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Sensation seeking and internet dependence of Taiwanese high school adolescents

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Abstract

The present study examined excessive Internet use of Taiwanese adolescents and a psychological aspect of users, sensation seeking, thus to differentiate motivation of Internet dependents and non-dependents. Seven hundred and fifty three Taiwanese high school students were selected using cluster sampling and 88 of them were categorized as Internet dependent users. Results indicated that Internet dependents spent more time on-line than non-dependents. While Internet dependents perceived significantly more negative Internet influences on daily routines, school performance, and parental relation than non-dependents, both Internet dependents and non-dependents viewed Internet use as enhancing peer relations. Making friends through the Internet has become a popular activity among adolescents, potentially leading to its excessive use. Internet dependents scored significantly higher on overall sensation seeking and disinhibition than Internet non-dependents. However, both groups did not differ in the life experience seeking subscale and thrill and adventure seeking subscale. This finding contradicts that of Lavin, Marvin, McLarney, Nola, and Scott [CyberPsychol. Behav. 2 (2000) 425]. Possible reasons for this discrepancy and for the relation between Internet dependence and disinhibition in Taiwanese adolescents are also discussed.

Keywords: Sensation seeking; Internet dependence; Internet addiction; Internet abuse; Internet usage patterns; Adolescence

1. Introduction

Owing to the Internet's recent emergence as a popular media for mass and personal communications as well as its potential to enhance global competitiveness, Taiwanese government has strongly advocated Internet use island-wide for commercial and educational purposes. Internet use in Taiwan has exploded in terms of the growth rate of subscribers to Internet Service Providers (ISPs) since popular con-

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sumption took hold in 1995. An Internet survey company, Iamasia, recently estimated that 30% of the Taiwanese population, approximately 6.4 million people, have used the Internet at least once in the past 4 weeks (Chen, 2000).

Despite the widely perceived merits of the Internet, policy makers and educators have been cautioned to realize its negative impacts, especially excessive use of the Internet, the related physical and psychological problems, and harmful consequences toward significant others (Brenner, 1996, 1997; Egger & Rauterberg, 1996; Greenfield, 2000; Griffiths, 1998; Kraut, Patterson, Lundmark, Kiesler, Mukopadhyay, & Scherlis, 1998; Young, 1996b, 1997). These studies adopted quantitative and qualitative methods to identify Internet addicts, sometimes used terms such as Internet dependents, technology addicts, problematic Internet users, or pathological Internet users. Several researchers in Taiwan (e.g. Chen, 1998; Chou, Chou, & Tyan, 1999; Chou & Hsiao, 2000) have also reported on excessive Internet use among Taiwanese university students, roughly 20 hours weekly, i.e. a pattern closely resembling the findings of American and European studies.

Having connected the campus computer networks of universities island-wide, the Taiwanese government is promoting the establishment of networks that would connect high school campuses. Despite the anticipated effects, high school students that gain more access to the Internet will possibly become more vulnerable to Internet dependence. Although excess Internet use among high school students is likely to surface, empirical evidence on Internet dependent adolescents is still lacking. Previous studies on Internet addiction focused mainly on undergraduate students, adults, or general users who voluntarily responded to Internet surveys (Greenfield, 2000; Griffiths, 1998).

This study is a second year follow up of a research project "Internet addiction among Taiwanese high school students". During the first phase, Lin and Tsai (1999) and Tsai and Lin (1999) designed a measurement tool to (a) identify Internet dependence among Taiwanese adolescents, (b) examine its reliability and validity, and (c) investigated how Internet vulnerability and perception in using the Internet are related. During the second phase of the study, this study analyzed whether sensation seeking is related to adolescents' excessive use of the Internet.

Sensation (novelty) seeking is a prominent feature of adolescence (e.g. Farley & Cox, 1971; Newcom & McGee, 1991) and closely related to risky or adventurous behaviors, such as drug use (Donohew, Hoyle, Clayton, Skinner, Colon, & Rice, 1999), drinking driving (Johnson & Cropsey, 2000; Jonah, 1997), diving or parachuting (Zarevski, Marusic, Bunjevac, & Vukosav, 1998). Surfing the Internet or many online activities are widely viewed as a global high tech adventure and, therefore, could be considered a form of sensation seeking. In sum, exploring how sensation seeking and Internet dependence among adolescence are related is of relevant interest.

