Factor Structure for the Internet Addiction Test: A Confirmatory Approach

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Abstract

Internet addiction is getting substantial attention and a number of diagnostic scales have been developed in recent years. To better investigate the internet addiction phenomenon, it is important that we have a better understanding of the structure, validity, and reliability of the assessment instruments. Thus, the current study attempts to evaluate the Internet Addiction Test (IAT) using a confirmatory approach.

Four hundred and ten questionnaires were collected via a survey of undergraduates from eight universities in Hong Kong. Data from half of the sample was submitted to exploratory factor analysis and that of the hold-out sample was analyzed using confirmatory factor analysis in order to assess the psychometric properties and factor structure of the IAT scale. Three factors named "Withdrawal and Social Problem", "Time Management and Performance" and "Reality Substitute" were extracted from the analysis. These three dimensions of the refined IAT instrument exhibits adequate reliability and validity. They provide valuable insights about Internet-related addictive behaviors and future research directions.

1. Introduction

The 21st century is a digitized era where technologies have profound influence on our life. Every day, people deal with electronic devices, computers and especially the Internet. It is no doubt that the Internet has changed our life enormously and the benefits brought by such powerful tool are obvious to all. The Internet is an abundant database which provides a simple and economical way for information access. Besides, it allows the creation and maintenance of social contacts without time-distance constraint, and its anonymity nature also facilitates communication for certain groups (Chou, Condron, & Belland, 2005).

Nevertheless, many literatures suggest that people may use the Internet addictively and this can exert harmful effects on individuals by altering their social behaviors, habits and abilities in a negative way (e.g. Neumann, 1998; Beard, 2002; Charlton, 2002; Stanton, 2002; Chen, Tarn, & Han, 2004; Young, 2004). Attention to this phenomenon has encouraged studies on problems related to Internet use and researchers have adopted different terminologies such as Internet addiction, Internet addiction disorder, Internet dependence, problematic Internet use, or pathological Internet use (Goldberg, I., 1995; Shaffer, 1996; Scherer, 1997; Griffiths, 1998; Kandell, 1998; Young, 1998a; Chou & Hsiao, 2000; Morahan-Martin & Schumacker, 2000; Davis, 2001; Chen et al., 2004) to describe the negative effects of excessive Internet use on personal lives.

Increased interest in Internet addiction has urged the development of different instruments like Internet Addiction Test (Young, 1998a), Pathological Internet Use scale (Morahan-Martin & Schumacker, 2000), and Generalized Problematic Internet Use Scale (Caplan, 2002) for assessing such behavior. Early assessment tools mainly focused on the criteria to diagnose Internet addiction while recent measurement design emphasizes the psychometric development approach, viewing Internet addiction as a multifaceted construct which covers biomedical criteria for addiction (e.g. tolerance and withdrawal symptoms) and psychosocial perspectives (e.g. interferences with other areas of life) (e.g. Lin & Tsai, 2001; Caplan, 2002; Cheng, Weng, Su, Wu, & Yang, 2003).

Although there are various proposed instruments for studying Internet addiction, to better understand the phenomenon, it is crucial to establish the validity and reliability of these instruments. Thus, the current study attempts to evaluate one of the instruments – Internet Addiction Test (IAT) (Young, 1998a).

Young and her associates have done a lot of works in defining Internet addiction (Yellowlees & Marks, 2007) and IAT is one of the early diagnostic scales that have been developed. It has been applied to measure individuals' level of Internet addiction and it has demonstrated strong internal reliability across studies (e.g. Young, 1998a; Yang, 2001; Widyanto & McMurran, 2004; Yang, Choe, Baity, Lee, & Cho, 2005). While the overall reliability of IAT scale as measured by Cronbach's alpha was good in these studies, there is paucity of research that assesses the factor structure of IAT and thus in understanding Internet addiction as a multi-dimensional construct. Hence, the present study aims to examine the dimensionality of IAT scale, refine and validate it using a confirmatory approach.

