Cross-validation of reliability, convergent and discriminant validity for the problematic online game use scale

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ABSTRACT

The main purpose of the present study is to develop a measure of problematic online game use by identifying underlying factors and testing external validities of the scale. The authors tested the scale with the three age groups: 5th, 8th, and 11th graders. Through a series of exploratory and confirmatory factor analyses, the present study confirmed that the POGU scale produced reliable and consistent factorial structures across the independent samples. The results supported convergent validity of the scale: POGU showed significant correlations with academic self-efficacy, anxiety, loneliness, and satisfaction with daily life. The results also supported the discriminant validity. The POGU scale did not redundantly measure any of individual difference constructs and was statistically distinguishable from the closely correlated constructs.

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1. Introduction

Researchers have developed various measures to assess problematic online game use. These measures are based on constructs such as Internet addiction, pathological video game use, problematic Internet use, and computer game addiction. Problematic online game use, which has been treated as subordinate to Internet addiction, focuses mainly on the amount of game playing, tolerance for negative consequences, and withdrawal symptoms (Ng & Wiemer-Hastings, 2005; Pratarelli & Browne, 2002; Suhail & Bargees, 2006; Young, 1999). These scales, which were originally developed to measure video game or Internet addiction, have been used frequently to measure problematic online game use, substituting, for example, the term "Internet" or "video game" for "online game" in the item wording. However, these scales do not adequately capture features of online games such as massively multiplayer online role playing game, which has distinct characteristics such as simulation and the presentation of social interactions.

It is necessary, therefore, to develop new scales specifically designed to measure problematic online game use, rather than "Internet addiction" broadly defined, for at least two reasons: First, the Internet is now a source for everything society desires. Through the Internet, users may indulge in gambling, shopping, chatting, and viewing sexually explicit material, to name just a few. In other words, the Internet is just a way through which people may access to whatever they want. If users of the Internet are addicted to "something," that might be some content or services that the Internet provides, rather the Internet itself: Internet users are no more addicted to the Internet than alcoholics are addicted to bottles. Second, online games differ from traditional stand alone games, such as video games, in important respects. Online games allow social interaction through the Internet; an "online game is a game added to the network system" (Choi & Kim, 2004, p. 14), allowing users to meet other users in virtual space. In fact, meeting and interacting with other online gamers may be the strongest attraction of the games. Gamers meet and interact with other users on the Net. Online gamers initiate and maintain interpersonal relationships through the games. The avatars represent the users' identities to other people. Online game users may "grow" and "realize themselves" in a virtual society. With regards to Internet addiction, it has been reported that seeking social interaction is associated with problematic Internet use (Chou & Tsai, 2007; Lo, Wang, & Fang, 2005; Sanders, Field, Diego, & Kaplan, 2000). Likewise, users of online games, just as users of traditional computer and video games may experience "continuous scoring, promotion, immediate feedback, and achievement of self-satisfaction" (Wan & Chiou, 2006, p. 318).

Problematic online game use, thus, has characteristics that cannot be adequately captured by the scales that had been invented to measure addictive behaviors in gambling, shopping, alcohol consumption, or playing video games. The purposes of the present study are to (a) develop a more appropriate measure problematic online game use scale, (b) identify types of problematic online game use, and (c) assess the validity of problematic online game use scale.

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2. Characteristic of online game

Online game can be categorized in two ways: PC game (i.e., played on one personal computer only, although possibly involving multiple users) and Net game. Net game can be further divided into web game, network game, and interactive online game (i.e., massive multiplayer online playing game; MMORPG). Web game use a website as an interface, and users must register in order to play, while network game allow multiple users to use their own PCs to interact through local area networks or the Internet, and many of these closely resemble PC game. To play network game, users must buy and install game software, but do not pay any other fees beyond those for the Internet connection. Online game requires users to log into a server. After selecting a role, users interact with other virtual roles, accumulate valuable experience, and collect virtual assets (Lo et al., 2005). In the present paper, we focus on the interactive online game, or MMORPG, which has two components: traditional stand alone video games and social interactions via Net. MMORPG has now become the common form of online games, which has now more than 99% of market share of all online games (Korea Game Development & Promotion Institute, 2008; Korea Game Industry Agency, 2008). By simply "online game," the authors of the present paper specifically refer to the interactive online game, or MMORPG.

Online games have characteristics of gambling. Users may make money in the real world by selling items that they acquire in the virtual world to the other users of the games (Lo, 2008). In South Korea, some people actually make their living by playing online games all day long (Ahn, 2009, Septmeber 17; Lim, 2009, November 10): They "raise" avatars and acquire items and sell the avatars and items online market for the real money. Prices of some rare or "unique" items often go over several thousand US dollars. In this sense, online games have characteristics of gambling, which may facilitate addictive behaviors.

In fact, it has been reported that problematic online game users get high and show tolerance and withdrawal symptoms (Charlton & Danforth, 2007), a lot like pathological gambling individuals (Crookford, Goodyear, Edwards, Quickfall, & el-Guebaly, 2005; Potenza et al., 2003). Similarly, Thalemann, Wölfling, and Grüsser (2007) found that problematic online game users reported a significant increase of craving for online games, which is similar to pathological gambling individuals for gambling cues.

