

Temperament and Problematic Internet Use in Adolescents: A Moderated Mediation Model of Maladaptive Cognition and Parenting Styles

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Abstract The present study investigated the mechanisms underlying the relation between temperament (i.e., effortful control, sensation seeking, and dispositional anger/frustration) and adolescent problematic internet use (PIU) by examining the mediating role of maladaptive cognition toward internet use in linking temperament and PIU and the moderating role of parenting styles in influencing the mediation. A total of 660 Chinese middle-school adolescents completed anonymous questionnaires regarding temperament, maladaptive cognition toward internet use, maternal parenting styles, and PIU. After controlling for gender, age, and family socioeconomic status, it was found that effortful control was negatively related to PIU, whereas sensation seeking and anger/frustration were positively related to PIU. Moreover, maladaptive cognition partially mediated the relation of effortful control and dispositional anger/frustration to PIU and completely mediated the relation of sensation seeking to PIU. Moderated mediation analyses further revealed that authoritative and permissive parenting styles moderated the relation between sensation seeking and maladaptive cognition. Specifically, in adolescents with low authoritative or low permissive mothers, sensation seeking promoted maladaptive cognition, whereas in adolescents with high authoritative or high permissive mothers, sensation seeking no longer predicted PIU. Theoretical and practical implications were discussed.

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Introduction

Over the past two decades, as the Internet has gradually become the predominant means for information exchange and communication, there has been growing concerns over the impact of internet use on individuals' psychosocial well-beings (Young and de Abreu 2011). These concerns have been raised substantially after recent research worldwide on adolescents identified a heightened negative impact of problematic internet use (PIU) on their health, social, and academic status (see review by Ko et al. 2012). PIU, in general, is defined as the "use of the Internet that creates psychological, social, school, and/or work difficulties in a person's life" (Beard and Wolf 2001, p. 378). Three major subtypes of PIU that have been identified and studied are excessive gaming, sexual preoccupation, and excessive e-mail and text messaging (Block 2008). Internet users of these subtypes shared some common characteristics such as excessive use, emotional withdrawal, intolerance if desired usage is not satisfied, and negative physical and interpersonal repercussions (Block 2008).

Identification and treatment of PIU tend to be difficult because individuals with PIU are often affected by other psychological and behavioral problems. Thus, researchers seeking the etiology of PIU often resort to literature on similar disorders such as substance dependency and gambling addiction that are conceptually along the line of compulsive-impulsive spectrum disorder (Block 2008). Although some precursors of PIU have been identified such as temperament (e.g., Larose and Eastin 2004; Ko et al.

2006) and maladaptive cognition toward internet use (e.g., Davis 2001), the challenge remains to understand the development of PIU in social contexts in order to provide theoretical support for development of prevention and remediation plans.

In the literature of substance abuse and gambling addiction, a psychosocial learning model has been proposed (i.e., the acquired preparedness model; McCarthy et al. 2001). The model conceptualizes that temperament influences a person's participation in problem behaviors (such as addictive drinking and gambling) through its influence on the individual's cognition toward the behaviors. In addition, the development of problem behaviors in general has long been considered as a result of the interplay between an organism and its environment (i.e., the organism-environment interaction approach; Rothbart and Bates 2006; Wachs and Plomin 1991). Based on these two theoretical models, it may be reasonable to postulate that in a comprehensive model of PIU, factors that influence PIU could be individual or environmental, the individual factors could directly or indirectly influence PIU, and this influence could vary depending upon the environmental factors that directly or indirectly impact PIU.

One individual factor related to PIU is temperament, which refers to biologically-based individual differences in reactivity and self-regulation (Rothbart and Bates 2006). Temperament plays an important role in the development of problem behaviors, such as depression, delinquency, substance abuse, and gambling (De Pauw and Mervielde 2010; Rothbart and Bates 2006), by either predisposing an individual toward problem behaviors through mediating processes or interacting with other factors to produce problem behaviors (Nigg 2006). Specific dimensions of temperament, such as effortful control, sensation seeking, and dispositional anger/frustration, are often related to the occurrence of PIU (LaRose et al. 2003; Lin and Tsai 2002; Ko et al. 2008).

The first dimension—effortful control—is a core aspect of self-regulation and refers to the ability to regulate attention in response to situational needs (Rothbart and Bates 2006). Ample evidence supports the beneficial role of effortful control in fostering desirable behaviors and inhibiting maladaptive behaviors in children (see review by Eisenberg et al. 2007). Recent research in PIU also suggests that effortful control serves as a protective function from PIU. For example, LaRose et al. (2003) and LaRose and Eastin (2004) found that deficient self-regulation was one of the determinants for excessive use of the Internet. Likewise, Kim et al. (2008) found that self-control, a concept similar to effortful control, was negatively correlated with online game addiction.