The rest of this paper proceeds as follows. The next section reviews the existing measurements for Internet addiction. After that, the method used to collect the empirical data is described. Then, how exploratory factor analysis and confirmatory factory analysis have been used to establish the factor structure of IAT scale is reported. The final section discusses the implications of results.

2. Literature Review

Over the years, researchers have devised different kinds of measurement to operationalize the concept of Internet addiction. Most assessment tools invented in early stage were designed as a set of diagnostic criteria or checklist which intent to describe the phenomenon of Internet addiction and distinguish those having Internet-related addictive behaviors.

Goldberg (1995) borrowed the ideas from substance disorders to design the Internet Addiction Disorder (IAD) scale. The IAD scale contains seven diagnostic criteria which describe Internet addiction from both the abuse (failure in role and social problems) and dependence (tolerance, withdrawal symptoms, more than intended, unsuccessful cut-backs, great deal of time) perspectives. Similarly, Griffiths (1998), proposed six criteria – salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse – for identifying Internet addicts.

Apart from this, other researchers have developed self-report checklists containing questions which ask about one's Internet use patterns. For instance, Brenner's (1997) Internet-Related Addictive Behavior Inventory (IRABI), Scherer's (1997) clinical symptoms of Internet dependency, Young's (1998b) Diagnostic Questionnaire (YDQ), and Morahan-Martin and Schumacker's (2000) Pathological Internet Use (PIU) scale. Actually, these checklists identify Internet addiction through a similar way: assessing any evidences that Internet use is causing work-related or interpersonal problems, distress, tolerance or withdrawal symptoms, and whether there is mood-altering use of the Internet.

Instead of just distinguishing the Internet addicts from normal Internet users, assessment tools developed in later stage attempt to measure the degree of Internet addiction via Likert scale. For example, Young (1998a) expanded the original YDQ and developed another measurement called Internet Addiction Test (IAT). The IAT scale comprises 20 items (as shown in Appendix) which assess the severity of negative consequences due to excessive Internet use. These items cover an individual's Internet use habits, his/her thoughts about the Internet as well as the related problems of Internet use. For each item, a graded response (1 = "not at all" to 5 = "always") can be selected and the higher summed item scores represent higher level of Internet addiction.

In recent years, researchers emphasize Internet addiction be measured as a multifaceted construct. They have integrated biochemical, genetic, psychological, familial and environmental dynamics to design some instruments which can assess Internet addictive behaviors from certain dimensions. For example, the Pathological Internet Use Scale for Taiwanese high school students (PIUST) was designed by Lin and Tsai (2001) to measure Internet addiction from four aspects – compulsive use and withdrawal; tolerance; family, school and health problems; interpersonal and financial problems. Also, Cheng et al. (2003) have devised the Chinese Internet Addiction Scale (CIAS) which consists of five subscales covering compulsive use, withdrawal, tolerance, time management problem, together with interpersonal and health problems. Moreover, Caplan (2002) has developed the Generalized Problematic Internet Use Scale (GPIUS), which addresses seven dimensions (mood alteration, social benefits, negative outcomes, compulsive use, excessive time online, withdrawal, and social control) of Internet use, to operationalize Davis's (2001) cognitive-behavioral approach

to problematic Internet use.

As mentioned in previous section, there is paucity of research on the dimensionality of Young's IAT. One study that we know was carried out by Widyanto and McMurran (2004). They recruited participants through the Internet to fill in a Web-based questionnaire and performed exploratory factor analysis to test the psychometric properties of the IAT scale. Based on 86 valid responses (29 males and 57 females), Widyanto and McMurran (2004) extracted six factors – salience, excess use, neglecting work, anticipation, lack of self-control, and neglecting social life – from the 20-item IAT and found that these factors had moderate to good internal consistency (Cronbach's alphas ranged from 0.54 to 0.82). Since the sample size of this study is quite small, further validation of IAT should contribute to the study of internet addiction. Our attempt to do that is described in the following sections.