Social interaction is considered one of the most important aspects related to online games that are distinct from traditional computer and video game (Charlton & Danforth, 2007; Choi & Kim, 2004). Social interaction is defined as the behavior of communicating with two or more objects and affecting each other. For example, users can build their own virtual organizations and create individual factions, guilds, and teams based on shared beliefs, goals, preferences, or other factors (Klang, 2004; Lo et al., 2005). Social interaction has been found to have a substantial impact on the popularity of game, because a set of several sequences of interaction is a narrative or storytelling tool used to construct a user experience in online games (Cummins, 2002; Eskelinen, 2001).

Within online games, users are able to interact and compete with other players. In contrast to single player game, which consists of rather solitary activities, online game allows social interaction, including chatting, battling each other, and achieving objectives together with other human players. As social interaction is a basic need of humans, the social elements of online game could be a factor in explaining their popularity. In discussing the consequences of social interaction in virtual environments, McKenna and Bargh (1999) came to the conclusion that "there is an abundance of interacting going on out there in cyberspace, and it is having surprisingly strong effects of people's real life" (p. 249). In a nutshell, the authors of the present study would argue that the two qualities of online game, gambling and social interaction, are the main causes of addictive behaviors, and as such, scales of problematic online game use should cover these qualities.

3. Problematic online game use

The focus of the present study is on possibilities of problematic online game use. For example, students endorsing a greater number of indicators of pathological Internet use have been shown to play online games more than those endorsing fewer or no indicators (Morahan-Martin & Schumacher, 2000). Also, in a study of the socio-demographic characteristics of online game users, Griffiths, Davies, and Chappell (2003) found that 25% of users played for more than 41 h per week, and suggested that these people may be addicted since playing to this extent would be highly likely to have an impact on other aspects of an individual's life.

3.1. Defining problematic online game use

Various labels have been used to describe people who engage in excessive use of online games which results in negative outcomes, including "online game addiction", "pathological online game use", "online game addictive behavior", and "problematic online game use". Despite evidence indicating that online game playing is somewhat dysfunctional, there are disagreements in the literature about how to theoretically and operationally define it. The most common perspective is that of Internet addiction, which treats problematic online game use as a behavioral addiction similar in character to other impulse control disorders. Individuals who meet the diagnostic criteria are said to experience social, psychological, and occupational impairment (Charlton & Danforth, 2007; Ng & Wiemer-Hastings, 2005). The Internet addiction perspective, however, has certain limitations. It fails to account for what people actually do online. As mentioned above, people use the Internet for gambling, shopping, chatting, and playing games. Similarly, as Beard and Wolf (2001) suggested the following:

> Future research also needs to focus on what it actually is that people are addicted to. Is it the computer? Is it the typing? Is it the information gained? Is it the anonymity? Is it the types of activities in which the individual is engaged? (p. 381).

In this sense, it is difficult to tell whether online game users are addicted to the online game itself or to the Internet. Online games have been added to the network system, which gives many users additional opportunities to meet and interact with one another in virtual space. These interactions may be an important contributor to an optimal Internet experience (Choi & Kim, 2004). The fact that people can gamble and interact with one another through online games leads them to participate in virtual reality. Therefore, measuring online game addiction through existing gambling scales could be problematic.

Hence, Brown (1991, 1997) has argued that the concept of addiction is useful for explaining excessive use of online games and should not be restricted to the ingestion of substances. Although Brown's work is fundamental to the present study, usage of the term addiction has been considered controversial. For example, the DSM-IV-TR (American Psychiatric Association (APA), 2000) does not include the term either in connection with the ingestion of drugs, where terms such as substance dependence and substance abuse are preferred, or in connection with behaviors such as gambling, where the term pathological gambling is preferred (Charlton, 2002; Charlton & Danforth, 2007). In the present study, the present study adopt the term "problematic online game use (POGU)" to describe people who engage in the excessive use of online games which results in negative outcomes. In general, POGU can be defined as playing online games to the extent that it creates psychological,

social, school, and work difficulties in a person's life (Charlton & Danforth, 2007; Griffiths et al., 2003; Ng & Wiemer-Hastings, 2005).

Many researchers conceptualize problematic online game use as a unidimensional construct. As a result, previous studies have little to say about whether or how we should change our approach to treating POGU. One exception is the study by Charlton and Danforth (2007), in which POGU is classified as both core (i.e., pathological) and peripheral (i.e., nonpathological). Charlton and Danforth (2007) used Griffiths' (1995, 1998) criteria for behavioral addiction, which are based on those of Brown (1991, 1993). Briefly, the six criteria of Brown can be summarized as follows: salience – domination of a person's life by the activity; euphoria – a 'buzz' or a 'high' is derived from the activity; tolerance – the activity has to be undertaken to a progressively greater extent to achieve the same 'buzz'; withdrawal symptoms – cessation of the activity leads to the occurrence of unpleasant emotions or physical effects; conflict – the activity leads to conflict with others or self-conflict; relapse and reinstatement – resumption of the activity with the same vigor subsequent to attempts to abstain (Charlton, 2002). Similarly, Kim, Kim, and Kim (2007) and Kim, Lee, Kim, and Kim (2007) reported that there are several types of POGU and suggested that POGU is a multidimensional construct. Charlton and Danforth's (2007) distinction is useful for further research on this affliction and for sketching out an initial model, but their criteria do not fully reflect the characteristics of problematic online game use, because they have been taken mainly from the criteria for pathological gambling as stated in the DSM-IV (APA, 2000).

