Structure and function of maladaptive cognitions in Pathological Internet Use among Chinese adolescents

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A B S T R A C T

This study empirically investigated the structure and function of maladaptive cognitions related to Pathological Internet Use (PIU) among Chinese adolescents. To explore the structure of maladaptive cognitions, this study validated a Chinese Adolescents’ Maladaptive Cognitions Scale (CAMCS) with two samples of adolescents (n1 = 293 and n2 = 609). The results of the exploratory factor analysis and confirmatory factor analysis revealed that CAMCS included three distinct factors, namely, “social comfort,” “distraction,” and “self-realization.” To examine the function of maladaptive cognitions, this study tested an updated cognitive-behavioral model in the third sample of 1059 adolescents. The results of structural equation model analyses verified both the direct effect of maladaptive cognitions on PIU and their mediating role in the relationships between distal factors (social anxiety and stressful life events) and PIU among Chinese adolescents. Theoretical and practical implications of these findings were discussed.

1. Introduction

Extensive research has provided evidence that Pathological Internet Use (PIU) may have negative influences on development of adolescents in areas such as academic achievement, physical health and interpersonal relationships (Chou, Condron, & Belland, 2005; Flisher, 2010; Greenfield & Yan, 2006; Shaw & Black, 2008). Researchers have proposed theories (Davis, 2001; Kraut et al., 1998; Suler, 1999; Young, 1999) to explain how PIU occur among adolescents. Among these theories, the most representative one is the cognitive-behavioral model (Davis, 2001). In this model, Davis emphasized the key role that PIU-related maladaptive cognitions play in the onset and development of PIU. Davis’ initial work has inspired and motivated subsequent theory-driven empirical research on PIU (e.g., Caplan, 2002, 2003, 2005, 2010; Davis, Flett, & Besser, 2002; Liu & Peng, 2009). For example, Caplan (2010) recently validated a PIU measurement instrument, the Generalized Problematic Internet Use Scale 2 (GPIUS2), and empirically tested an updated cognitive-behavioral model of general PIU. These studies have substantially advanced the existing knowledge regarding PIU.

Most of the recent studies on the characteristics of maladaptive cognitions were conducted using subjects with Western cultural backgrounds. Consequently, new and important research questions have emerged. First, would the structure of maladaptive cognitions be the same across different cultures? Second, if there were cultural differences in the structure of maladaptive cognitions, then would their function be equivalent across cultures? To answer these questions, we conducted the present study in Chinese adolescents, a group that is considered to be at high risk for PIU (e.g., Hechanova & Czincz, 2008; Yen, Yen, & Ko, 2010; Zhang, Amos, & McDowell, 2008). The goals of the study were to (1) explore the structure of maladaptive cognitions among Chinese adolescents and (2) examine the function of maladaptive cognitions in the development of PIU in this group. We aimed to explain the mechanism by which PIU develops in Chinese adolescents and to provide evidence that existing theories of PIU can be generalized across cultures.

1.1. The structure of maladaptive cognitions

Davis (2001) introduced a cognitive-behavioral model of PIU. One contribution of this model was that it distinguished between two distinct forms of PIU: specific and generalized PIU. Specific PIU refers to the pathological use of content-specific functions of the Internet (e.g. gambling, stock trading, viewing sexual materials), which would be likely manifested in some alternative ways if the individual was unable to access the Internet; in contrast, generalized PIU describes a multidimensional overuse of the Internet, which is associated with the unique social context available on Internet. Davis argued that individuals with generalized PIU were considerably more problematic; thus, generalized PIU should be
especially interesting to researchers (Caplan, 2002). Another important contribution of the cognitive-behavioral model of PIU was that it focused on the maladaptive cognitions associated with PIU. This was the appealing feature of this model. In this model, Davis (2001) proposed that the presence of maladaptive cognitions was critical for the development and maintaining of PIU. In the following part, we will introduce the definition of maladaptive cognitions and will discuss the structure of maladaptive cognitions.

1.1.1. Definition of maladaptive cognitions
Maladaptive cognitions refer to cognitive biases that individuals form toward themselves and the world after they start using the Internet (Davis, 2001). The cognitive biases are extreme thoughts that the real “self” is never good enough and only the online “self” is satisfying, and these biases are based on self-doubt, a low sense of self-efficacy and negative self-value in the real world as well as positive feelings about self-worth in the virtual world. An example of a maladaptive cognition that could arise from PIU might be, “I am worthless offline, but online I am someone.” Individuals holding such cognitive biases may simply believe that the online world is better than the real world. They might believe that “the Internet is the only place where I am respected,” “nobody loves me offline,” or “the Internet is my only friend.”

Maladaptive cognitions emerge only after individuals begin to use the Internet (Davis, 2001), and they involve comparative thoughts about which is more satisfying, the offline world or the online world. Thus, the development of maladaptive cognitions might be similar to the “needs-satisfying” process that Suler (1999) suggested to explain PIU. Initially, certain needs of an individual that cannot be satisfied in real life are satisfied by using the Internet. Then, as this “needs-satisfying” process is repeated, the perception that the online world is better than real life would be strengthened, ultimately becoming an automatic pattern of thought. Therefore, it could be inferred that the development of maladaptive cognitions might be related to specific needs that are difficult to satisfy in real life. Such a hypothesis has been indirectly supported by some studies (Caplan, 2002, 2003, 2005; Davis et al., 2002; Liu & Peng, 2009). For example, Caplan (2002, 2003, 2005) found that individuals lacking social skills in real life were more likely to use the Internet for social interactions to satisfy their need for interpersonal relationships. Thus, these individuals might develop the maladaptive cognition of Preference for Online Social Interaction (POSI).