3. Method

Subjects for the current study were undergraduates from eight universities in Hong Kong: the University of Hong Kong (HKU), Chinese University of Hong Kong (CUHK), Hong Kong University of Science and Technology (HKUST), Hong Kong Polytechnic University (POLYU), Hong Kong Baptist University (HKBU), City University of Hong Kong (CITYU), Lingnan University (LU), and Hong Kong Institute of Education (HKIED).

Over a six-week data collection period, 480 paper questionnaires were evenly distributed to the eight universities. In each university, subjects were recruited from campus (libraries, canteens, computer centers, student hostels etc.) to fill in the questionnaire. Participants had to complete the 20-item Internet Addiction Test (IAT) along with some demographic information like gender, age, education background, academic performance, weekly Internet usage, Internet experience, and the type of Internet activity frequently engaged.

Of the distributed questionnaires, a total of 410 usable responses (completed by 187 males and 223 females) were collected, with the number of participants rather evenly distributed among the eight universities (ranged from 11.5% to 15.1%). Also, this sample comprises students majoring in diverse areas of study such as philosophy, arts, law, business administration, social sciences, mathematics, natural sciences, medicine, computer science.

After the data was collected, exploratory factor analysis and confirmatory factor analysis were used to establish the factor structure of the IAT.

4. Results

To examine the psychometric properties of the Internet Addiction Test (IAT) scale, participants' responses were subjected to factor analysis. The original data set (n = 410) was randomly divided into two equally sized subsamples, with each subset being used for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) respectively. EFA was conducted firstly to identify the underlying structure of the IAT scale. After that, CFA was performed to validate the results of EFA and assess the generalizability of the extracted factor structure.

4.1. Exploratory Factor Analysis

Data from the first subsample (n = 205) was submitted to EFA to investigate the dimensionality of the IAT scale. At the beginning, a principal components factor analysis with varimax rotation was carried out on the full set of IAT items noted in Appendix. Eigenvalues and Scree plot were used to determine the number of factors to be extracted.

4.1.1. EFA for Full Set of IAT Items

Using the latent root criterion of retaining factors with Eigenvalues greater than 1.0, a four-factor structure was identified, with the extracted factors explaining 59.3% of the total variance. Factor loadings of the rotated solution are shown in Table 1, with all factor loadings less than 0.40 suppressed. Given the sample size of 205 and a 0.05 alpha level, factor loadings of 0.40 and higher is considered significant for interpretation purposes (Hair, Anderson, Tatham, Black, & Babin, 2006). Based on such threshold, each item loaded significantly high on one factor, except for one observation that needed attention: the cross-loadings for items Q2 and Q10.

Item Q2 cross-loaded on both factor 2 and 3, with the loadings of 0.499 (factor 2) and 0.498 (factor 3) being the same.

This problematic item should first be eliminated before further analysis could proceed. For item Q10, it had cross-loadings on three factors (factor 1, 3 and 4) and did not load particularly high on any of them. Actually, item Q10 should be deleted due to its cross-loadings. However, such deletion might end up with two few items given on factor 4. Thus, it was decided to drop item Q2 first and get the remaining 19 items recalculated at this stage.

Varimax-Rotated Loadings				ngs	
	Factor				
Item No.	1	2	3	4	Communality
Q3	.663				.547
Q4	.620				.516
Q5	.526				.579
Q9	.605	.496			.623
Q11	.473				.469
Q13	.644				.516
Q15	.742				.635
Q18	.721				.691
Q19	.589				.508
Q20	.642				.564
Q1		.687			.625
Q2		.499	.498		.619
Q6		.695			.659
Q8		.785			.680
Q16		.649			.646
Q17		.706			.674
Q12			.721		.618
Q14			.580		.434
Q7				.807	.689
Q10	.409		.411	.401	.560
Sum of Squares (Eigenvalue)	4.661	3.882	2.019	1.291	11.853
Percentage of Variance Explained	23.303	19.409	10.093	6.457	59.261

Table 1 Exploratory Factor Analysis for Full Set of IAT Items

Factor loadings less than 0.40 were suppressed.