For the present study, it is hypothesized that there are multiple types of POGU. Through online games, people can do many things, such as play games, gamble, and interact with others. In other words, users become addicted to online games for quite different reasons. This study define POGU as: (a) an increasing investment of excessive resources in online game-related activities (Lee & Ahn, 2002; Ng & Wiemer-Hastings, 2005), (b) feelings of pleasure when playing an online game (Charlton & Danforth, 2007; Kim, Kim, et al., 2007; Kim, Lee, et al., 2007), (c) an increasing tolerance of the effects of playing online games (Charlton & Danforth, 2007; Kim, 2008), (d) loss of control and denial of the problematic behavior (Charlton & Danforth, 2007; Kim, 2008; Kim, Kim, et al., 2007; Kim, Lee, et al., 2007), and (e) preference for virtual experiences over real-world experiences (Choi & Kim, 2004; Kim, Kim, et al., 2007; Kim, Lee, et al., 2007; Whang & Chang, 2004). In a nutshell, online games combine the characteristics of traditional video games and the Internet, which leads to computer and video game addiction (e.g., sensation seeking, compulsiveness, depression, aggressiveness, low self-esteem) and Internet addiction (e.g., seeking relationships, loneliness, social anxiety); all of these can lead to POGU.

Informed by findings reported in the literature, the present study describes the development of a measure to assess problematic online game use. First, the procedures used to develop the POGU scale are described, after which its reliability and factor structure are established across several independent samples. To establish the convergent validity of the measure, this study examines its relationship to four expected correlates: life satisfaction, academic self-efficacy, anxiety, and loneliness. Evidence of discriminant validity is provided by illustrating that the POGU scale is statistically distinguishable from these other measures.

4. Method

4.1. Participants

In Phase 1 of the present study, 1422 fifth graders (674 females and 748 males, $M_{age} = 11.88$) were recruited from seven private elementary schools located a predominantly middle-class area of Seoul, South Korea. In Phase 2, the present study obtained additional data from 199 eighth grade males ($N = 199$, $M_{age} = 14.74$) from a private junior high school in a predominantly middle-class area of Seoul. In Phase 3 of the present study, 393 eleventh graders (198 females and 195 males, $M_{age} = 17.87$) from two public high schools in a predominantly middle-class area of Seoul.

4.2. Statistical analysis

The data for the present study did not have many missing cases, but each and every indicator had one to four missing cases. Because listwise-deletion and pairwise-deletion can result in biased parameter estimates due to nonrandom attrition (Arbuckle, 2003), the present study employed the full-information maximum-likelihood (FIML) estimation, which has been found to be very efficient for incomplete data (Schafer & Olsen, 1998). With regard to the normality assumptions of the FIML estimation, we investigated the normality of each variable in terms of its kurtosis and skewness. According to the guideline of normality (i.e., skewness < 2, kurtosis < 4; Curran, West, & Finch, 1996) proposed by West, Finch, and Curran (1995), results may be distorted when the assumption of normality is severely violated. The normality assumption, however, was well met for all the variables used in this study's model.

4.3. Model evaluation criteria

The χ^2 values should be non-significant in a well-fitting model. Although the χ^2 difference test is widely used to compare the fit of nested models, it has been observed that one should not rely exclusively on the χ^2 difference test because the χ^2 likelihood ratio statistic is extremely sensitive to trivial discrepancies between the observed and hypothesized covariance matrices, especially when the sample size is large and a large number of constraints are applied (Levesque, Zuehlke, Stanek, & Ryan, 2004). Besides the χ^2 analysis, the present study used well-established indices such as Tucker–Lewis Index (TLI; Tucker & Lewis, 1973) and root-mean-square error of approximation (RMSEA; Hu & Bentler, 1995; Ullman, 1996) to compare model fitness. For the TLI, values of about .90 or higher are generally considered as representative of an acceptable model. For the RMSEA, smaller than .06 are generally considered as a very good fit, .08 or better as a reasonable fit, and greater than .10 as indicative of a poor fit (Hu & Bentler, 1995; Ullman, 1996).

4.4. Item selection

The initial 25 items were adopted from the following sources for modification: (a) the *Internet Game Addiction Scale* (Lee & Ahn, 2002); (b) the *Online Game Playing Questionnaires* (Charlton & Danforth, 2007); (c) the *Internet Addiction Scale* (Young, 1999); (d) the *Internet Related Problem Scale* (Armstrong, Phillips, & Saling, 2000); and (e) the *Generalized Problematic Internet Use Scale* (Caplan, 2002).