The second dimension of temperament related to PIU is sensation seeking, which refers to the tendency to seek out novel and highly stimulating experiences, and the

willingness to take subsequent risks (Zuckerman 2007). Numerous studies have identified sensation seeking as a partial determinant of high-risk and antisocial behaviors (Zuckerman 2007). Some recent evidence also suggests a positive relation between sensation seeking and PIU. For example, Lin and Tsai (2002) found that high school adolescents who used the Internet excessively scored significantly higher on sensation seeking scales compared with their peers who maintained a relatively low-level of internet use. Similarly, Ko et al. (2006, 2007) identified high sensation seeking as a powerful predictor for internet addiction in high school adolescents. Finally, in a meta-analytical study aggregating results from 37 independent studies from Mainland China, Taiwan, United States, and Iran on middle school, high school, and college students, Wang et al. (2013) reported a moderate and positive relation between sensation seeking and PIU.

The third dimension of temperament related to PIU is dispositional anger/frustration, which refers to an individual's tendency to experience negative affect when he or she is interrupted on an ongoing task or blocked from attaining specific goals (Rothbart and Bates 2006). Dispositional anger/frustration and similar traits of hostility are found to be positively related to PIU. For instance, Ko et al. (2008) identified high levels of frustration related to internet addiction, especially in adolescent boys. Similarly, Yen et al. (2008) found that hostility was significantly related to internet addiction in middle and high school adolescents even after controlling for other psychiatric symptoms.

Although previous studies have established direct relation between temperament and PIU, the underlying mechanism of such relation remains unknown. Related research has identified aspects of social learning as a mediator between temperament and problem behaviors. In the acquired preparedness model proposed by McCarthy et al. (2001), temperament of an individual is perceived to influence the individual's beliefs and expectations, and in turn his or her tendency to engage in problem behaviors. The model has been validated in studies on substance abuse (Doran et al. 2013; Hayaki et al. 2011; Settles et al. 2010) and gambling (Cyders and Smith 2008). Because PIU is a kind of problem behavior, it is reasonable to postulate that adolescents' maladaptive cognition about internet use plays a role in mediating temperament and PIU. Empirical evidence linking maladaptive cognition and PIU can be found in an etiological model of PIU proposed by Davis (2001). In this model, maladaptive cognition was identified as a sufficient cause of both the development and continuation of PIU. Recent clinical research on PIU patients based on a framework of cognitive-behavioral therapies has provided additional support for the utility of therapies targeting maladaptive cognition in remediation of PIU (Young and de Abreu 2011). Although empirical evidence linking

temperament and maladaptive cognition is lacking, it may be reasoned that adolescents with high effortful control ability are better at suppressing impulsive acts and recognizing situational complexities when making behavioral decisions. Consequently they are more cognizant of the negative effects of problem behaviors and have better control over impulses that may lead to such behaviors. In contrast, adolescents high in sensation seeking are more susceptible to the desirable aspects of a problem behavior and therefore would likely form positive attitudes toward it. Similarly, adolescents high in dispositional anger/frustration are less skillful in calming their emotions and thus are prone to develop a negative affect state after repeated failures. This state might lead to the formation of cognitive styles in favor of online activities that compensate the lack of necessary social interactions. Thus, based on the acquired preparedness model (McCarthy et al. 2001), it may be anticipated that certain styles of temperament (i.e., low effortful control, high sensation seeking, and high dispositional anger/frustration) would predispose adolescents to maladaptive cognition, which would in turn promote PIU.

Another important factor underlying the relation between adolescents' temperament and PIU is parental influence. The dynamic nature of parental influence on their children may be described in parenting styles, which consist of three main types: authoritative, authoritarian, and permissive (Baumrind 1971). Authoritative parents provide their children with a warm and structured social environment and encourage and support their independence. Children of these parents were found to have low levels of psychological and behavioral dysfunction in general and low levels of PIU in particular (Alexander et al. 2006; Xiuqin et al. 2010; Valcke et al. 2010). In contrast, authoritarian (vs. authoritative) parents tend to value obedience, favor punitive and forceful measures, and discourage reciprocal communication. The effect of this parenting style on PIU is less clear. On one hand, authoritarian parenting is associated with obedience and conformity (Lamborn et al. 1991), which might reduce PIU (Valcke et al. 2010), but on the other hand it is also associated with poor self-concepts in children (Lamborn et al. 1991), which might motivate adolescents to seek alternative self-actualization and social interactions via the Internet and, thus, promote PIU (Xiuqin et al. 2010). Permissive parents tend to provide low regulation in a "laissez faire" attitude. Children of these parents were found to have higher occurrence of substance abuse and delinquent behaviors, as well as prolonged internet use (Valcke et al. 2010).

Although the conditional effect of parenting styles on the relation between temperament and PIU (i.e., whether the direct and indirect relations between temperament and PIU vary as a function of parenting styles) has not yet been studied, the interplay between individuals and their environment as well as the effect of this interplay on problem

behaviors in general have been well documented (Rothbart and Bates 2006; Wachs and Plomin 1991). Thus, it may be reasoned that when parents fail to provide a warm and controlled social environment, adolescents who are predisposed to indulgence, high-risk activities, or hostile emotions might develop maladaptive venues to cope with stress and to obtain stimulation and social interactions otherwise lacking in real life. Therefore, they might be more likely to develop maladaptive cognition and PIU compared with their peers who experience positive parenting.