4.1.2. EFA for Reduced Set of IAT Items

The remaining 19 items of the IAT scale were submitted to another principal component factor analysis. This time, a three-factor structure which accounted for 54.9% of the total variance was suggested using the criterion of an Eigenvalue greater than 1.0. Although nearly all items had significant high loadings on a single factor, a cross-loading exhibited by Q11 should be noted. Such cross-loading was rather substantial that the loadings of 0.460 (factor 1) and 0.411 (factor 3) were almost identical. Since at least two items were given on both cross-loaded factors, item Q11 was deleted from the analysis and the loadings for the remaining 18 items were recalculated.

Having respecified the factor model, a new factor solution was derived using the same EFA approach. This resulted in three orthogonal factors which explained 55.6% of the total variance. As shown in Table 2, the factor solution displayed a rather clear loading pattern, with each item having a significant high loading on a single factor. Two items (Q9 and Q18) had cross-loadings on factor 2. However, as these items still loaded much higher on factor 1, the deletion was precluded.

	Varimax-	lings		
	Factor			
Item No.	1	2	3	Communality
Q3	.673			.550
Q4	.632			.487
Q5	.556			.458
Q9	.595	.485		.591
Q13	.644			.519
Q15	.732			.597
Q18	.707	.407		.679
Q19	.593			.507
Q20	.649			.563
Q1		.683		.541
Q6		.701		.660
Q8		.778		.659
Q16		.673		.643
Q17		.752		.709
Q7			.666	.453
Q10			.537	.525
Q12			.690	.526
Q14			.443	.350
Sum of Squares (Eigenvalue)	4.356	3.744	1.915	10.015
Percentage of Variance Explained	24.198	20.802	10.641	55.641

 Table 2
 Exploratory Factor Analysis for Reduced Set of IAT Items: Q2 and Q11 Dropped

Factor loadings less than 0.40 were suppressed.

4.2. Confirmatory Factor Analysis

To verify the EFA identified factor structure, CFA was performed on the hold-out sample (n = 205) using the LISREL program. The 18 IAT items were modeled as reflective indicators of the extracted factors. Variances for the three factors were fixed to one and the factors were allowed to correlate freely in the CFA model. The maximum likelihood approach was adopted for model estimation, with the item covariance matrix as input data. The result is presented in Table 3.

Goodness-of-fit was assessed using a number of fit indices, including chi-square, RMSEA, CFI, NNFI and SRMR. As suggested by (Bentler, 1989), the chi-square normalized by degrees of freedom (χ^2/df) of a measurement model should not exceed 5.0 to demonstrate good fit. For the current CFA model, χ^2/df was 2.735 ($\chi^2 = 361.059$; df = 132); CFI was 0.968; NNFI was 0.963; RMSEA was 0.095 and SRMR was 0.057, indicating sufficient model fit. This model has already provided an adequate fit. However, in order to check whether possible model improvement was available, certain diagnostic measures – the completely standardized loadings, standardized residuals and modification indices – were also examined.

	Factor				
Item No.	1	2	3		
Q3	.710				
Q4	.630				
Q5	.716				
Q9	.773				
Q13	.726				
Q15	.817				
Q18	.833				
Q19	.633				
Q20	.815				
Q1		.691			
Q6		.813			
Q8		.772			
Q16		.800			
Q17		.859			
Q7			.373		
Q10			.668		
Q12			.571		
Q14			.578		
Variance Extracted	.552	.622	.415		
Construct Reliability	.916	.891	.635		

 Table 3
 Confirmatory Factor Analysis for the EFA Extracted Model

Completely Standardized Loadings

4.2.1. Model Modification

The evaluation of diagnostic measures began by looking at the completely standardized loadings. According to the general rule of thumb, each factor loading should be statistically significant with its size between 0.50 to 0.70 or higher (Hair et al., 2006). Refer to Table 3, except the loading for item Q7 (0.373) fell far below the less conservative 0.50 cutoff, all other items loaded significantly high (ranging from 0.571 to 0.859) on the hypothesized factors. Thus, item Q7 became a prime candidate for deletion.