1.1.2. The structure of maladaptive cognitions in the western context
Davis et al. (2002) first described maladaptive cognitions as a construct of two-dimensions, social comfort and distraction, and developed the Online Cognition Scale (OCS) based on this notion. Social comfort refers to an individual’s perception of the online world as a social context that is safer than the real world because rejection can be avoided. Distraction refers to the idea that an individual can use the Internet to escape from the pressures, tasks and troubles of the real world. Caplan (2003, 2010) considered general PIU to be mainly associated with interpersonal Internet usage. He presented a type of maladaptive cognition termed POSI and developed the GPIUS as a measuring tool. POSI refers to the belief that one will perform better and feel better about oneself in online social interactions and relationships than in similar offline activities. POSI is composed of two sub-dimensions (Caplan, 2002): social benefit, the perceived social benefits of Internet use, and social control, the perception of having increased control when interacting with others online. Liu and Peng (2009) used a single dimension of “Preference for a Virtual Life (PVL)” to describe maladaptive cognitions. Individuals with PVL consider themselves to behave better, feel better and be treated better in the virtual world than the real world. PVL was assessed using combined items from both OCS (Davis et al., 2002) and GPIUS (Caplan, 2003).

The dimensions of the maladaptive cognitions presented above can be divided into two categories. The first category, termed “social comfort,” involves cognitive biases that the interpersonal self and the environment of the virtual world may be better than those in real life. The social comfort (Davis et al., 2002), POSI (Caplan, 2003; Caplan, 2010), and PVL (Liu & Peng, 2009) measures mentioned above can be classified into this category. These measures are all characterized by a preference for using the Internet’s social functions to satisfy a need for interpersonal relationships (Casale & Fioravanti, 2011; Lee & Stapinski, 2012; Morahan-Martin & Schmechek, 2003; Shek, Tang, & Lo, 2008; Tekinarslan & Gürer, 2011). Additionally, this category of maladaptive cognitions relates to the negative characteristics surrounding forming interpersonal relationships (e.g., loneliness, rejection sensitivity, and lack of social skills). The second category, “Distraction,” involves the maladaptive belief that hiding oneself in the Internet world may help one avoid real-life pressures (e.g., Davis et al., 2002). This category of maladaptive cognitions is characterized by aimless usage of the Internet to satisfy a need to escape from the real world (Davis et al., 2002).

1.1.3. The structure of maladaptive cognitions in Chinese culture
Chinese adolescents can be considered a high-risk group of PIU, as PIU was found to be more prevalent among adolescents in China than in their counterparts in Western countries (Block, 2008; Hechanova & Czincc, 2008; Yen et al., 2010; Zhang et al., 2008). The incidence rates of PIU in the USA and Europe ranged between 1.5% and 8.2% (Johansson & Götestam, 2004; Siomos, Dafouli, Braimiotis, Mouzas, & Angelopoulou, 2008; Villelaa et al., 2011; Weinstein & Lejoyeux, 2010; Zborsalski et al., 2009), whereas in China, the incidence rate was found to be as high as 13.7% (Block, 2008), it is important to determine the structure of Internet-related maladaptive cognitions that Chinese adolescents may develop.

It could be considered that the maladaptive cognitions of Chinese adolescents should include the two dimensions identified in studies within Western cultures. Similar to adolescents in Western countries, Chinese adolescents have a strong need for interpersonal relationships. Thus, the maladaptive cognitions of Chinese adolescents may include the dimension “social comfort,” as the virtual world might best meet certain social needs that are unattainable in real life. Furthermore, compared with adolescents in Western countries, most Chinese adolescents are shouldering greater levels of academic stress from their parents, schools and society. Hence, the maladaptive cognitions of Chinese adolescents may likely include the dimension “distraction,” as the virtual world may become a convenient place to escape from these significant real-life pressures.

In addition, maladaptive cognitions among Chinese adolescents may include other novel dimensions. As mentioned above, adolescents in China experience much greater academic stress than adolescents in Western countries (Yen et al., 2010). As academic ranking is usually an important indicator of a student’s success, it is hard for adolescents who are only at the average level to feel a sense of achievement in such an environment. Thus, they are easier to find another means to satisfy their needs for attaining a sense of achievement or self-realization. Several studies have found that adolescents with PIU in China are particularly addicted to playing online games (Chou & Hsiao, 2000; Huang et al., 2009; Li & Chung, 2006; Lo, Wang, & Fang, 2005; Wan & Chiou, 2006). Online games may happen to meet their needs in this regard, as one may be able to attain high scores and rankings with sufficient practice and dedication. This may provide a much easier means for academically poor students, who may be neglected by their parents,
teachers and classmates, to gain a sense of success. They may spend substantial amounts of time surfing online and may try hard to become superior in online games by scoring more points and winning more awards, thus gaining a sense of self-value that would be difficult to attain in the real world. Leung (2003) also found that individuals with PIU tended to try out new roles in the virtual world and to participate in activities in which they excelled to experience a high level of self-esteem and imaginary self-value. Based on these studies, we propose that the structure of maladaptive cognitions in Chinese adolescents may include a third dimension termed “self-realization.”