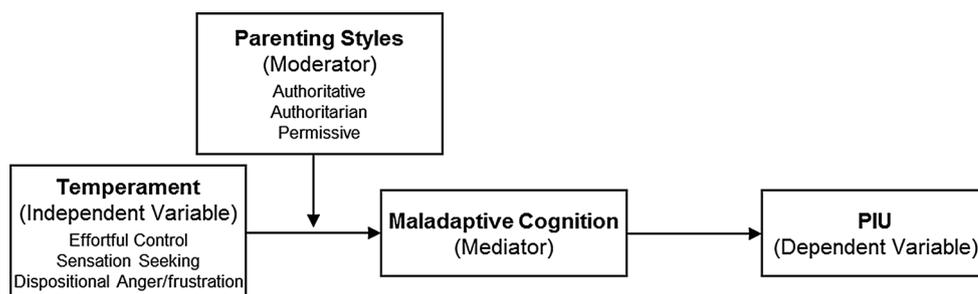
In the present study, we propose an integrated theoretical model by bringing together two hitherto largely separate lines of research (the acquired preparedness model and the organism-environment interaction approach) to study the mechanisms between temperament and PIU in adolescence. Our research hypotheses, taken together, constitute a "moderated mediation" model whereby the mediating process affecting the relation between the predictor and the outcome depends upon the value of a moderator variable (Edwards and Lambert 2007; Muller et al. 2005). This moderated mediation effect is also referred to as the "conditional indirect effect" (Preacher et al. 2007, p. 185). Mediation, or an indirect effect, occurs when the effect of an independent variable on a dependent variable is transmitted by a mediator. After the mediation effect is established, the interest becomes whether the mediation effect would remain constant across different contexts. Particularly, our purpose is twofold: (a) to investigate whether the relation between temperament and PIU would be mediated by maladaptive cognition, and (b) to examine whether the direct and indirect paths linking temperament and PIU would vary as a function of maternal parenting styles. This integrated model can address questions about mediation (i.e., how temperament relates to PIU) and moderation (i.e., when the relation is most potent) in one model. Figure 1 illustrates the proposed research model. Specifically, we hypothesize that temperamental styles of low effortful control, high sensation seeking, and high dispositional anger/frustration predispose adolescents to maladaptive cognition and henceforth promote PIU. We also hypothesize that such relations would be much weaker at high levels of authoritative parenting and low levels of permissive parenting. Because the moderation pattern of authoritarian parenting remains unclear, we choose to study it in an exploratory manner.

Method

Participants

Participants were 660 students in Grades 7 and 8 from four middle schools in southern China. Forty-five percent of the

Fig. 1 Conceptual model of temperament and problematic internet use (PIU) illustrating moderated mediation effects



participants were male. The mean age of the participants was 14.14 years ($SD = 0.86$). Research has shown that adolescents at this age have a relatively higher tendency to engage in PIU compared with elementary and high school students (Dong and Lin 2011; Wang et al. 2008). The employment history of the participants' parents showed that 84.2 % of the fathers and 58.8 % of the mothers had a stable job in the past year. An examination of parental education level showed that 15.8 % of the fathers and 34.8 % of the mothers completed elementary education, 55.0 % of the fathers and 50.8 % of the mothers completed junior high school, 22.4 % of the fathers and 11.7 % of the mothers completed high school, and 6.8 % of the fathers and 2.7 % of the mothers completed college education. Although the socioeconomic status of the study sample is much lower compared with that of a representative sample from the Western developed countries in general, these statistics are similar to those of the local and national populations according to the 2010 Chinese census data (Population Census Office under the State Council & Department of Population and Employment Statistics of National Bureau of Statistics 2012), indicating that the sample reflects the average Chinese population. Given prior research showing that adolescents' gender, age, and family socioeconomic status were correlated with PIU (Li et al. 2013; Siomos et al. 2008), we included each of them as control variables in statistical analyses.

Procedures

The study was approved by the research ethics committee at the corresponding author's institution. Because the protocol was judged to pose low risk to participants and the data were collected and processed anonymously, oral consent was recommended and obtained from school boards and participants prior to data collection. Very few participants declined to participate. The survey was administered in classrooms by trained graduate research assistants. The administrators explained requirements and confidentiality procedures to all participants following standard instructions and monitored survey completion. Participants were given approximately 20 min to complete the survey.

Measures

Temperament

Effortful control was assessed using a subscale from the Early Adolescent Temperament Questionnaire-Revised Short Form (Ellis and Rothbart 2001). This subscale consists of 16 items that measure attention, activation control, and inhibitory control (e.g., "Although the assignment is hard, I can finish it on time"). Items were translated following standard translation and back-translation procedures and slightly modified to suit Chinese culture (Li et al. 2010, 2012). Participants were asked to rate how true each statement was on a 6-point scale ranging from 1 (*not at all true*) to 6 = (*always true*). Cronbach's alpha was .76 for the present sample.