Further, the examination of standardized residuals and modification index also revealed two remarkable issues. Firstly, high standardized residual (4.161) and modification index for error terms (14.774) were found between items Q7 and Q8. Secondly, the value of standardized residual between items Q6 and Q8 (4.182) as well as the modification index for their error terms (17.489) were quite high.

For item Q7 (which asks about one's frequency of checking e-mail before doing something else), not only was its loading below 0.50, but it also had high standardized residual (4.161) and modification index (14.774) with item Q8. Taking these evidences together, one modification to the CFA model was to delete item Q7. Besides, as lots of people tend to check emails first when they get access to the Internet, it is not necessary for them to addict to the Internet to have such actions. Thus, item Q7 was deleted because it can not well represent the Internet addiction construct.

Regarding the high standardized residual (4.182) between Q6 and Q8, another adjustment to the CFA model was to add an error covariance between these two items. The correlated error terms imply that their associated indicators share a common source of variance other than the indicator-associated construct (Cheung & Rensvold, 2001). Correlated error

term refers to situations in which knowing the residual of one indicator helps in knowing the residual associated with another indicator. Thus, having errors correlated can be meaningful. After examining the content of items Q6 and Q8 in the IAT scale, it was found that the two items are actually asking the same question about whether the Internet would affect one's work performance. As a result, if one answers either of these questions in a certain way, there is high probability that this person will response to another item in a similar manner (Garson, D., 2005). Therefore, the use of correlated errors between item Q6 and Q8 can be justified.

4.2.2. Modified Measurement Model

Having respecified the CFA model by dropping item Q7 and allowing two error terms (between items Q6 and Q8) correlated, the measurement model validity was reassessed and the result is presented in Table 4. For the modified CFA model, χ^2/df was 2.645 ($\chi^2 = 304.139$; df = 115), showing an improved fit for the model. Also, other goodness-of-fit indices (CFI = 0.973; NNFI = 0.968; RMSEA = 0.089; SRMR = 0.053) supported that the model had adequate fit.

Second, convergent validity was evaluated for the 17-item/three-factor model. As shown in Table 4, factor loadings of the IAT items were high and significant at an alpha level of 0.05. Besides, the composite reliabilities of factors (ranged between 0.646 and 0.917) suggested adequate reliability. Except factor 3, the average variance extracted by other factors was higher than the 0.50 rule of thumb. Taken together, the evidence supported the convergent validity of the measurement model.

	Factor			
Item No.	1	2	3	
Q3	.709			
Q4	.631			
Q5	.717			
Q9	.768			
Q13	.729			
Q15	.816			
Q18	.830			
Q19	.639			
Q20	.818			
Q1		.689		
Q6		.782		
Q8		.739		
Q16		.815		
Q17		.876		
Q10			.658	
Q12			.593	
Q14			.593	
Variance Extracted	.552	.613	.379	
Construct Reliability	.917	.887	.646	

 Table 4
 Confirmatory Factor Analysis for the Modified Model

Finally, discriminant validity was assessed using a series of chi-square difference tests (Bagozzi & Phillips, 1982), where the χ^2 of an unconstrained CFA model (with all factors freely correlated) was compared with that of a constrained model (with covariance between two factors set equal to unity) and discriminant validity between the constrained pair of factors was indicated by a significant χ^2 change. According to Table 5, the chi-square differences due to the added

Table 5 Confirmatory Factor Analysis for the Modified Model				
Constrained Factor Covariance	χ^2	df	Δχ²	∆df
None	304.139	115		
Factor 1 and Factor 2	351.581	116	47.442*	1
Factor 1 and Factor 3	310.078	116	5.939*	1
Factor 2 and Factor 3	321.372	116	17.233*	1
* p < 0.05				

4.3. Factor Structure of the 17-Item IAT Scale

Given a validated factor model, the analysis proceeded to examine the content of the 17 IAT items, which then resulted in assigning the labels named "Withdrawal and Social Problem", "Time Management and Performance", and "Reality Substitute" to the three factors respectively.