In a pilot study with an independent sample of 8th grade males, five items were dropped, leaving 20 items. The present study used several criteria to identify and exclude poor questions from 25 items. First, this study excluded any questions that showed little variability in response of if only a very small percentage of respondents made a response in a particular direction. Second, the present study excluded questions with especially small initial communalities in a principal axis factoring (PAF). This study, then, rotated with direct oblimin (oblique) for two reasons: (a) the present study assumed that POGU is a multidimensional construct and (b) the goal of PAF in the present study is to generate results that best fit the data. Specifically, oblimin (oblique) rotation permits

correlations among factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999) and Thurstone (1947) emphasized that oblique rotation is more plausible representation of reality. Third, a question was excluded if including it in final scale substantially lowered Cronbach's α relative to when it was excluded. These criteria resulted in the exclusions of 20 questions.

In the initial data analysis, the PAF yielded a 5-factor solution using the Kaiser criterion (eigenvalue > 1) and a parallel analysis to determine how many factors to extract. The five factors in the PAF analysis accounted for around 65.13% of item variance. All items in the scale had factor loadings in excess of .60. Table 1 shows the rotated factor pattern loadings after extraction. Each of the five factors was interpreted according to the magnitude of its salient pattern coefficients. The first factor consisted of items describing a high level of 'buzz' and ease from online game experience. Therefore, this factor was named for the *Euphoria*. The reliability of the Euphoria factor subscales appeared adequate (α = .836). The second factor was characterized by items dealing with physical problems resulting from online game playing and was named the *Health Problem*. The reliability of the Health Problem factor subscales appeared adequate (α = .777). The third factor included items about online games conflicting with other activities and interpersonal relationships. This factor was named the *Conflict*. The reliability of the Conflict factor subscales appeared adequate (α = .811). The fourth factor had high loadings on items concerning preoccupation with online games (e.g., cannot control playing time). As a result, the fourth factor was named the *Failure of Self-Control*. The reliability of the Failure of Self-Control factor subscales were acceptable (α = .822). The fifth factor was characterized by items describing preference for playing online games over face-to-face relationships. This factor was named the *Preference for Virtual Relationship*. The reliability of the Preference of Virtual Relationship factor subscales appeared adequate (α = .866).

5. Results

5.1. Development of the problematic online game use scale

Using a series of multidimensional factor analyses, this study identified types of POGU. The unidimensional model tested the possibility for the 20-item to form a single factor POGU model (Model 1). Model 1 fit much worse than the corresponding multidimensional models, Model 2 and Model 3 (see Table 2). The five factor model (Model 2) fit data: χ^2 (160, N = 1422) = 882.228, p < .001, TLI = .932, RMSEA = .056. In Model 3, correlations among the five first order factors were adequately explained in terms of the one-second order factor: χ^2 (165, N = 1422) = 1119.729, p < .001, TLI = .913, RMSEA = .064. Even though the goodness of fit for one-second order factor model (Model 3) solution was less strong than the corresponding five factor model, the goodness of fit of the two-second order factor model (Model 3) was as good as the traditional guidelines of what constitutes of an acceptable fit (Browne & Cudeck, 1989; Hu & Bentler, 1999). The χ^2 difference between the two models (Model 2 and Model 3) was statistically significant, $\Delta\chi^2$ (5, N = 1422) = 237.501, p < .001, but the differences of model fitness were minimal: ΔTLI = −.019, ΔRMSEA = .008. When there was virtually no difference in model fitness between the two models, the more restricted one should be taken. Thus, the present study should take Model 3 over Model 2. The implication is that the one-second order factors in Model 3 reflect a higher dimension rather than refer to conceptually separate constructs. The factor structure models for POGU are presented in Fig. 1.

5.2. Cross-validations of reliability

The initial development of the POGU scale yielded a 20-item measure that can produce reliable data using internal consistency as the criterion. However, it is possible that the items hang together only with restricted samples of respondents. To rule out the possibility that the one-second order factor of the POGU was achieved only through the post hoc selection of statements that met our selection criteria, the present study administered the POGU scale to two new groups of respondents: (a) 8th grade males; and (b) 11th grader males and females.

The data from these two samples were analyzed separately, first examining the reliability of 20-item, and then performing a confirmatory factor analysis (CFA) to examine the fit of one-second order factor solution and to test the significance of the factor loadings. The reliabilities of the 20-item were above .70 in the two samples, which was generally acceptable (Nunnally, 1978). In the CFA, the goodness of fit of the two subsamples also met the traditional guidelines of what constitutes of an acceptable fit. Results are summarized in Table 3. In sum, the reliability of 20-item of POGU and the one-second order factor structure determined during the initial scale development can be generalized beyond the original sample.

5.3. Establishing the validity of problematic online game use scale

Two analyses were undertaken to determine whether the POGU scale is a measure of problematic online game use or just a redundant measure of an existing construct. First, the present study tested convergent validity that the POGU scale was correlated with measures of individual differences, which should be correlated with. Second, we then assessed discriminant validity that the POGU scale "yields measurements that are statistically distinguishable" (Hayes, Glynn, & Shanahan, 2005, p. 309) from individual differences.