Sensation seeking was assessed using a subset of 6 items from the Sensation Seeking Scale (Zuckerman et al. 1978) as suggested by Steinberg et al. (2008), which indexed thrill or novelty seeking (e.g., "I like to have new and exciting experiences and sensations even if they are a little frightening"). Items were also slightly modified to suit Chinese culture in previous studies (Li et al. 2010, 2012). The same 6-point rating scale was used. Cronbach's alpha was .69 for the present sample.

Dispositional anger/frustration was also assessed using items adapted from the Early Adolescent Temperament Questionnaire-Revised Short Form (Ellis and Rothbart 2001). The anger/frustration subscale included 7 items (e.g., "I get irritated when I have to stop doing something that I am enjoying."). These items were slightly modified to suit Chinese culture (Li et al. 2012; Wang et al. 2012). Participants were asked to indicate how true each statement was on the same 6-point scale used in the previous two temperament subscales. Cronbach's alpha was .64 for the present sample.

Maladaptive Cognition

In the present study, maladaptive cognition is defined as unrealistic thoughts and/or exaggerated beliefs associated with internet use. This construct was measured by 10 items

that were first used by Li et al. (2010). These items captured the perceived utility of internet for compensation for the lack of social interaction (using survey statements such as “Friends online are more trustable than those offline” and “Friends online are much more friendly than those offline”) and management of situational and emotional stresses (using survey statements such as “People can escape from the stress in daily life when they are online” and “When you are online, you do not have to worry about the difficult school work”). Participants rated how true each statement was on a 6-point scale ranging from 1 (*not at all true*) to 6 (*always true*). Thus higher mean scores represent stronger emphasis on the desirable functions of internet use. Cronbach’s alpha was .88 for the present sample.

Parenting Styles

The Parenting Styles and Dimensions Questionnaire-Short Version (Robinson et al. 2001) was modified to assess the level of maternal parenting behaviors. The original questionnaire comprises 32 items that correspond to Baumrind’s (1971) three parenting style typologies. The authoritative style dimension includes 15 items measuring parental characteristics of warmth/involvement, reasoning/induction and democratic participation. The authoritarian style dimension includes 12 items measuring parental corporal punishment, verbal hostility, and nonreasoning/punitive strategies. The permissive style dimension includes 5 items measuring lack of follow-through and ignoring misbehavior by parents. The original measure exhibited good psychometric properties (Olivari et al. 2013) and has been used in Chinese populations (Fu et al. 2013; Robinson et al. 2001; Zhou et al. 2008). In the present study, the questionnaire was first translated into Chinese through standard translation and back translation procedures to ensure equivalence in language, culture and measurement validity and was afterwards adapted for adolescent self-report. The translated questionnaire was tested in a pilot study in several middle-school classrooms and the participants did not report difficulties in understanding the items. After consulting with school counselors and adolescents in the pilot study, 3 items that were judged to be redundant based on Chinese culture were excluded. Thus, the Chinese version of the questionnaire used in this study consisted of 29 items. Representative items for each of the three dimensions are: “She gives me reasons why rules should be obeyed”, “She yells at me when I misbehave”, and “She gives into me when I cause a commotion about something”, respectively. The Chinese version of the questionnaire was shown to correlate in theoretically predicted ways with important developmental outcomes and other measures of parenting styles (Li et al. 2012; Wang et al. 2012). Participants rated each item on a 5-point scale

ranging from 1 (*never*) to 5 (*always*) with higher scores indicating higher tendency that parents would use that specific type of parenting style. The measure yields a separate and continuous score for each dimension of parenting style (Li et al. 2012; Zhou et al. 2008). For the present sample, Cronbach’s alpha coefficients were .90, .84, and .71 for authoritative, authoritarian, and permissive parenting styles, respectively.

PIU

Adolescent PIU was assessed using a 10-item scale adapted from Young’s questionnaire for screening internet dependency (Young 1998). This scale has demonstrated good reliability and validity in Chinese samples (Li et al. 2010, 2013a, b) and similar items have been used in the National Children’s Study of China project (Dong and Lin 2011). A representative item was “Do you use the Internet as a way of escaping from problems or an unhappy mood?” Participants indicated how true each item was on a 6-point scale ranging from 1 (*not at all true*) to 6 (*always true*). Therefore, higher mean scores represent higher levels of PIU. Cronbach’s alpha was .72 for the present sample.

Socioeconomic Status

Socioeconomic status comprises parental education levels, parental occupations and family economic status. Participants reported on parental education levels of their fathers and mothers, separately, according to four categories (i.e., elementary school, middle school, high school, college or graduate school). Participants also reported on parental occupations of their fathers and mothers, separately, indicating whether the parent had a stable job or not in the past year. Family economic status was assessed using a measure developed by Song et al. (2014) that includes 5 items (e.g., “My family does not have enough money to buy new clothes”). Participants indicated how true each item was for his or her family using a 4-point scale ranging from 1 (*not at all true*) to 4 (*always true*). A factor score was calculated for each participant based on factor analysis of average parental educational level, average parental occupation, and family economic status, with higher scores representing higher levels of family socioeconomic status.