1.2. The function of maladaptive cognitions

1.2.1. The direct and mediating effects of maladaptive cognitions

According to Davis’ cognitive-behavioral model (2001), maladaptive cognitions act as proximal causes that directly result in PIU symptoms, which in turn trigger various PIU-related negative outcomes. On the other hand, the emotional vulnerability or predisposition of individuals to anxiety, depression, and loneliness, along with external stressors such as negative life events, may act as distal causes that influence PIU indirectly and may be mediated by maladaptive cognitions.

The hypothesis that maladaptive cognitions have direct effects on PIU has been supported by strong evidence (Caplan, 2002, 2003, 2005, 2010; Li, Zhang, Li, Zhen, & Wang, 2010; Liu & Peng, 2009; Peng & Liu, 2010). Empirical studies (Caplan, 2003, 2005; Li et al., 2010) also support the hypothesis that maladaptive cognitions may mediate the relationship between distal causes and PIU. For instance, Caplan (2003, 2005) found that in the Western context the maladaptive cognitions POSI played a full mediatory role in the relationship between the individual vulnerability dimension (termed “lack of social skills”) and PIU.

The findings of Li et al. (2010) described the major effects of maladaptive cognitions on the development of PIU among Chinese adolescents. However, the tool by which maladaptive cognitions were measured in their study was developed under a Western background. As mentioned above, the maladaptive cognitions of Chinese adolescents may have a structure different from that of adolescents in Western countries. Hence, to explore the common function of maladaptive cognitions across cultures, it is necessary to assess the function of maladaptive cognitions in the development of PIU using a specially designed measurement suitable for Chinese adolescents within the context of Chinese culture.

1.2.2. The function of maladaptive cognitions among Chinese adolescents

The function of maladaptive cognitions in the development of PIU among Chinese adolescents may be similar to that in adolescents in Western countries. Maladaptive cognitions may act as proximal causes directly resulting in PIU symptoms and related negative outcomes, or mediate the effects of distal causes, including individual vulnerability and external stress, on PIU (Davis, 2001). Concerning individual vulnerability such as depression, social anxiety, and substance dependence (Davis, 2001), social anxiety was found to be an important factor in the development of PIU (Caplan, 2007; High & Caplan, 2009; Lee & Stapinski, 2012; Lo et al., 2005; Weinstein & Lejoyeux, 2010). Social anxiety refers to emotional responses in social situations that may lead to avoidance behaviors, such as strong apprehension, worry or fear. Individuals with social anxiety may prefer to use the Internet to avoid face-to-face social interactions with others (Shepherd & Edelmann, 2005). Regarding external stressors such as some life events (Davis, 2001), stressful life events were found to be important antecedents of PIU (Leung, 2007; Li et al., 2010; Li, Wang, & Wang, 2009). Stressful life events may include stress from family, school, peers or other social networks in daily life (Liu, Liu, Yang, & Zhao, 1997). When facing significant life stress, individuals may utilize new media such as the Internet in an attempt to escape real life (Whang, Lee, & Chang, 2003). Including these factors in a model of PIU may help better predict and explain the function of maladaptive cognitions.

The present study was conducted in two steps. In Study 1, a Chinese Adolescents Maladaptive Cognitions Scale (CAMCS) was developed to examine the structure of maladaptive cognitions in Chinese adolescents. In Study 2, a model was constructed to explore the positive predictive effects of maladaptive cognitions on PIU symptoms and related negative outcomes in Chinese adolescents, as well as their mediating effects on the relationship between distal causes and PIU.

2. Study 1

2.1. Method

2.1.1. Sample and procedure

When analyzing the structure of a scale, both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are necessary (Floyd & Widaman, 1995; Hau, Wen, & Cheng, 2004; Reise, Waller, & Comrey, 2000). Thus, in the present study, data for these analyses were based on two independent samples of middle school students (n1 = 293; n2 = 609).

2.1.1.1. Sample 1. This sample consisted of 293 students (49.02% females) from general secondary schools in Guangdong, southern China. The mean age of the participants was 15.41 years (SD = 2.08) with a range of 12–19 years. All participants had more than 1 year of Internet experience, and 10.24% (40.00% of which were females) were diagnosed with PIU according to the diagnostic criteria described by Ko et al. (2005). That is, individuals with a total score of more than 63 in the Revised Chinese Internet Addiction Scale (CIAS-R; Chen, Weng, Su, Wu, & Yang, 2003) would be diagnosed as PIU. More information about CIAS-R and this criteria could be found in the following Section 2.1.2.

2.1.1.2. Sample 2. This sample consisted of 609 students (47.03% females) from general secondary schools in Guangdong, southern China. The mean age of the participants was 15.23 years (SD = 1.73) with a range of 12–19 years. All participants had more than 1 year of Internet experience, and 11.99% (30.14% of which were females) were diagnosed with PIU according to the diagnostic criteria described by Ko et al. (2005).