2. Related studies

Griffiths (1998) characterized Internet or computer addicts as individuals who tend to be "socially unskilled male teenagers who have little or no social life and/or self confidence, and are described by names such a nerd, geek, and/or anorak" (p. 63).

Morahan-Martin and Schumacher (2000) indicated similar popular stereotype of Internet addicts but with detailed description about their Internet usage and psychological features. Internet addicts are "more likely to be males, technologically sophisticated, use real time interactive activities, such as on-line games and chat lines, and feel comfortable and competent on-line" (p. 14). Breaking this stereotype, Young (1996a) described an Internet addiction case involving a middle age housewife in the United States.

However, Kandell (1998) identified college students as more vulnerable to problematic Internet use than other groups. This phenomenon can be attributed to several reasons. Most university students move away from home to a dormitory, thus allowing them to physically cut family ties if desired. Away from parents' guidance, students have more freedom in governing their use of the Internet. During this period, university students strive to develop their personal identities as well as meaningful interpersonal relationships or even intimacy. Their personal needs may lead them to explore the enormous social network connected by the Internet. Additionally, the educational system encourages college students to use the Internet owing to its promotion as a super high way to the high tech world and innovativeness. It is reasonable to expect that this similar phenomenon will occur as the Internet becomes increasingly accessible to high school students.

Lin and Tsai (1999) identified a small group ($N = 61$) of potential Internet dependents among Taiwanese high school students. These Internet dependents excessively used the Internet, approximately 20 h weekly. The most frequently used Internet applications for the young Internet dependents were listed in a descending sequence, WWW (5.79 h/week), BBS (3.85 h/week, Bulletin Board Systems are a very popular Internet application in Taiwan), chat rooms/IRC (3.61 h/week), FTP (2.73 h/week), Internet games/MUD (2.04 h/week), and e-mail (1.77 h/week).

However, long time spent on-line is merely the surface characteristic of Internet dependence. The dependents appeared to have symptoms of non-substance addiction, following the screening criteria of Young (1998) which is in turn based on Pathological Gambling described in DSM-IV (APA, 1994), i.e. tolerance, compulsive use and withdrawal, and some consequent problems.

The Internet dependents in Lin and Tsai (1999) admitted tolerance syndromes. Their insatiable desire to spend more time or to engage more extensively in Internet activities was the only way to reach the initial excitement they experienced when beginning to use the Internet. They also showed compulsive use of the Internet and withdrawal symptoms. Most of them urged to get on-line and easily lost track of time. They frequently attempted to reduce their Internet usage, although seldom successfully, which brought on depression, anxiety and a sense of emptiness. While recognizing the abuse of the Internet, they admitted how the Internet negatively impacts their lives, such as in school, health, and parental relations. These high school students demonstrated problematic consequences of Internet dependence similar to those found in previous literature (e.g. Brenner, 1996; Egger & Rauterberg, 1996; Young, 1996b), such as skipping meals, losing sleep and study time, increasing on-line charge, as well as rearranging daily routines or avoiding interpersonal interaction to become more involved in the Internet.

Tsai and Lin (2000) reported on Roger, a 17-year-old Internet dependent boy, who spent 3–4 h on-line daily and longer on the weekend or during vacation (more than 6 h). He used the Internet mainly to communicate with people and even admitted to have more Internet friends than real-life friends. He viewed on-line usage as a way of life. Roger's parents, who had a junior high school education, could not understand their son's fascination with the Internet. As owners of a family business, they were frequently away from home (up to at least 12 h a day), thereby leaving Roger unattended while on-line. Roger claimed to have stayed on-line for 11 consecutive days without sleep, setting a world record. Consequently, Roger's school performance has dropped owing to his excessive time on the Internet. His teacher even once went to his house to plug off his Internet utilities from the computer and hide them away.