Table 1
Factor loadings after extraction (8th graders).

Factor	Q#	Loading
Euphoria	POGU1	.77
	POGU2	.74
	POGU3	.76
	POGU4	.73
Health problem	POGU5	.86
	POGU6	.75
	POGU7	.64
Conflict	POGU8	.68
	POGU9	.74
	POGU10	.62
	POGU11	.66
	POGU12	.68
Failure of self-control	POGU13	.69
	POGU14	.70
	POGU15	.68
	POGU16	.67
	POGU17	.72
Preference of virtual relationship	POGU18	.84
	POGU19	.79
	POGU20	.86

Table 2
Summary of the factor models and goodness of fit statistics (5th graders).

Factor models	χ^2	df	TLI	RMSEA
One factor model: Model 1	3361.361	170	.718	.115
Five factor model: Model 2	882.228	160	.932	.056
One-second order factor model: Model 3	1119.729	165	.913	.064

Note: N = 1422.
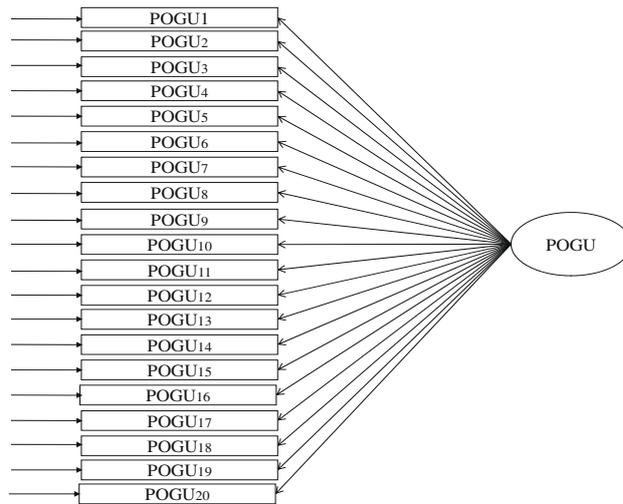
Model 1 (Uni-dimensional, One factor)
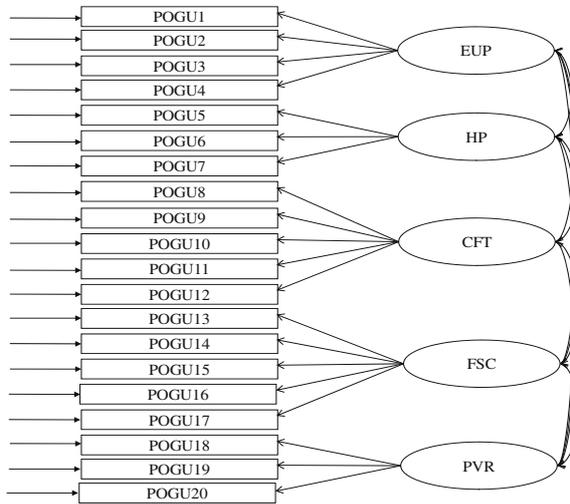
Model 2 (Five factor)

Model 3 (One second order factor)

Fig. 1. Factor structure for problematic online game use. *Note:* POGU = problematic online game use; EUP = euphoria; HP = health problem; CFT = conflict; FSC = failure of self-control; PVR = preference of virtual relationship.

Table 3
Internal consistency reliability and goodness of fit statistics in two samples.

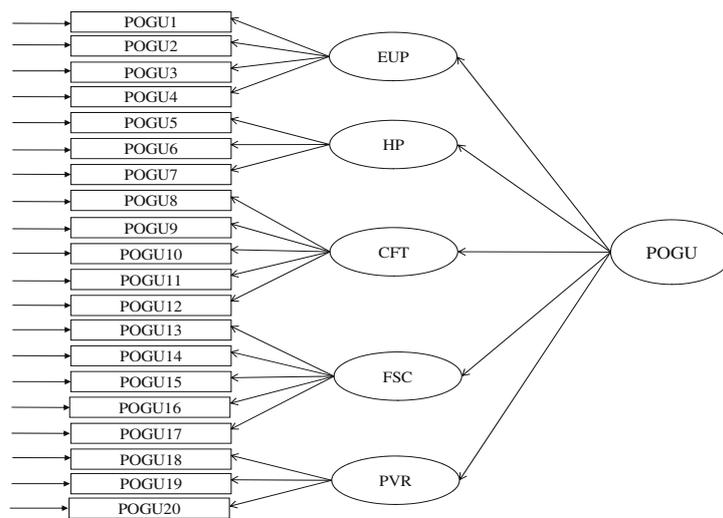| Sample	Cronbach's α	χ^2	df	χ^2/df	TLI	RMSEA
8th graders ($N = 199$)	.911	332.884	165	2.017	.886	.072
11th graders ($N = 393$)	.948	717.943	165	4.351	.880	.082

Note: $N = 1422$.