The data collection procedure was the same for both samples: after informed consent was obtained from both the school and the participants, the assessment was conducted in the classroom within 10 min, and the questionnaires were collected immediately after completion. After excluding invalid responses and data from participants without any Internet experience, the percentages of valid data from both samples exceeded 90% (91.56% and 90.90%, respectively).

2.1.2. Measures

2.1.2.1. Maladaptive cognitions. CAMCS was used to measure maladaptive cognitions. The initial items on the scale originated from three procedures. (1) 15 items were obtained from interviews with 50 students who were diagnosed with PIU according to the diagnostic criteria reported by Ko et al. (2005). Based on the definition of maladaptive cognitions given by the cognitive-behavioral model, the interview questions mainly involved two aspects: Internet-related all-or-none cognitions about the world and self, focusing on “things existing only in the Internet world, but not in real life” and including words expressing absolute meanings such as “only” or
“never.” Examples of the items included “I don’t have to think about the difficult homework when I am surfing online,” “I feel myself more powerful when surfing online,” “I can talk bravely only online,” and “Only friends online will tell you more sincere words.” (2) Based on a sample of 300 general secondary school students from Guangdong, an analysis was conducted on the 20-item maladaptive cognitions subscale (including social comfort and distraction) from the OCS (Davis et al., 2002). After eliminating items for which scores were too high (those with means greater than 4 when scored on a 5-point scale) and the discrimination of which was too low, a factor analysis was conducted on the remaining items. Items that could not be clearly classified into a certain dimension were excluded from further analyses. In total, 17 items were obtained. (3) Two items were borrowed from the GPIUS (Caplan, 2002), as they were obviously different in meaning from items in the OCS.

The items selected from the OCS and GPIUS were translated bi-directionally. A Psychology doctoral student first translated all of the items into Chinese, and then two graduate students majoring in English translated them back into English. Another two graduate students then compared the two versions of the items to confirm that they expressed the same meaning. After this procedure was repeated twice, the final Chinese items were considered to have the same meaning as the original English versions.

Twenty secondary school students were invited to assess the items. According to the assessment, items that were difficult to understand, items with multiple meanings and items overlapped by other items were eliminated. Finally, 30 items were included in the pilot survey. They were scored on a 5-point scale ranging from “totally disagree” to “totally agree,” with higher scores indicating greater levels of maladaptive cognitions.

2.1.2.2. Pathological Internet Use (PIU). The Revised Chinese Internet Addiction Scale (CIAS-R; Chen et al., 2003) was used to assess the PIU tendencies of adolescents. The scale was composed of two subscales: Core Symptoms of Internet Addiction (CSIA) and Related Problems of Internet Addiction (RPIA). The former included three dimensions: compulsive use (e.g. I cannot control my impulse for using the internet.), withdrawal (e.g. I would feel uncomfortable if I have not been using the internet for some time.) and tolerance (e.g. I need to spend more time online now than before until I feel satisfied.,). The latter included two dimensions: interpersonal and health-related problems (e.g. My interactions with families and friends decrease because of using the internet.) and time management problems (e.g. I would stay up late using the internet and thus feel listless on the next day.). The entire 26-item scale was scored on a 4-point scale ranging from “totally disagree” to “totally agree.” The total scores on the CIAS-R ranged from 26 to 104, with higher scores indicating a higher severity of PIU. Individuals with a total score of more than 63 in CIAS-R would be diagnosed as PIU according to the criteria proposed by Ko et al. (2005). CIAS-R and its diagnostic criteria (Ko et al., 2005) appeared to be more comprehensive than other existing measurements used to assess PIU (Hechanova & Czincc, 2008). The internal reliability of the scale and the two subscales in the original study ranged from .79 to .93. The CIAS-R had good reliability and validity (Ko et al., 2009). The Cronbach’s $\alpha$ in the present study ranged from .67 to .92.

2.1.3. Analyses

SPSS 13.0 and LISREL 8.72 were used to implement the analyses. Before the analyses, we inspected the data for missing values. The average percentage of missing values per variable was .40% (ranging from .00% to 1.70%). All missing values were then replaced using the expectation maximization (EM) algorithm method in SPSS (Allison, 2002).

Following stringent procedures for scale development (Floyd & Widaman, 1995; Hau et al., 2004; Reise et al., 2000), the data analyses comprised three steps. In Step 1, a primitive item analysis was conducted with Sample 1 to screen out low-quality items, and an EFA with Sample 1 was executed to explore the initial framework of adolescents’ maladaptive cognitions. In Step 2, a CFA was performed with Sample 2 to confirm the factor structure of the measurement as revealed in Step 1. Finally, in Step 3, reliability and validity analyses for the scale were conducted on the merged data of Sample 1 and Sample 2, including correlation and regression analyses.

2.2. Results and discussion

2.2.1. Exploring the factor structure of CAMCS using EFA

To screen out low-quality items and gain initial items for EFA, a primitive item analysis was conducted on Sample 1. Items that met the following criteria were considered low-quality items: with the standard deviation lower than 1, the skewness of distribution higher than 1, the item-test correlation lower than .40, or the item discrimination lower than .60. Finally, four candidate items were excluded. With the remaining 26 items, the Bartlett’s test was statistically significant, $\chi^2 = 2873.30, df = 325, p < .001$, and Aider–Meyer–Olkin statistics ($KMO = .92$) was greater than its threshold value of .50. Thus, the data was suitable for EFA.