Data Analysis

We first followed Baron and Kenny’s (1986) four-step procedures to test the mediation effect of maladaptive cognition on the relation between temperament and PIU. The procedure includes three separate regression analyses (Table 2, Equations 1–3) followed by a significance test on the indirect effect of the predictor variable on the outcome

variable via the mediator. The mediation effect is confirmed if all the following requirements are satisfied: (1) significant effect of the predictor on the outcome in Equation 1; (2) significant effect of the predictor on the mediator in Equation 2; (3) significant effect of the mediator on the outcome after controlling for the predictor in Equation 3; and (4) significant Sobel test on the indirect effect of the predictor on the outcome via the mediator. All analyses included control variables for participants' gender, age, and socioeconomic status (SES) of their families.

We then followed Muller et al.'s (2005) guidelines to test the moderated mediation hypothesis which require three separate regression analyses (Equations 1–3 in Table 3). Moderated mediation is established if Requirement #1 and at least one of Requirements #2 and #3 are satisfied: (1) significant main effect of the predictor on the outcome not affected by the moderators in Equation 1; (2) significant effect of the predictor on the mediator affected by the moderator(s) in Equation 2; and (3) significant effect of the mediator on the outcome affected by the moderator(s) in Equation 3.

Results

Descriptive statistics and bivariate correlations for all variables are presented in Table 1. The results showed that effortful control was negatively related to maladaptive cognition and PIU, whereas sensation seeking and dispositional anger/frustration were both positively related to maladaptive cognition and PIU. These findings suggest that low effortful control, high sensation seeking, and high dispositional anger/frustration are potential risk factors for the onset of maladaptive cognition and PIU. In addition, the results also showed that authoritative parenting was negatively related to maladaptive cognition and PIU, whereas authoritarian parenting and permissive parenting were both positively related to maladaptive cognition and PIU. This finding indicates that low authoritative parenting, high authoritarian parenting, and high permissive parenting are potential risk factors for maladaptive cognition and PIU. Finally, maladaptive cognition was found to be positively related to PIU, which is in line with findings from previous research.

Testing for Mediation Effect

The mediation effect was tested following Baron and Kenny's (1986) procedure. Maladaptive cognition was found to mediate the relations of temperament dimensions to PIU based on the following results: (1) all three temperament dimensions significantly predicted PIU (Equation 1, Table 2); (2) all three temperament dimensions significantly predicted maladaptive cognition (Equation 2,

Table 2); (3) after controlling for temperament, maladaptive cognition still significantly predicted PIU (Equation 3, Table 2); (4) Sobel tests indicated that the indirect effects of all three temperament dimensions via maladaptive cognition were significant for PIU ($Z = -6.07$, $SE = 0.02$, $p < .001$ for effortful control; $Z = 5.23$, $SE = 0.02$, $p < .001$ for sensation seeking; and $Z = 4.57$, $SE = 0.02$, $p < .001$ for dispositional anger/frustration).

Testing for Moderated Mediation

Following Muller et al.'s (2005) guidelines, we found moderated mediation for sensation seeking on PIU. In particular, as reported in Table 3, we observed (1) an overall effect of sensation seeking on PIU not moderated by authoritative or permissive parenting (Equation 1), (2) significant main effects of all three temperament dimensions on maladaptive cognition plus two significant interaction effects of Sensation Seeking \times Authoritative Parenting and Sensation Seeking \times Permissive Parenting on maladaptive cognition (Equation 2), and (3) significant effect of maladaptive cognition on PIU (Equation 3) not moderated by parenting styles. These observations suggested that authoritative and permissive parenting styles moderated the effects of the predictor (sensation seeking) on the mediator (maladaptive cognition), and that the indirect effect of sensation seeking on PIU was moderated by authoritative and permissive parenting styles.

To visually describe the moderation effect, the effect of sensation seeking on maladaptive cognition was calculated at high and low levels (one SD above and below the mean) of the moderator (Fig. 2). Testing of simple slopes showed that, for adolescents with low authoritative or low permissive mothers, higher sensation seeking was related to higher maladaptive cognition (low authoritative: $b_{\text{simple}} = 0.28$, $SE = 0.06$, $p < .001$; low permissive: $b_{\text{simple}} = 0.30$, $SE = 0.05$, $p < .001$). For adolescents with high authoritative or high permissive mothers, sensation seeking was not related to maladaptive cognition (high authoritative: $b_{\text{simple}} = 0.07$, $SE = 0.06$, $p > .05$; high permissive: $b_{\text{simple}} = 0.04$, $SE = 0.06$, $p > .05$). However, authoritarian parenting style was not found to moderate either direct or indirect relations between sensation seeking and PIU. Furthermore, none of the three parenting styles was found to moderate either direct or indirect relations between effortful control and PIU, or between dispositional anger/frustration and PIU.