To assess convergent validity and discriminant validity, as a preparatory step, the present study considered which specific individual differences are related to POGU. Previous studies have investigated various psychological factors associated with POGU. Some studies have focused on the negative aspects of psychological conditions, including loneliness and anxiety (Kim, 2005; Lo et al., 2005; Ng & Wiemer-Hastings, 2005; Whang & Chang, 2004), as the main contributors to problematic online game use. Other research, on the other hand, explored the effects of life satisfaction on the positive outcomes of online game use (Kim, Kim, et al., 2007; Kim, Lee, et al., 2007; Wan & Chiou, 2006). In addition, previous research suggested that low academic self-efficacy is reported to contribute to online gaming use (Kim, 2008; Kim, Kim, et al., 2007). Thus, validity of the POGU scale could be established by showing the correlation with the four following individual difference measures (i.e., life satisfaction, academic self-efficacy, anxiety, and loneliness).

5.3.1. Life satisfaction

The current study modified the *Satisfaction with Life Scale* (SLS; Diener, Emmons, Larsen, & Griffin, 1985). This scale consists of three items measuring life satisfaction (e.g., "I am satisfied with my school life"). All responses were measured on 6-point scales ranging from 1 (strongly disagree) to 6 (strongly agree).

5.3.2. Academic self-efficacy

To measure academic self-efficacy, this study modified the *Academic Self-Efficacy Scale* (Chemers, Hu, & Garcia, 2001). This scale consists of three items measuring academic self-efficacy (e.g., "I try to answer hard questions because it's fun to answer hard questions"). All responses were measured on 6-point scales ranging from 1 (strongly disagree) to 6 (strongly agree).

5.3.3. Anxiety

To measure anxiety, the *General Health Questionnaire-28* (GHQ-28; Goldberg & Hillier, 1979) was adopted. The GHQ-28 assessed the extent to which respondents experienced the presence of the four types of psychological problems: depression, anxiety and insomnia, somatic symptoms and social dysfunction. In the present study, only seven items related to anxiety (e.g. "I have recently felt constantly under strain") were used. For the structural equation modeling, the present study created three parcels as indicators for the latent variable of anxiety. More specifically, including all items as indicators in a structural equation modeling (SEM) requires a substantially larger sample size as the number of indicators increases (Landis, Beal, & Tesluk, 2000). However, the present study did not have the required sample sizes for analysis; we adopted composite formation techniques to reduce the number of estimated parameters. The present study used one technique to reduce the number of estimated parameters. Following Kishton and Widaman (1994), this study randomly created three parcels, using averages of those seven items in each parcel as the indicators of the latent variable: three items for one parcel and two items for two parcels.

5.3.4. Loneliness

To measure loneliness, the present study modified the *UCLA Loneliness Scale* (Russell, Peplau, & Cutrona, 1980). This scale consists of the 20 statements measuring the sense of loneliness (e.g., "How often do you feel you are no longer close to anyone?"). All responses were measured on 6-point scales ranging from 1 (never) to 6 (very often). For the SEM, the present study randomly extracted eight items and then created three parcels: two or three items for each of the three parcels. The present study used the averages of those items in each parcel as the indicators of the latent variable (Kishton & Widaman, 1994).
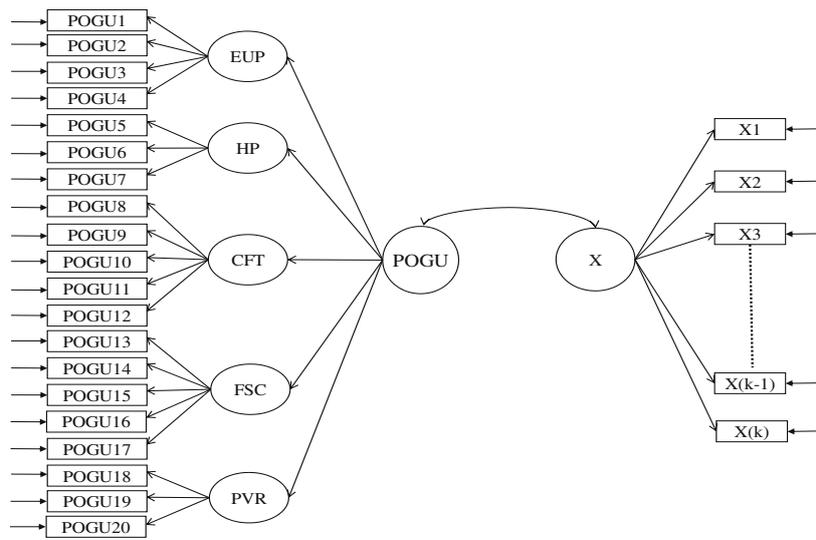
5.4. Convergent validity

Convergent validity can be inferred from an examination of the factor coefficients (Anderson & Gerbing, 1988; Huang & Michael, 2000). Convergent validity based on "the relationship between test scores and other measures of the same construct" (AERA & NCME, 1999, p. 174). Similarly, Huang and Michael (2000) suggested the following:

> If the factor analysis of intercorrelations of scores on two or more items or test variables is associated with relatively high coefficients on the same factor, this result would indicate that the scores on the measures reflect the presence of a common construct and hence evidence of the convergent validity of the measures (pp. 781).

