolescents with higher levels of self-esteem and lower levels of internet game addiction tended to have better relationships with their peers later. Peer relationship did not significantly influence self-esteem at subsequent time point (p < .05), whereas internet game addiction appeared to have a significant impact on self-esteem at subsequent time point (p <.01). This indicates that adolescents with higher levels of internet game addiction tended to have lower levels of self-esteem later. Lastly, peer relationship and self-esteem did not significantly affect Internet game addiction at subsequent time point (p > .05). Such structural relationships suggest that self-esteem may play the role of a mediator as internet game addiction affects peer relationship. As such, the significance of this mediating effect was tested, and the longitudinal indirect effect of Internet game addiction on peer relationship via self-esteem was statistically significant (p < .05).

IV. Conclusions

1. Discussion

This latent autoregressive cross-lagged modeling study explored the causal relationships among internet game addiction, peer relationships, and self-esteem using survey data of 625 Korean adolescents at three time points. First, peer relationship seemed to be significantly influenced by self-esteem and Internet game addiction of previous time point. Second, self-esteem was significantly affected by the Internet game addiction, but not by peer relationships, of previous time point. Third, the influence of self-esteem and peer relationships of previous time points on Internet game addition was not statistically significant. Fourth, the longitudinal indirect effect of Internet game addiction on peer relationship via self-esteem was found to be statistically significant. Taken together, low self-esteem and poor peer relationships may not be contributing factors of adolescent Internet game addiction but consequences.

Adolescents seemed more likely to have poor peer relationships when they have lower self-esteem. This finding is consistent with existing research results that have shown that adolescents' quality of peer relationships is negatively correlated with self-esteem [40,41] and Internet addiction [6,17,42]. Beyond correlations, several studies have already pointed to self-esteem as a factor that influences peer relationships. Orth & Robins [43] have suggested that low self-esteem in late childhood may be a cause of shyness and aggressiveness in early adolescence, and such personality traits are predictive of hampered social life [44,45]. Dekovic and Meeus [46] also have suggested that a positive self-concept predict satisfactory peer relationships in adolescence. However, the opposite direction of influence (where peer relationship affects self-esteem) was not statistically significant.

As for internet addiction, the current study

discovered excessive online gaming to be a precursor to decreased or unsatisfactory peer relationships as well as self-esteem, but not the other way around. In other words, Internet game addiction turned out to be a factor that influences self-esteem and peer relationships rather than a factor that was being influenced by them. Also, this study found that self-esteem partially mediates the effect of internet game addition on peer relationships. Put another way, internet game addition can have a direct influence on peer relationships but can also have an indirect influence via self-esteem. This result is inconsistent with the results of Park and Park [47] and Yoon and Song [31] studies where peer relationships appeared to affect the level of Internet game addition. It is also against Kim's study [48] where self-esteem was found to influence Internet game addition.

However, Toker and Baturay [49] have confirmed that game addiction had a negative impact on academic performance and self-esteem of adolescents, and hinted that low academic performance as a result of excessive gaming to be a possible link to decreased self-esteem. As such, adolescents addicted to games might end up performing poorly in various domains of life and subsequently lose confidence and feel isolated in friendships. Another study by Beard and Wickham [50] suggested that online gamers who depend on gaming to maintain their sense of self-worth tend to have low self-esteem in the real world. Developmentally, adolescents are susceptible to wavering self-esteem [51]. Park, Kang, and Kim [30] suggested that the variability of adolescent self-esteem can be partly explained by the temperamental factors and situation-specific factors that make youths fall into game addiction. According to Kernis et al. [52], stable self-esteem is fueled by feelings of self-worth that is not easily affected by a specific evaluative event. Unstable self-esteem, however, fluctuates according to the changes in the surroundings and especially vulnerable to external evaluations such as praise or criticism [53]. Thus, adolescent students with unstable self-esteem may be easily influenced by accumulated gaming behavior and the environmental changes that follow.

As a phenomenon that has received attention more recently than internet addiction, internet game addition has fewer studies done on its risk or protective factors, and studies that have examined the relations between related variables were based on extant internet addition studies. In this light, previous internet game addition studies appear to have conceptualized that self-esteem and peer relationships influence internet game addition by modeling after the internet addition studies [54,55,1]. However, the findings of this study contend against the idea that self-esteem and peer relationship issues are the causes of internet game addition. Instead, it appears that as adolescents get addicted to internet games, they become less involved in their real-life peer relationships and experience a decrease in self-esteem. In other words, adolescents may not be running away to the virtual world because they do not have good friendships or have low self-esteem. They may be more likely to immerse themselves in games due to other individual characteristics such as sensation seeking tendency, and excessive immersion in games may disturb their daily life routines and deteriorate their peer relationships and self-esteem.

2. Conclusion

Based on such findings, the significance of the study can be summarized as follows. First of all, unlike previous studies that have mainly analyzed cross-sectional data collected at one time point, this longitudinal study confirmed how self-esteem and peer relationships consistently affect adolescents' level of internet game addiction with time. Specifically, the study revealed that contrary to previous inferences, internet game addiction may harm friendships and self-esteem with time. Such findings of the study provide a basis for a

new perspective on counseling and educational interventions to combat the problem of adolescent internet game addiction. It appears that the interventions that seek to improve students' self-esteem and peer relationships may be effective in minimizing the daily life consequences of internet game addiction but will not actually prevent or treat adolescent internet game addiction.

However, there are some limitations to this study. First, the study was done on adolescent population only. The direction of influence among the studied variables may vary in different age groups. Second, this study analyzed data from three time points over a duration of approximately one year. Thus, a longer longitudinal study may present different results. Finally, casual relationships revealed through latent autoregressive cross-lagged modeling cannot be taken as conclusive. In other words, not everyone fits in the final model derived here, and for instance, some people may become more addicted to the internet due to unsatisfactory peer relationships. Therefore, practitioners in counseling and education who work with adolescents with internet game addiction issues should always be mindful of individual differences. Researchers in this field may want to conduct experimental studies to find a more robust conclusions on the causal relationships among related variables.

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