Discussion

In an attempt to explain the mechanisms underlying the relation between temperament and PIU in adolescence, the present study proposed and tested a theoretical model

Table 1 Univariate and bivariate statistics for all study variables

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Gender	–										
2. Age	.09*	–									
3. SES	–.01	–.16***	–								
4. Effortful control	–.11**	–.13**	.09*	–							
5. Sensation seeking	.07	.10*	–.00	–.23***	–						
6. Anger/frustration	–.06	–.18**	–.00	–.31***	.32***	–					
7. Authoritative parenting	–.00	.16***	.14***	.31***	–.12**	–.18***	–				
8. Authoritarian parenting	.12**	–.14***	–.08*	–.27***	.26***	.22***	–.47***	–			
9. Permissive parenting	.12**	.11**	–.08*	–.28***	.19***	.32***	–.35***	.35***	–		
10. Maladaptive cognition	.17***	.16***	–.01	–.37***	.32***	.34***	–.19***	.29***	.31***	–	
11. PIU	.28***	.20***	.02	–.47***	.34***	.29***	–.19***	.25***	.29***	.64***	–
<i>M</i>	0.45	14.14	0.00	4.09	3.90	2.95	4.32	2.45	1.71	2.77	2.60
<i>SD</i>	0.50	0.86	1.00	0.69	0.89	1.05	1.01	0.98	0.82	1.07	1.09

Gender was coded as 1 (male) or 0 (female). SES denotes socioeconomic status. PIU denotes problematic internet use

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2 Testing the mediation effects of temperament on PIU

Predictors	Equation 1 (criterion PIU) <i>b</i> (<i>SE</i>)	Equation 2 (criterion MC) <i>b</i> (<i>SE</i>)	Equation 3 (criterion PIU) <i>b</i> (<i>SE</i>)
Gender	0.52 (0.07)***	0.28 (0.07)***	0.39 (0.06)***
Age	0.06 (0.04)	0.11 (0.04)**	0.01 (0.03)
SES	0.07 (0.04) [†]	0.04 (0.04)	0.05 (0.03)
Effortful control	–0.38 (0.04)***	–0.26 (0.04)***	–0.26 (0.03)***
Sensation seeking	0.13 (0.04)***	0.22 (0.04)***	0.03 (0.03)
Anger/frustration	0.22 (0.04)***	0.19 (0.04)***	0.13 (0.03)***
Maladaptive cognition			0.51 (0.03)***
<i>R</i> ²	0.35	0.26	0.51
<i>N</i>	660	660	660

Each column corresponds to a regression equation that predicts the criterion at the top of the column. Gender was coded as 1 (male) or 0 (female). SES denotes socioeconomic status. PIU denotes problematic internet use. All predictors were transformed into standardized z-scores. Multicollinearity was not found

[†] $p < .10$, ** $p < .01$, *** $p < .001$

based on the acquired preparedness model and the organism-environment interaction approach. More specifically, the research questions addressed were how temperament is linked to PIU (i.e., does maladaptive cognition toward internet use mediate this relation?) and under what conditions this link between temperament and PIU is most potent (i.e., do parenting styles employed by the mothers of the participants moderate this mediation?). The results suggested that maladaptive cognition linked the indirect relation between temperament and PIU and that this indirect relation was dependent upon levels of authoritative or permissive maternal parenting styles.

The study contributes to the literature in the following two ways. First, we tested the acquired preparedness model (McCarthy et al. 2001) in a new and emerging field of

study. We found that maladaptive cognition fully mediated the positive relation between sensation seeking and PIU, partially mediated the positive relation between dispositional anger/frustration and PIU, and partially mediated the negative relation between effortful control and PIU. These findings support the acquired preparedness model, which viewed maladaptive cognition as an important mediator between individuals’ temperamental dispositions and the development of problem behaviors (McCarthy et al. 2001). The findings also support, albeit partly, the cognitive behavioral model on PIU by Davis (2001). The fact that maladaptive cognition was a significant predictor of PIU was consistent with Davis’s expectation. However, maladaptive cognition in the present study was not found to be a necessary cause of PIU as suggested by Davis. Although

Table 3 Testing the moderated mediation effects of temperament on PIU

Predictors	Equation 1 (criterion PIU) <i>b</i> (<i>SE</i>)	Equation 2 (criterion MC) <i>b</i> (<i>SE</i>)	Equation 3 (criterion PIU) <i>b</i> (<i>SE</i>)
Gender	0.50 (0.07)***	0.25 (0.07)***	0.38 (0.06)***
Age	0.05 (0.04)	0.10 (0.04)**	0.00 (0.03)
SES	0.08 (0.04)*	0.05 (0.04)	0.05 (0.03)
Effortful control (EC)	-0.36 (0.04)***	-0.23 (0.04)***	-0.25 (0.04)***
Sensation seeking (SS)	0.10 (0.04)*	0.17 (0.04)***	0.01 (0.03)
Anger/frustration (AF)	0.21 (0.04)***	0.17 (0.04)***	0.13 (0.04)***
Authoritative parenting (A1)	-0.00 (0.04)	0.03 (0.04)	-0.02 (0.04)
Authoritarian parenting (A2)	0.02 (0.04)	0.09 (0.04)*	-0.03 (0.04)
Permissive parenting (P)	0.12 (0.04)**	0.14 (0.05)**	0.06 (0.04)
EC × A1	0.04 (0.04)	-0.04 (0.04)	0.06 (0.04)
SS × A1	-0.02 (0.04)	-0.11 (0.04)*	0.03 (0.04)
AF × A1	0.01 (0.04)	-0.04 (0.04)	0.03 (0.04)
EC × A2	0.04 (0.04)	-0.04 (0.04)	0.07 (0.04) [†]
SS × A2	0.03 (0.04)	0.01 (0.04)	0.01 (0.04)
AF × A2	0.03 (0.04)	0.02 (0.04)	0.02 (0.04)
EC × P	-0.01 (0.04)	-0.06 (0.04)	0.03 (0.04)
SS × P	-0.06 (0.04)	-0.13 (0.04)***	0.01 (0.03)
AF × P	0.03 (0.05)	0.05 (0.05)	-0.00 (0.04)
Maladaptive cognition (MC)			0.51 (0.04)***
MC × A1			-0.00 (0.04)
MC × A2			0.04 (0.04)
MC × P			0.01 (0.04)
<i>R</i> ²	0.36	0.31	0.52
<i>N</i>	660	660	660