Factor 1, "Withdrawal and Social Problem", captures one's degree of moodiness or difficulties when being restricted away from the Internet (e.g. "Q20: How often do you feel depressed, moody or nervous when you are offline, which goes away once you are back online?"). This factor also includes items focusing on interpersonal problems due to Internet use (e.g. "Q9: How often do you become defensive or secretive when anyone asks you what you do online?").

Factor 2, "Time Management and Performance", involves the degree of compulsive Internet use and one's failure to control or reduce the amount of time spent online (e.g. "Q17: How often do you try to cut down the amount of time you spend online and fail?"). Besides, items about problems of work or academic performance (e.g. "O6: How often do your grades or school works suffer because of the amount of time you spend online?") are captured as well.

Factor 3, "Reality Substitute", mainly describes the extent to which an individual regards the Internet environment as another reality and over-depends on it for relieving real-life disturbances (e.g. "Q12: How often do you fear that life without the Internet would be boring, empty, and joyless?").

5. Discussions

Good measurement is a pre-condition for building up knowledge in the research area of Internet addiction. As initial instrument development may contain some ambiguities in modeling a latent structure appropriately, more precise model specification is required to improve the interpretation of research results. In view of this, the current study sought to enhance Young's (1998a) Internet Addiction Test (IAT) by refining its structure and assessing it more rigorously using confirmatory factor analysis. The results from factor analyses show that Internet addiction can be explained from three aspects: withdrawal and social problem; time management and performance; reality substitute. Also, the refined IAT scale has exhibited adequate reliability and validity.

As mentioned, Widyanto and McMurran's (2004) has found a six-factor structure for the IAT. The six factors are salience, excess use, neglecting work, anticipation, lack of self-control, and neglecting social life. On the other hand, the present study finds that a three-factor structure is a satisfactory representation of the IAT instrument. The results in current study are comparable with those obtained by Widyanto and McMurran (2004) and expand their findings about the factor structure of Internet addiction. In support of Widyanto and McMurran's (2004) results, and despite the preclusion of some insignificant items in current analysis, various IAT items covary in a similar pattern as that described in their six-factor model. For example, the "Withdrawal and Social Problem" dimension contains items alike those loaded on two of the factors, "salience" and "neglecting social life", identified by Widyanto and McMurran (2004) while the "Time Management and Performance" dimension resembles what they described as "lack of self-control" and "neglecting work". However, added to Widyanto and McMurran's (2004) findings, results from the present study indicate that another factor "Reality Substitute", separate from the constellation described by them, may have important ramifications for the understanding of Internet addictive behavior.

Besides, the three factors extracted are consistent with prior findings concerning the diagnostic criteria for Internet addiction (e.g. Goldberg, 1995; Brenner, 1997; Griffiths, 1998; Lin & Tsai, 2001; Caplan, 2002). They show that Internet addiction is a rigid behavior with certain degree of compulsion and reflect an individual's motivations to use the Internet continuously based on the fear of withdrawal symptoms. Also, these factors indicate one's acknowledgement that Internet use behavior is interfering with social life, and his/her recognition of excessive Internet use in terms of insight into the problem. Besides providing supports for previous studies, the results in current study exhibit two noticeable implications worth addressing: (1) the constituents of factor "Withdrawal and Social Problem"; and (2) the distinctive nature for factor "Reality Substitute".