The parents refused to pay Roger's telephone bill incurred from Internet usage. To pay off a bill that averaged 300 US $ monthly, Roger took several part time jobs, mainly assembling personal computers for sale or designing homepages. Although trying several times, Roger failed to control his Internet usage. However, his Internet adolescence friends admired him for breaking family rules and school discipline. This admiration enhanced his low confidence that had been damaged when failing to achieve the expectations of parents and teachers. From this case and cases studied by Griffiths (2000), we believe that some adolescents may use Internet dependent behaviors as coping strategy for low self-esteem or other maladaptive problems. Besides, Roger did not regard the Internet as stimulating his sensations. For example, when he met new friends in IRC or chat rooms, he might feel a little bit excited but talking with familiars is nothing special. Especially, after entering the Internet world for almost 3 years, there is less chance to meet new people nowadays.

When researchers tried to link personality to television use pattern, research has found some psychological features of TV viewers may contribute to the development of a perceived dependence on TV. For example, Eysenck (1978) suggested that sensation seeking is the underlying mechanism to explain excessive television viewing. Zuckerman (1979) defined sensation seeking as a trait illustrating "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" (p. 10). Sensation seeking has emerged as capable of explaining a variety of behaviors, such as drug use, aggression, sex, sky diving, bungee jumping, body-contact sports, hiking and camping, or playing computer and video games (Zuckerman, 1979).

Zuckerman's sensation seeking scale (1979) measures individual differences in sensation seeking along four dimensions: thrill and adventure seeking, experience seeking, disinhibition, and susceptibility to boredom. While the adventure seeking dimension includes thrill-taking behaviors such as engaging in physically risky activities, the experience seeking dimension measures behaviors of pursuing new experiences through travel, music, art, and drug usage. The disinhibition dimension features behaviors that ignore social constraints such as fighting, seeking social stimulation through parties, social drinking, and a variety of sex partners. The susceptibility to boredom subscale measures the level to avoid boredom produced by unchanging circumstances.

Eysenck (1978), based on his famous personality model of introvert and extrovert, predicted that introverts who are more inner-oriented, easier to perceive over-aroused, and may seek to reduce environmental stimulation, would be less likely to watch television excessively long. Whereas, the extroverts who tend to seek stimulation (sensation seeking) may become heavy television viewers. Unfortunately, he did not empirically examine his hypothesis.

Concerning the personality of computer-game players, Griffiths and Dancaster (1995) found individuals with Type A personality experience greater psychological reaction in response to the psychologically stimulating caused by computer games. The finding suggests that computer-game players become aroused while playing and perhaps for seeking this arousal they may be more likely to play games again. Furthermore, they suggest that Type A individuals might be more susceptible to computer-game addiction for they experience greater arousal if they are willing to seek for high stimulation from computer games.

While investigating 342 undergraduates in a small American university, Lavin, Marvin, McLarney, Nola, and Scott (2000) hypothesized that the Internet addiction is positively correlated with sensation seeking. That study identified 43 (12.6%) participants as Internet dependents. Internet dependents scored significantly lower than non-dependents in terms of overall sensation seeking, thrill and adventure seeking, as well as experience seeking that contradicted original expectations. Lavin et al. (2000) then further explained their finding by suggesting that sensation seeking of Internet dependents might not be physical, as measured by Zuckerman scale, but rather mental or virtual. Unfortunately, this study included subjects from only one institution that is underrepresented in its population, i.e. university students in the United States.

3. Methods

3.1. Subjects

Approximately 1000 Taiwan high school students were selected as the participants of this study using cluster sampling. The population of high school students in Taiwan was clustered into three demographic areas: northern, central, and southern Taiwan. Eight schools were selected from the three areas. For each school, two to three classes were randomly selected to form the original subject pool, i.e. of about 900 students. However, if any subject had never used the Internet, the data was excluded for further statistic analyses. Therefore, 753 subjects remained in the final sample pool.