To explore the initial framework of maladaptive cognitions, an EFA was executed with the remaining 26 items on Sample 1. The analysis followed the principal axis factoring method with Promax (Kappa = 4) Oblique Rotation. The initial run produced a six-factor unforced solution according to Kaiser’s criterion. However, the result of Cattell’s screen test on the sedimentation graph suggested a three-factor solution. We then deleted 14 items that either failed to load substantially on any factor (i.e., with factor loadings less than .40), loaded almost equally on more than one factor, or belonged to factors that explained less than 3.0% of the variance or included less than three items. With the remaining 12 items ($KMO = .87$; Bartlett’s test $\chi^2 = 970.78, df = 66, p < .001$), the second run of EFA produced a clear three-factor solution based on Cattell’s screen test on the sedimentation graph and preliminary eigenvalues. Each factor included four items with factor loadings ranging from .40 to .78 (see Table 1); the eigenvalues of the three factors were 4.33, 1.50 and 1.04, respectively. The three factors accounted for 36.11, 12.16% and 8.70% of the explainable variance, respectively, and the overall scale explained 57.27% of the variance. All correlation coefficients between the factors were all statistically significant, $r = .64, .49, .42, ps < .001$.

Based on the existing literature and examining the meaning of items in each group, the three factors were initially labeled as “social comfort,” “distraction” and “self-realization.”

2.2.2. Confirming the factor structure of CAMCS using CFA

To confirm the measurement model of CAMCS and formally assess its construct validity, a CFA was performed with Sample 2. A covariance matrix and the maximum likelihood fitting method were used for the analysis.

To evaluate the model, we followed the guidelines proposed by Hau et al. (2004). First, we examined the parameter estimates for an improper solution. All were found to be statistically significant, and no abnormal values were found. Next, we examined the fit
indices of the model to determine whether the model fit the data well. A model satisfying the following four criteria would be considered acceptable: \( \chi^2/df < 5 \), Non-Normed Fit Index (NNFI) > .90, Comparative Fit Index (CFI) > .90, Root Mean Square Error of Approximation (RMSEA) < .05, and Standardized Root Mean Square Residual (SRMR) < .08 (Hau et al., 2004; Marsh, Hau, & Wen, 2004). Results showed that the three-factor model fit the data well, \( \chi^2 = 184.60, df = 51, \chi^2/df = 3.62, \text{NNFI} = .94, \text{CFI} = .95, \text{RMSEA} = .066, \text{SRMR} = .045 \) (see Fig. 1). Third, we examined the modification indices produced by LISREL, finding that no new path that could statistically significantly improve the model’s fit was suggested. Fourth, we examined the parameter estimates again to determine whether the factor structure was proper. The factor loadings were at least moderately large in magnitude, ranging from .42 to .71 (.57 average), indicating that all the items converged meaningfully onto the scale.

However, as the correlation coefficient between “social comfort” and “self-realization” was .81 and it is suggested that two factors might overlap if their correlation coefficient was higher than .70 (Jia & Jia, 2009; MacKenzie, Podsakoff, & Jarvis, 2005), we tried to merge the items within “social comfort” and “self-realization” and developed a two-factor model (see Fig. 2). To compare the fitness of the two-factor model with the three-factor model, another CFA was conducted on the two-factor model, \( \chi^2 = 211.59, df = 53, \chi^2/df = 4.02, \text{NNFI} = .93, \text{CFI} = .94, \text{RMSEA} = .070, \text{SRMR} = .049 \). This two-factor model showed a statistically significantly larger chi-squares, \( \Delta \chi^2 = 26.98, \Delta df = 2, p < .0001 \). Its NNFI and CFI were reduced by .01, whereas RMSEA and SRMR increased by .004. These results indicated that the three-factor model was better fit than the two-factor model, using the rules for model comparison (Hau et al., 2004; Marsh et al., 2004).

### 2.2.3. Reliability and validity analyses

The reliability and validity of the CAMCS were analyzed using the merged data of Sample 1 and Sample 2 (n = 902).

#### 2.2.3.1. Reliability

The coefficient of internal consistency for the overall scale was good (\( \alpha = .81 \)). For each of the three subscales, the coefficients of internal consistency ranged from moderate to high: “social comfort” (\( \alpha = .66 \)), “distraction” (\( \alpha = .67 \)), and “self-realization” (\( \alpha = .74 \)).