Data from all the respondents were used for these analyses. As noted above, each respondent completed one of the individual difference measures in addition to the 20-item POGUS. The POGU scale and the other scales were treated as latent variables, and the correlations between them were estimated using a latent measurement model (see Fig. 2). The primary advantage of estimating a correlation in this manner is that the result is an estimate of what the correlation would be in the absence of measurement error.

The present study measured the individual differences to assess the validity of the POGU scales and what direction of correlation would provide evidence consistent with its construct validity. Previous studies have focused on the negative consequences of excessive game playing in the personal, social, and academic realms (Roe & Muijs, 1998; Sanger, Willson, Davies, & Whittaker, 1997; Williams & Clippinger, 2002). In addition, Kandell (1998) insists that we should deal with the underlying psychological issues in Internet addiction rather than Internet use per se, because once people reestablish balance in their life, Internet usage is bound to decline on its own. Based on a cognitive-behavioral model, Davis (2001) also contends that generalized problematic Internet use is a consequence rather than the cause of broader psychopathology, such as obsessive–compulsive disorder or depression. He reported that existing psychosocial problems predispose individuals to develop maladaptive thoughts associated with their Internet use. Therefore, we have assumed in the present study that problematic online game use, too, is a consequence of psychological factors, as online games have similar characteristics to Internet and computer games (Lo et al., 2005; Wan & Chiou, 2006).

In addition, as the theory of positive psychology contends, the existence of negative psychological states should not be equated

Fig. 2. Measurement model used to establish convergent validity and discriminant validity. *Note:* POGU = problematic online game use; EUP = euphoria; HP = health problem; CFT = conflict; FSC = failure of self-control; PVR = preference of virtual relationship.

with the lack of positive psychological states (Seligman, 2002). The present study assumed that not only the existence of unhealthy psychological states (e.g., anxiety and loneliness), but the non-existence of healthy psychological conditions (e.g., life satisfaction and academic self-efficacy) may correlate to problematic online game use. Thus, if the POGU scale has convergent validity, we would expect a negative relationship between healthy psychological conditions (i.e., life satisfaction and academic self-efficacy) and the POGU scale, as well as a positive relationship between unhealthy psychological conditions (i.e., anxiety and loneliness) and the POGU scale. As can be seen in Table 4, the pattern of correlations is as predicted excepting loneliness in 11th grade sample. In addition, the goodness of fit of each psychological conditions sample model was as good as the traditional guidelines. These results are suggestive of the validity of the POGU scale.

5.5. Discriminant validity

Even though convergent validity has been established by the correlations reported above, squaring these correlations reveals that about half of the variability in problematic online game remains to be explained. For example, the correlation between 5th graders' loneliness and the POGU scale is .337, leaving approximately 88% of the variability in the POGU scale unexplained by

individual differences in loneliness. At this point, the 88% must be considered measurement error. However, discriminant validity could be assessed by constraining the correlation between each pair of factors to unity (Anderson & Gerbing, 1988; Huang & Michael, 2000; Kline, 1998). Discriminant validity based on "the relationship between test scores and measures of different constructs" (AREA et al., 1999, p. 175). If the POGU scale is a redundant measure of loneliness, constraining the correlation model should fit better than freely estimated correlation model. The constraining the correlation model in which the factor correlation is fixed to 1 is a nested model of the freely estimated correlation model. As can be seen in Table 5, in every case the freely estimated correlation model show better model fit than constraining the correlation model, with a statistically significant differences in the χ^2. Furthermore, the TLI was always larger and RMSEA was always smaller for the freely estimated correlation model. These results suggest that the POGU scale is not redundantly measuring any of individual difference constructs, but POGU is statistically distinguishable from these constructs.

6. Discussion

Previous research has dealt with problematic online game use as a subordinate concept of Internet addiction, focusing mainly

Table 4
Convergent validity of the problematic online game use scale.

Trait	Sample	Correlation	χ^2	df	TLI	RMSEA
Life satisfaction	5th graders	−.324[***]	1235.220	224	.917	.056
	8th graders	−.412[***]	397.462	224	.891	.063
	11th graders	−.192[**]	795.532	224	.886	.080
Academic self-efficacy	5th graders	−.285[***]	1264.162	224	.922	.057
	8th graders	−.146[*]	415.011	224	.889	.066
Anxiety	8th graders	.533[***]	423.254	224	.888	.067
Loneliness	5th graders	.337[***]	1211.002	224	.916	.056
	11th graders	−.100	579.949	224	.917	.069

Note: 5th graders (*N* = 1422), 8th graders (*N* = 199), 11th graders (*N* = 393).
[*] *p* < .05.
[**] *p* < .01.
[***] *p* < .001.

Table 5
Discriminant validity of the problematic online game use scale.