More boys remained in the final sample pool, which was roughly twice the number of girls (Table 1). The evidence that more male than female used the Internet corresponds to Internet usage research conducted worldwide (e.g. Griffiths, 1998). Subjects who scored more than 80 on the Internet Addiction Scale for Taiwanese high schoolers ($N = 88$, 11.69% of subject, described later) were categorized as the Internet dependents in this study.

3.2. Measurements

Subjects completed a questionnaire encompassing three sections, basic information, Internet addiction, and sensation seeking.

3.2.1. Basic information

The first section of the questionnaire included nine questions concerning demographic data, Internet usage, and perception of the Internet influences. Subjects were asked to report demographic data, such as gender, age, year in high school, and general grade point in the last semester. For Internet usage, all subjects were asked if they had used the Internet. Those who had used the Internet needed to report how long they had used it, average weekly usage of various Internet applications, such as WWW, Chat room/IRC, BBS, ftp, Email, Internet games/MUD, Newsgroup, and where they used the Internet. About the perception of the Internet influences, subjects were asked to rate how the Internet had influenced their various life aspects, daily routines, school performance, parental relations, health, teacher relations, and peer relations, using an eight-point Likert style scale, ranging from 1 = extremely positive to 8 = extremely negative.

Table 1
Frequencies and χ^2 tests of Internet dependents and non-dependents on gender, grade, and Internet experience

Background	Internet dependents *N* (%)	Non-dependents *N* (%)	Total *N* (%)	χ^2	df
Gender					
Male	70 (80.5)	437 (65.8)	507 (67.5)	7.523**	1
Female	17 (19.5)	227 (34.2)	244 (32.5)		
Grade					
Grade 1 (10th)	12 (13.6)	122 (18.4)	134 (17.8)	9.045*	2
Grade 2 (11th)	43 (48.9)	331 (49.8)	374 (49.7)		
Grade 3 (12th)	32 (36.4)	211 (31.8)	234 (32.3)		
Internet experience					
< 1 year	25 (28.4)	291 (44.2)	316 (42.4)	15.625**	4
1–2 years	33 (37.5)	234 (35.6)	267 (35.8)		
2–3 years	18 (20.5)	96 (14.6)	114 (15.3)		
3–4 years	7 (8.0)	27 (4.1)	34 (4.6)		
> 5 years	5 (5.7)	10 (1.5)	15 (2.0)		
General grade point					
Upper 1/3	34 (41.5)	279 (45.8)	313 (45.3)	0.589	2
Middle 1/3	29 (35.4)	204 (33.5)	233 (33.7)		
Bottom 1/3	19 (23.2)	126 (20.7)	145 (21.0)		
Total	88 (11.8)	664 (88.2)	752 (100.0)		

* $P < 0.05$; ** $P < 0.01$.

3.2.2. Internet addiction

The Internet Addiction Scale for Taiwanese high schoolers (IAST; Lin & Tsai, 1999) was used to collect subjects' responses about problematic use of the Internet. The IAST has 29 items with Likert style scale, ranging from 1 (strongly agree) to 4 (strongly disagree), thus indicating the degree of accuracy that the statement describes their Internet use behavior.

Four dimensions were extracted and accounted for 53.7% of total variance explained, i.e. tolerance (10 items), compulsive use and withdrawal (seven items), related problems: family, school, and health (eight items), and related problems: interpersonal and financial (four items). Lin and Tsai (1999) and Tsai and Lin (1999) also pointed out that the reliability and validity index of IAST were both satisfactory.

Typical items of the subscale of compulsive use and withdrawal note: "Although I plan to use the Internet for a short time, I end up staying on-line longer than originally intended" and "When I tried to reduce my Internet use, I felt anxious." An example of the tolerance subscale states "I have to search for more exciting information to achieve the original satisfaction that I found when I began using the Internet." The related problematic consequences of Internet addicts included problems with family, school, and health. A typical item is "More than once, I cut classes to use the Internet for something unrelated to school learning." The fourth subscale describing interpersonal and financial problems includes items such as "Communicating with on-line friends is more interesting than with people I meet in real life".