#### 2.2.3.2. Convergent and discriminant validity

An initial correlation analysis was executed among the 12 items. The results indicated that all items were statistically significantly correlated with each other (Pearson’s \( r = .10–.46, p < .01 \)), indicating that the scale had good convergent validity. Second, an independent t-test was conducted to compare the means between the two sets of correlation coefficients (\( r \) values) among inner-factor items (items sharing a common factor) and those among inter-factor items (items belonging to different factors). Before the t-test, the \( r \) values of the two sets of correlation coefficients were transformed into their Fisher’s \( Zr \) values. Results indicated that the mean coefficients among the inner-factor items (mean \( Zr = .38 \)) were statistically significantly larger than those among the inter-factor items (mean \( Zr = .23 \)), \( t(64) = 6.01, p < .001, d = 1.66, 95\% \text{CI} [.09,.19] \), indicating that the scale had good discriminant validity.
2.2.3. Construct validity. A hierarchical regression analysis with the Enter method was conducted to investigate the effects of each type of maladaptive cognition on PIU. The results indicated that with the effects of gender and age considered, all three types of maladaptive cognitions could positively predict PIU in adolescents ($\beta = .12$, $p < .001$). These three types of maladaptive cognitions in total explained extra 25% of the variation in PIU ($\Delta R^2 = .25$). These results were consistent with the theoretical hypothesis of maladaptive cognitions proposed by Davis (2001), indicating that the concept validity of CAMCS was good. In addition, the standardized effect sizes of the “distraction” and “self-realization” dimensions were larger than that of the “social comfort” dimension; this will be discussed in the general discussion.

2.2.4. Interpretations of the three factors

The results of the EFA and CFA, as well as the reliability and validity analyses, provided support for the hypothesis that the scale of maladaptive cognitions among Chinese adolescents contained three factors: “social comfort,” “distraction,” and “self-realization.”

The first factor is similar to the social comfort factor proposed by Davis et al. (2002) and the POSI factor suggested by Caplan (2003), Caplan (2010), which refers to an individual's preference for engaging in social interactions online rather than face-to-face communication and his/her feelings of safety and security in being part of virtual social networks.

The second factor is consistent with the maladaptive cognition dimension of distraction introduced by Davis et al. (2002), which involves using the Internet for the purpose of escape. An individual may use the Internet to be distracted from a stressful event, task, or thought.

The third factor is a new category of maladaptive cognitions introduced in the present study. It refers to an individual’s desire to gain respect from an imaginary audience or to enhance one’s self by accomplishing difficult tasks online to gain a sense of self-worth that may be lacking in real life.

All three factors are analogous to the important reasons Davis described for why individuals may be drawn to spending time online. They reflect the experienced sentiment of a preference for a virtual context rather than the real world.

3. Study 2

To examine the effects of maladaptive cognitions on PIU among Chinese adolescents, the present study specified a model M1 (see Fig. 3) based on the existing literature (Caplan, 2002, 2003, 2005, 2010; Davis, 2001; Li et al., 2010). In this model, maladaptive cognitions positively predict PIU symptoms, which in turn result in related negative outcomes (e.g., interpersonal and health problems), and maladaptive cognitions also mediate the positive links between social anxiety and stressful life events and PIU symptoms.

We also proposed an alternative model M2 (see Fig. 4) to examine the mediating roles of maladaptive cognitions in a more rigorous manner. In model M2, social anxiety and stressful life events influenced PIU symptoms directly without the mediating effects of maladaptive cognitions. In addition, if the mediating role of maladaptive cognitions was supported, we proposed another alternative model M3 to examine whether maladaptive cognitions had full or partial mediating effects (see Fig. 5). In model M3, maladaptive cognitions partially mediate the positive links from social anxiety and stressful life events to PIU symptoms, that is, social anxiety and stressful life events had direct effects as well as indirect effects through maladaptive cognitions on PIU Symptoms.

3.1. Method

3.1.1. Sample and procedure

The participants consisted of 1174 students from general secondary schools. The main data collection procedure was the same as that described for Study 1. After eliminating invalid data and data from participants without any Internet experience, the number of subjects used for the final analyses was 1059 (48.07% females), accounting for 90.20% of the total data collected. The mean age of the participants was 15.25 years ($SD = 1.74$), with a range of 12–19 years. All subjects had experience using the Internet for more than 1 year, and 11.89% (32.54% females) were diagnosed with PIU according to the diagnostic criteria presented by Ko et al. (2005).

3.1.2. Measures

When the participant background and maladaptive cognitions were assessed by the measurements same as those applied in Study 1, social anxiety, stressful life events, PIU symptoms, and PIU negative outcomes were assessed using instruments described in the following text.

Social anxiety was assessed using the Interaction Anxiousness Scale (IAS) developed by Leary (1983) and revised by Ma (1999).
This 15-item measure is scored using a 5-point scale, with higher scores indicating a higher tendency toward social anxiety. The internal consistency reliability of the scale was .87, and the retest reliability was .80. Some items were modified to fit the participants of the present study; for example, the term “the boss” was replaced with “the elder.” Cronbach’s α for the scale was .81 in the present study.

Stressful life events were assessed with the Adolescent Life Events Scale (ASLEC), which was developed by Liu et al. (1997) and revised by Gao (2006). Spanning six dimensions (interpersonal relationships, academic stress, health adaptation problems, loss, penalties, and other events) and 26 items, this scale is scored on a 5-point scale, with a higher total score of stressful life events indicating a greater impact on the individual. The scale’s internal consistency reliability was .89. Cronbach’s α for this scale was .89 in the present study.

PIU symptoms and PIU-related negative outcomes in the adolescents were assessed respectively with the two subscales, CSIA and RPIA, of the CIAS-R developed by Chen et al. (2003) (see Section 2.1.2). Cronbach’s α for these two subscales in the present study was .90 and .88, respectively.