When examining the measurement items for factor "Withdrawal and Social Problem", it is found that this factor is actually carrying two building blocks: it comprises the withdrawal symptoms like unpleasant feelings/physical effects when one is refrained from using the Internet as well as the negative impacts on social life due to Internet use. The "Withdrawal" block is related to the criteria set of substance dependence while the "Social Problem" block is related to the substance abuse set in DSM-IV (American Psychiatric Association, 1994). Comparing with other measurements of Internet addiction, these two building blocks were mostly developed as separate dimensions for a scale (Griffiths, 1998; Cheng et al., 2003). However, results of current study suggest that the two blocks are best served by a single factor, demonstrating the strong interplay between one's withdrawal symptoms and the interpersonal problems faced by an individual. This can be explained by Davis's (2001) Cognitive-Behavioral Model of Pathological Internet Use: people suffering from Internet addiction exhibit certain withdrawal symptoms (e.g. defensiveness, diminished impulse control) which can distress their interpersonal relationship. Although people notice their Internet use behaviors are socially undesirable, they fail to control the addiction behaviors and the frustrations encountered in social life in turn lead to further withdrawal symptoms. As a result, the two building blocks "Withdrawal" and "Social Problem" reinforce each other and maintain a vicious cycle. Apart from this, despite the fact that these two blocks are related to different criteria sets in DSM-IV (American Psychiatric Association, 1994), some findings have shown that the abuse and dependence criteria were measuring a similar latent construct and there was not enough support to separate them into two factors (e.g. Lewinsohn, Rohde, & Seeley, 1996; Harrison, Fulkerson, & Beebe, 1998; Fulkerson, Harrison, & Beebe, 1999). Thus, this further supports that "Withdrawal" and "Social Problem" are not easily separable due to their duality and that it is reasonable to treat them as a single factor.

Another insight from current findings is the identification of factor "Reality Substitute". This aspect is relatively distinct from other studies in terms of the severity of one's Internet addiction behavior. While prior studies talked about the general negative consequences of Internet addiction (e.g. interferences with family, personal health, job performance, learning etc.), the factor "Reality Substitute" implies that people maybe so addicted to the Internet that they will substitute the real world with Internet environment. In fact, this factor is especially specific to Internet addiction because of the unique nature of Internet. Nearly all activities conducted in the real world – shopping, gambling, studying, social interaction etc. – can be accomplished through the Internet while most constraints encountered in real life such as time, distance and cost can be eliminated in the Internet context. Therefore, people can be addicted to the Internet in a way that they make themselves live in a virtual world.

The "Reality Substitute" dimension is an area worth exploring because it provides another direction for defining the diagnostic criteria for Internet addiction so that proper treatments for this kind of addictive behavior can be developed. Based on the factor-analytic results in current study, the average variance extracted and construct reliability for "Reality Substitute" is relatively low compared with the other two factors. This implies that its measurement items require improvement. Thus, to enhance the validity and diagnostic utility for this factor, future research can identify a set of representative items for the "Reality Substitute" dimension and cross-validating its reliability.

6. Conclusions

Using both exploratory and confirmatory factor analysis, this study has examined the latent structure of the IAT scale. Three dimensions – withdrawal and social problem, time management and performance, reality substitute – are identified and these dimensions are found to be useful in understanding the phenomenon of Internet addiction. The results support the reliability and validity of the dimensions. Although further improvements are required for the reality substitute dimension, the refined scale should provide a good basis for future research.

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Appendix

No. **Details of Items** Q1 How often do you find that you stay online longer than you intended? Q2 How often do you neglect household chores to spend more time online? Q3 How often do you prefer the excitement of the Internet to intimacy/relationships with your partner/friends? Q4 How often do you form new relationships with fellow online users? Q5 How often do others in your life complain to you about the amount of time you spend online? Q6 How often do your grades or school works suffer because of the amount of time you spend online? Q7 How often do you check your e-mail before something else that you need to do? Q8 How often does your job performance or productivity suffer because of the Internet? Q9 How often do you become defensive or secretive when anyone asks you what you do online? Q10 How often do you block out disturbing thoughts about your life with soothing thoughts of the Internet? Q11 How often do you find yourself anticipating when you will go online again? Q12 How often do you fear that life without the Internet would be boring, empty, and joyless? Q13 How often do you snap, yell, or act annoyed if someone bothers you while you are online? Q14 How often do you lose sleep due to late-night log-ins? Q15 How often do you feel preoccupied with the Internet when offline, or fantasize about being online? Q16 How often do you find yourself saying "just a few more minutes" when online? Q17 How often do you try to cut down the amount of time you spend online and fail? Q18 How often do you try to hide how long you've been online? Q19 How often do you choose to spend more time online oven going out with others? Q20 How often do you feel depressed, moody or nervous when you are offline, which goes away once you are back online?

Full Set of Items in IAT Scale