3.2.3. Sensation seeking

Young (1987) and Chiu (1990) translated and adapted Zuckerman's (1979) original Sensation Seeking Scale (SSS). The original SSS was a 40-item questionnaire with four subscales, thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility. Sensation Seeking Scale Taiwan version (SSST) contained only 27 items designated to three dimensions: (1) life experience seeking (11 items) combining the original factors of experience seeking and boredom susceptibility; (2) thrill and adventure seeking (nine items); and (3) disinhibition (seven items).

Table 2
Means, standard deviations, and *t*-tests on IAST subscales and overall IAST score for Internet dependents ($N=88$) and non-dependents ($N=665$)

Internet dependence	Groups	Mean	S.D.	*t*-tests
Compulsive use/withdrawal	Dependent	21.11	3.320	15.784***
	Non-dependent	15.51	3.105	
Tolerance	Dependent	31.83	3.235	18.887***
	Non-dependent	24.56	4.419	
Related problems: family, school, health	Dependent	19.66	3.081	15.768***
	Non-dependent	14.05	3.142	
Related problems: interpersonal/finance	Dependent	13.00	1.800	11.940***
	Non-dependent	10.24	2.064	
Overall score	Dependent	85.60	5.595	30.768***
	Non-dependent	64.36	8.969	

*** $P<0.001$.

Typical items of the life experience seeking scale state "I would like a job that requires a lot of traveling" and "I get bored seeing the same old faces." For the thrill and adventure seeking scale, the example item is "I would like to try parachute jumping." The item of the disinhibition scale notes "I sometimes have an urge to act irresponsibly." The scale displayed good reliability indexes, Cronbach α from 0.61 to 0.81, and validity. Each item contained two statements from which a person had to choose. The number of chose items corresponded to each dimension was summed as dimension score and, then, an overall score was obtained by summing up the scores of three dimensions.

4. Results

4.1. Demographic data

The backgrounds of the Internet dependents ($N = 88$) differed from those of the non-dependents ($N = 664$, Table 1). The chi square analyses showed that Internet dependents contained significantly more boys (ratio of 4 boys to 1 girl), more 12th graders (36.4%) while less 10th graders (13.6%) than the non-dependents (31.8% in 12th grade and 18.4% in 10th grade). Internet dependents had significantly longer Internet experiences than the non-dependents. Thirty-two percent of the dependents had used the Internet for at least 2 years while this figure was 20% among the non-dependents. However, these two groups reported they achieved roughly the same in school during the last semester.

4.2. Vulnerability of Internet dependents

The Internet dependents obtained a significantly higher overall IAST score and scores on four subscales (tolerance, compulsive use and withdrawal, related problems: family, school, health, and related problems: Interpersonal and finance) than the non-dependents (Table 2).

The Internet dependents stated that they remained on-line significantly longer in using WWW, chat room/IRC, BBS (Bulletin Board System), and ftp than the non-dependents (Table 3). However, the Internet dependent and non-dependent groups spent roughly the same amount of time in using e-mail, playing Internet games/MUD, and browsing Newsgroup that are relatively not-so-popular applications of Internet for Taiwanese high school students. Although e-mail is widely used among Taiwanese college students, few high school computer centers in Taiwan distribute e-mail accounts to their students. In addition, not many Taiwanese high students, about 1/13 of our participants, ever tried to play Internet games (MUD) and Newsgroup. In sum, the dependent group spent an average of 17.574 h weekly online while the ordinary people spent only an average of 8.972 h.

The Internet dependents and non-dependents perceived significantly different Internet influences in terms of all six aspects of life (Table 4). The Internet dependents felt that the Internet negatively influences their daily routines, school performance, and

parental relations (4.965, 4.686, and 4.570 are larger than the midpoint, 4.5 in an eight-point Likert style scale, ranging from 1 = extremely positive to 8 = extremely negative). However, they felt the Internet positively influenced their health, teacher relations, and peer relations. For the non-dependents, the Internet positively influences all six aspects of their lives.