3.1.3. Analyses

Before the analyses, we inspected the data for missing values, finding that the average percentage of missing values per variable was .24% (ranging from .00% to 1.30%). All missing values were then replaced using the EM algorithm method in SPSS (Allison, 2002).

Using SPSS 13.0 and LISREL 8.72, to compare the three hypothesized models, the analyses comprised two steps. In Step 1, a CFA was conducted to fit a measurement model for the next step. In Step 2, SEM analyses were performed to validate the structural model (relations between the constructs) of each of the three models M1, M2, and M3, based on the measurement model constructed in Step 1. The procedure was conducted in accordance with the two-step method for using structural equation modeling to test and develop theories, as proposed by Anderson and Gerbing (1988) and recommended by Hau et al. (2004). The maximum likelihood fitting method and the covariance matrix were used for CFA and SEM.

3.2. Results and discussion

3.2.1. Fitting a measurement model

It was suggested that if the sample size is sufficiently large, then it would be better to adopt the parceling method to avoid an excessive number of parameters being estimated in one model (Bandolos & Finney, 2001; Hau et al., 2004). In addition, after parceling, the data would more closely approximate a normal distribution and would have better quality (Hau et al., 2004). Therefore, we used parcels as indicators (observable variables) to measure the latent variables (social anxiety, stressful life events, maladaptive cognitions, PIU symptoms and PIU-related negative outcomes). The parcels were used as the means of the subsets of items for each latent variable. The parceling strategy involved items in the same dimension being grouped into the same subset. Specifically, the indices of social anxiety were the three item parcels randomly grouped in the IAS; the indices of stressful life events were the six dimensions in the ASLEC; the indices of maladaptive cognitions were the three dimensions in the CAMCS; the indices of PIU symptoms were the three dimensions in the CSIA subscale from the CIAS-R; and the indices of PIU-related negative outcomes were the two dimensions in the RPIA subscale from the CIAS-R. Finally, a measurement model composed of seventeen indicators (observable variables), four exogenous latent variables and three endogenous latent variables.
was constructed. Table 2 presents the Pearson correlation coefficients among all the indicators in the measurement model. A CFA was performed to test this measurement model. The results indicated that all parameter estimates were statistically significant, and no abnormal values were found. All of the key fit indices of the model exceeded the criteria recommended by Hau et al. (2004) and Marsh et al. (2004), $\chi^2/df = 3.37$, NNFI = .98, CFI = .98, RMSEA = .049, SRMR = .042. The loadings of all of the indicators on their latent variables were reasonably high, ranging from .55 to .89, with a mean of .76 (see Table 3). Therefore, this model fit the data well.

### 3.2.2. Fitting the structural model

Results from SEM (see Table 4) showed that all of the three models fit the data well, moreover, M1 was statistically significantly better fit than M2, $\Delta \chi^2(1) = 16.69$, $p < .0001$, whereas M3 was statistically significantly better fit than M1, $\Delta \chi^2(2) = 39.48$, $p < .0001$. Thus, M3 was selected as the final model (see, Fig. 6).

The detailed results of model M3 were discussed as follow. In total, the equation of PIU symptoms explained 40.00% of the variation ($R^2 = .40$), and the equation of PIU-related Negative Outcomes explained 79.50% of the variation ($R^2 = .80$), suggesting that the model was effective for explaining PIU.

Specifically, the standardized direct effect of maladaptive cognitions on PIU symptoms was .54, $p < .001$, the standardized direct effect of PIU symptoms on PIU-related negative outcomes was .89, $p < .001$. These results support the hypothesis that maladaptive cognitions positively predict PIU symptoms, which in turn result in related negative outcomes. It is consistent with the theoretical hypothesis of the cognitive-behavioral model proposed by Davis (2001).

Both social anxiety and stressful life events had positive direct effects on PIU symptoms, standardized estimations of these direct effects were .16 ($p < .001$) and .20 ($p < .001$) respectively. At the same time, the effects of both factors were partially mediated by maladaptive cognitions. The proportion of the mediating effect of maladaptive cognitions on the relationship between social anxiety and PIU symptoms was 50.00%, and that on the relationship between stressful life events and PIU symptoms was 37.50%. These results support the hypothesis that maladaptive cognitions partially mediate the positive links from social anxiety and stressful life events to PIU symptoms. These findings confirm the theoretical hypothesis suggested by Davis (2001) that maladaptive cognitions, as a proximal factor, mediate the effects of distal factors on PIU. However, they were not consistent with the findings of Caplan (2003, 2005) and Li et al. (2010), who reported that maladaptive cognitions fully mediated the effects of distal factors on PIU. These results will be discussed further in the general discussion.

### 4. General discussion

The present study proposed a new dimension (“self-realization”) in the structure of maladaptive cognitions among Chinese adolescents in addition to the two dimensions (“social comfort” and “distraction”) found among adolescents in Western countries. Moreover, the present study also confirmed the decisive role that
maladaptive cognitions play in the development of PIU among Chinese adolescents.