Each column corresponds to a regression equation that predicts the criterion at the top of the column. Gender was coded as 1 (male) or 0 (female). SES denotes socioeconomic status. PIU denotes problematic internet use. All predictors were transformed into standardized z-scores. Multicollinearity was not found

[†] $p < .10$, * $p < .05$,

** $p < .01$, *** $p < .001$

it fully mediated the relation between sensation seeking and PIU, it only partially mediated the relations between the other two dimensions of temperament and PIU. The remaining direct and negative relation between effortful control and PIU suggests that effortful control may protect adolescents from PIU. Similarly, the remaining direct and positive relation between dispositional anger/frustration and PIU suggests that dispositional anger/frustration may function as a direct risk factor that predisposes adolescents toward PIU.

Second, we integrated the organism-environment interaction approach into the acquired preparedness model and tested a moderated mediation model to further explains the underlying relation between temperament and PIU. The integrated model was able to account for parenting styles as an important environmental factor in explaining variations in maladaptive cognition associated with temperament. An examination of the moderation mechanism showed that authoritative and permissive parenting styles moderated the relation between sensation seeking and maladaptive cognition. These findings partially support our hypotheses. Specifically, consistent with the hypotheses, in adolescents with low authoritative mothers, sensation seeking promoted

maladaptive cognition, whereas in adolescents with high authoritative mothers, sensation seeking did not yield a significant impact on maladaptive cognition. This finding indicates that authoritative parenting may function as a protective factor that mitigates the impact of adolescents' sensation seeking on maladaptive cognition towards internet use. It is likely that the amount of parental control and responsive communication used by high authoritative parents serve to protect high sensation-seeking adolescents from developing maladaptive cognition and thus, in turn, reduce PIU.

We hypothesized that permissive parenting moderated the effect of sensation seeking on maladaptive cognition such that when permissive parenting was high, sensation seeking predicted maladaptive cognition whereas when permissive parenting was low, sensation seeking was unrelated to maladaptive cognition. The finding revealed the opposite pattern, which needs to be interpreted with caution. When permissive parenting was high, maladaptive cognition consistently stayed at a high level regardless of the level of sensation seeking whereas when permissive parenting was low, sensation seeking predicted maladaptive cognition. This finding, taken together with the positive relation between permissive parenting and maladaptive

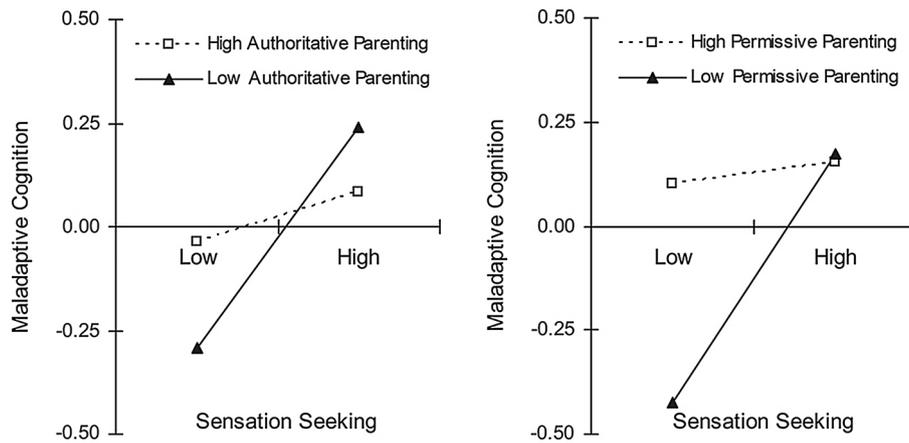


Fig. 2 Maladaptive cognition toward internet use among adolescents as a function of parenting styles (authoritative and permissive separately) and adolescents' temperament (sensation seeking). Functions are graphed on two levels of authoritative or permissive

cognition ($b = 0.14$, $SE = 0.05$, $p < .01$), signals the risk of high permissive parenting. When mothers place minimum restriction on duration and context of internet access, and engage in little preventative communication on the potential harm, adolescents might be influenced by outside socialization agents (e.g., peers) to adopt a positive view of internet use regardless of their sensation-seeking tendency.