Trait	Sample	Model	χ^2	df	TLI	RMSEA
Life satisfaction	5th graders	Freely estimated	1235.220	224	.917	.056
		Constrained	1978.213	225	.857	.074
	8th graders	Freely estimated	397.462	224	.891	.063
		Constrained	517.549	225	.818	.081
	11th graders	Freely estimated	795.532	224	.886	.080
		Constrained	996.771	225	.847	.093
Academic self-efficacy	5th graders	Freely estimated	1264.162	224	.922	.057
		Constrained	2080.542	225	.861	.076
	8th graders	Freely estimated	415.011	224	.889	.066
		Constrained	475.497	225	.855	.075
Anxiety	8th graders	Freely estimated	423.254	224	.888	.067
		Constrained	430.238	225	.885	.068
Loneliness	5th graders	Freely estimated	1211.002	224	.916	.056
		Constrained	1485.050	225	.893	.063
	11th graders	Freely estimated	579.949	224	.917	.069
		Constrained	746.309	225	.881	.082

Note: 5th graders (*N* = 1422), 8th graders (*N* = 199), 11th graders (*N* = 393).

on how much time people spend playing games, tolerance for the negative consequences of such playing, and withdrawal symptoms (Ng & Wiemer-Hastings, 2005; Pratarelli & Browne, 2002; Suhail & Bargees, 2006). Scales originally developed for measuring the use of video games or Internet addiction have often been used to measure problematic online game use. The present study suggests the need to develop new scales specifically designed for this latter construct. This study began by defining problematic online game use as an increasing investment of resources to online game-related activities, feelings of pleasure when playing online games, an increasing tolerance of the effects of playing online games, denial of problematic behavior, and preference of virtual relationship over face-to-face relationships with others. In addition, the present study hypothesized that (a) there are several types of problematic online game use and (b) problematic online game use is a multidimensional construct.

People can do many things with the Internet, such as play online games, watch movies, gamble, and shop. If someone is addicted to gambling on the Internet, for example, we would say that the person is addicted to gambling rather than to the Internet. For this reason, the present study developed a set of measures specifically for problematic online game use, which this study defined as an increasing investment of resources on online game-related activities, feelings of pleasure when playing online games, an increasing tolerance of the effects of playing online games, denial of the problematic behavior, and preference for virtual relationships with others. The present study treated this concept as a measurable individual difference. The data confirmed our hypotheses that problematic online game use has several types and is a multidimensional construct.

The present study addressed the question of whether the POGU scale functions as a measure of problematic online game use or just a redundant measure of an existing construct in two ways. First, to assess convergent validity, scores on the POGU scale were correlated with scores on four other individual difference measures. The goodness of fit for all the models of the individual difference measures met the traditional criteria. These results suggest that the POGU scale has convergent validity. Second, discriminant validity was demonstrated through a CFA showing that the POGU scale is statistically distinguishable from the other four measures of the same construct. In every case, the freely estimated correlation model fits the data better than the constrained correlation model. These results suggest that the POGU scale is not redundantly measuring any individual differ-

ence constructs and that it is statistically distinguishable from these constructs.

In conclusion, the present study represents an initial step toward developing and testing a new scale to measure problematic online game use. Several limitations of the current study provide directions for future research. First, this study looked at only a few variables related to individual differences; this limitation can be overcome by adding more variables in future research. Second, the participants of the present study consisted of adolescents recruited only from South Korea. On average, adolescents in South Korea played online games for 1.15 h per day during weekdays (Korea Social Research Center, 2003). By comparison, adolescents in the US were reported to play online games much less, for about 30 min per day (Kaiser family foundation., 2002). Future studies, therefore, should compare the results of the present study with data collected from other countries for better understanding of problematic online game use. Third, Ko, Yen, Chen, Chen, and Yen (2005) found that, contrary to our intuition, adults tend to have more severe problems with excessive online game use than adolescents. The POGU scale developed with the present study should be tested against with adult samples in a further study. Finally, problematic online game use is found to be different across genders (Chou & Tsai, 2007; Colley, 2003; Kim, Kim, et al., 2007; Kim, Lee, et al., 2007). Further studies should investigate gender differences as well.

Appendix

The problematic online game use questionnaire.

Factor	Q#	Statement
Euphoria	POGU1	I feel unrestricted when playing online game
	POGU2	I feel good and very interested while I play online game
	POGU3	I experience a buzz of excitement while I play online game
	POGU4	Playing online game is when I most feel pleasure
Health problem	POGU5	My health got worse from playing online game
	POGU6	I get headaches for over playing online game
	POGU7	My eyesight has dropped for overplaying online game

Appendix (*continued*)

Factor	Q#	Statement
Conflict	POGU8	I have broken my appointment because of playing online game
	POGU9	My parents often tell me off that I spend too much time playing online game
	POGU10	My school work and other activities suffer because of playing online game
	POGU11	Playing online games is a priority thing to do
	POGU12	Playing online game often interfere my school work
Failure of self-control	POGU13	When playing online games, I tend to play longer than originally intended
	POGU14	I image to play online game when I am not playing
	POGU15	I find myself saying "just a few more minutes" when playing online game
	POGU16	I put effort to reduce the time on playing online game, but I often fail
	POGU17	I tend to spend increasing amounts of time playing online game
Preference of virtual relationship	POGU18	I feel intimate with people who I know from online game than people in reality
	POGU19	I feel that many people playing online game acknowledge my skills than in real life
	POGU20	People I met in online game are easier to understand than real life people

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