4.1. Chinese adolescents’ maladaptive cognitions and the mechanism of PIU

The present study enriched the conceptual structure of maladaptive cognitions to some extent by finding a new dimension (“self-realization”) that has not yet been considered. This dimension, together with two other dimensions (“social comfort and distraction”) found in Western cultures, was consistent with the three types of needs (social interaction, escape and self-realization; Sulter, 1999) that might be satisfied by using the Internet. However, the question why the new dimension of “self-realization” would be found in Chinese adolescents whereas not in adolescents in Western countries might lead to further consideration of the causes of maladaptive cognitions. Although the Internet may satisfy different types of needs in different individuals, whether Internet use would cause certain maladaptive cognitions depends on whether individuals lack mechanisms to satisfy these needs in real life. The result that the structure of maladaptive cognitions in Chinese adolescents was different from that of adolescents in Western countries indicates that the structure of maladaptive cognitions might differ across cultures. Studies using participants from different cultural backgrounds may be necessary to obtain a more complete understanding of maladaptive cognitions.

The results of Study 2 verified both the direct effect of maladaptive cognitions on PIU and their mediating role in the relationships between distress factors and PIU among Chinese adolescents. This enriches and extends the literature on the cognitive-behavioral model of PIU (e.g., Caplan, 2003, 2005; Davis, 2001; Li et al., 2010) and provides evidence for the general function of maladaptive cognitions in the mechanism of PIU development. Although the specific content of maladaptive cognitions may differ in different cultures, studies from both China (e.g., Li et al., 2010) and Western countries (Caplan, 2003, 2005) have demonstrated that maladaptive cognitions play a decisive role in the development of PIU.

4.2. Explaining the high prevalence of PIU among Chinese adolescents

The present study confirmed the higher PIU prevalence found in Chinese adolescents compared to that in European and American adolescents. It is important to consider the underlying reasons for this increased prevalence of PIU.

Results from the regression analyses in Study 1 indicated that all three types of maladaptive cognitions had effects on PIU. Particularly, “self-realization” and “distraction” played more important roles in the development of PIU than “social comfort.” By contrast, the social function of the Internet has been found to be strongly associated with PIU in Western studies (e.g., Casale & Fioravanti, 2011; Lee & Stapinski, 2012), and PIU may be caused by maladaptive cognitions related to social comfort (e.g., POIS by Caplan (2005)). These different findings suggest that compared with Western countries, the structure of maladaptive cognitions might be more complex among Chinese adolescents and prove to be a decisive factor that would result in PIU. In other words, Chinese adolescents might be at a greater risk for PIU. This may help explain the higher prevalence of PIU among Chinese adolescents than among adolescents in Western countries.

4.3. Implications for PIU Prevention and Interventions

Consistent with earlier studies (Caplan, 2003, 2005; Li et al., 2010), we confirmed that the presence of maladaptive cognitions plays a decisive role in the development and maintenance of PIU. PIU was affected to a large extent by psychological factors, suggesting it might be reasonable to use psychotherapy (World Health Organization, 1990) as a PIU intervention rather than drug therapy or electric shock and electromagnetic treatments. Numerous studies and practical experience have indicated that removing psychological dependence is a key and effective way to solve addictive problems, including both substance abuse and behavioral addictions (Aston-Jones & Druhan, 1999; Holden, 2001; Nestler, 2001). Among the commonly used psychotherapy approaches, the approach of displacing irrational beliefs or dysfunctional schema used in cognitive-behavioral therapy was found to have long-term effects on PIU (Young, 2007). Because maladaptive cognitions have been found to have decisive effects on PIU, it is reasonable to treat individuals with PIU by helping them change their existing maladaptive cognitions.

The results from the regression analyses in Study 1 indicated that “self-realization” and “distraction” played more important roles in the development of PIU than “social comfort,” whereas in Western countries, “social comfort” was found to play a more important role (e.g., Caplan, 2003, 2005, 2010). These differing results imply that PIU treatments characterized by correcting maladaptive cognitions may need to be adjusted according to different cultures because the importance of certain maladaptive cognitions may differ across cultures. As Chinese adolescents were more influenced by the maladaptive cognition of “self-realization,” parents and educators might help them develop more interests and special skills in real life and at the same time educate them according to their aptitudes while avoiding an over-emphasis on academic achievement.

4.4. Future research

Although we found the effect of maladaptive cognitions on PIU symptoms was large in the current study, this does not account for the total variance in PIU. The results do not support the hypothesis in the cognitive-behavioral model that maladaptive cognitions were sufficient causes for PIU. The relationship between maladaptive cognitions and PIU may perhaps be moderated by a third factor. For example, a recent study by Li et al. (2010) indicated that effort control moderating the effects of maladaptive cognitions on PIU. Future studies should integrate other moderated factors to further investigate the mechanism of PIU.

Although the results of the current study indicated that the mediating effect of maladaptive cognitions was significant, the effects of stressful life events and social anxiety on PIU were not entirely mediated by maladaptive cognitions. There might be other proximal antecedents of PIU in addition to maladaptive cognitions, such as emotional aspects of the behavioral regulation system. For instance, some studies have found that emotional intelligence can predict PIU (Beranuy, Oberst, Carbonell, & Chamarro, 2009). Future research should integrate emotional factors to further investigate the mechanism of PIU.

When interpreting these results, it is important to remember that this research was cross-sectional. Although SEM analyses can assess the plausibility of hypothetical causal processes, strong causal inferences are not appropriate when this method is used with cross-sectional or correlational data. A longitudinal or experimental design would provide a stronger framework for identifying causal effects.

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