Authoritarian parenting was found to neither exacerbate nor alleviate the risk associated with sensation seeking, which is consistent with our hypothesis and may reflect the previously-mentioned contradicting effects it had on the development of obedience and conformity versus the development of self-concept (Lamborn et al. 1991). However, given that the statistical power to detect moderation effect is often low (McClelland and Judd 1993), future research is needed to confirm this result.

Nonetheless, our findings suggest that the indirect impact of temperament on PIU via maladaptive cognition may not be constant across all types and levels of maternal parenting styles. Thus, we should not neglect parenting styles when we are evaluating the indirect effect of temperament on PIU. By incorporating parenting styles into the mediation process of a new type of problem behavior (PIU), we discovered effects that would have been overlooked without analyzing the moderation effects. The moderated mediation model proposed in this study offers greater predictive power and conceptual versatility than the original acquired preparedness model alone.

Limitation and Future Direction

Several limitations should be noted, however. First, the concurrent research design does not allow us to conclude that certain temperamental styles such as low effort control, high

parenting respectively: 1 standard deviation above the mean and 1 standard deviation below the mean. Note that the graphs are for descriptive purposes only. All inferential analyses were based on the continuous values of temperament and parenting styles

sensation seeking, and high dispositional anger/frustration lead to maladaptive cognition. Longitudinal methods would be needed in the future to establish such directional relations. Second, all data in this study were based on adolescents' self-reports. We relied on adolescent report of their parents' styles of parenting because it has been argued that the parenting styles as subjectively experienced by adolescents may be more influential to the adolescents' development than the actual parenting styles, or the parenting styles as perceived by parents (Fulgini and Eccles 1993; Gray and Steinberg 1999; Schaefer 1965). In addition, it has been found that for variables that measure inherent and personal traits (such as parenting styles), adolescents' report more accurately reflects the actual practices than parental report (Schwarz et al. 1985). For example, parents would less likely report physical punishment on their children than would the adolescents themselves. Finally, the use of adolescent self-report allowed us to study a large and representative sample (Gray and Steinberg 1999; Lamborn et al. 1991). That being said, it would be helpful to use multiple informants and multiple methods in data collection to avoid common method bias. Third, the model was tested in a group of Chinese adolescents. Cross-cultural research in temperament/personality has identified that western cultures differ from eastern cultures in personality dimensions such as extraversion and neuroticism, which are linked to temperamental traits of surgency and negative affectivity respectively, with U.S. adults scoring higher in extraversion, lower in neuroticism, and similar in conscientiousness, compared with Japanese and Chinese adults (Allik and McCrae 2004; McCrae and Terracciano 2005; Schmitt et al. 2007). In addition, culture was also identified as a moderator on the relation between temperament and PIU. For example, sensation seeking was found to be a stronger predictor of PIU in eastern cultures than in western cultures

(Wang et al. 2013). These cross-cultural differences imply that while the present findings may be generalized to other populations of similar Asian cultures, more research is needed in adolescents from European and American cultures to confirm the relations between the variables in the theoretical model exemplified in this study. Finally, the present study only considered parenting styles of mothers. Although mothers were the primary caregivers in majority of the instances, future research needs to consider parenting styles of fathers to provide a balanced and comprehensive assessment of the home parenting environment.

Despite these limitations, the present study has important practical implications. First, our results indicated a strong relation between temperament and PIU and identified maladaptive cognition as a possible link to partially account for this relation. These findings would help practitioners understand pathways by which adolescents' temperament is related to their development of PIU, suggesting a possible venue for targeted interventions. For example, interventions targeting maladaptive cognition might ameliorate the influences of low effortful control, high sensation seeking, and high anger/frustration on PIU. The remaining direct relation between temperament and PIU not accounted for by maladaptive cognition reminds us of the inherent nature of PIU directly associated with personal temperament. Thus, understanding of these traits could facilitate early identification of adolescents prone to development of maladaptive cognition and PIU in order to provide alternative activities in prevention of PIU. Moreover, the remaining direct relation also suggests that interventions targeting maladaptive cognition in remediation of PIU should also consider temperamental factors such as low effortful control and high dispositional anger/frustration in individualizing treatment plans. Second, our findings suggest that the tendency of developing PIU indirectly associated with sensation seeking is dependent upon two parenting styles. Whereas authoritative parenting style was identified as a protective factor from maladaptive cognition and PIU, permissive parenting style was found to be a risk factor toward maladaptive cognition and PIU. Thus, family therapies targeting increased parental involvement and more effective parenting styles might be helpful in prevention and treatment of PIU. Overall, results from the concurrent examination of mediation and moderation suggest that these family therapies targeting parenting styles may be most effective when provided along with the individualized therapies targeting maladaptive cognition.

Conclusion

In summary, this study investigated the underlying mechanism between temperament and the development of PIU

in adolescence. It was found that maladaptive cognition linked temperament and PIU. It was also found that authoritative parenting protects adolescents from maladaptive cognition and PIU while permissive parenting exacerbates adolescents' risk toward maladaptive cognition and PIU. Our findings demonstrate the utility of moderated mediation models in understanding the conditional indirect effect of temperament on adolescent PIU.

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