Table 3
Average amounts of time spent (hours per week), standard deviations, and *t*-tests on various Internet applications for Internet dependents and non-dependents

Internet usage (h/week)	Groups	Mean	S.D.	*t*-tests
WWW	Dependent	4.727	5.208	3.139**
	Non-dependent	2.845	3.777	
Chat room/IRC	Dependent	3.079	5.880	2.908**
	Non-dependent	1.109	2.344	
BBS	Dependent	3.076	4.194	3.490**
	Non-dependent	1.409	2.701	
ftp	Dependent	2.324	4.148	3.192**
	Non-dependent	0.821	1.422	
Email	Dependent	1.604	3.570	1.786
	Non-dependent	0.995	2.743	
Internet games/MUD	Dependent	2.071	3.954	1.708
	Non-dependent	1.274	2.813	
Newsgroup	Dependent	0.693	1.579	0.925
	Non-dependent	0.519	1.023	

** $P < 0.01$.

Table 4
Means, standard deviations, and *t*-tests on Internet influences toward six life aspects

Internet influence on life aspects	Groups	Mean[a]	S.D.	*t*-tests
Daily routines	Dependent	4.965 N	2.111	5.067***
	Non-dependent	3.762 P	1.703	
School performance	Dependent	4.686 N	2.060	4.714***
	Non-dependent	3.598 P	1.601	
Parental relations	Dependent	4.570 N	1.901	5.918***
	Non-dependent	3.458 P	1.598	
Health	Dependent	4.282 P	1.881	3.779***
	Non-dependent	3.573 P	1.589	
Teacher relations	Dependent	4.000 P	1.762	3.587***
	Non-dependent	3.365 P	1.512	
Peer relations	Dependent	3.221 P	1.752	2.363*
	Non-dependent	2.756 P	1.394	

[a] N, negative Internet influences; P, positive Internet influences.
* $P < 0.05$; *** $P < 0.001$.

4.3. Sensation seeking and Internet dependence

Results obtained from *t*-tests indicated that Internet dependent adolescents scored significantly higher in terms of overall sensation seeking and disinhibition than the Internet non-dependents. However, both groups did not differ with respect to the life experience seeking subscale and the thrill and adventure seeking subscale (Table 5). This finding markedly differed from the results of Lavin et al. (2000) in which the Internet dependent American university students scored significantly

Table 5
Means, standard deviations, and *t*-tests for Internet dependent and non-dependent in sensation seeking

Sensation seeking	Groups	*n*	Mean	S.D.	*t*-tests
Life experience seeking	Dependent	88	8.506	2.236	1.903
	Non-dependent	665	8.263	2.525	
Thrill and adventure seeking	Dependent	88	7.617	2.356	0.418
	Non-dependent	665	7.561	2.380	
Disinhibition	Dependent	88	4.750	1.651	4.662***
	Non-dependent	665	4.348	1.518	
Overall score	Dependent	88	20.872	4.546	2.627**
	Non-dependent	665	20.171	4.773	

** $P<0.01$; *** $P<0.001$.

Table 6
For all of the subjects ($N=753$) and Internet dependents ($N=88$), the regression of sensation seeking on four dimensions of and overall Internet dependence: the standardized regression coefficients and coefficients of determination

Criterion	Predictor(s)	Beta	*T*	R^2	*F*
All subjects					
Tolerance	Disinhibition	0.201	5.636***	0.041	31.762***
Compulsive use/withdrawal	Disinhibition	0.141	3.897***	0.020	15.190***
Related problems: family, school, health	Disinhibition	0.200	5.580***	0.040	31.136***
Related problems: peer, finance	Disinhibition	0.105	2.864**	0.014	10.478**
	1. Disinhibition 2. Thrill/Adventure seeking	0.077	2.109*	0.020	7.488**
Overall Internet dependence	Disinhibition	0.225	6.321***	0.051	39.955***
Internet dependents					
Tolerance	Disinhibition	0.222	2.091*	0.049	4.452***
Compulsive use/withdrawal	–	–	–	–	–
Related problems: family, school, health	–	–	–	–	–
Related problems: peer interaction, finance	Disinhibition	0.243	3.318*	0.059	5.374*
Overall Internet dependence	Disinhibition	0.220	2.091*	0.048	4.373***

* $P<0.01$; ** $P<0.01$; *** $P<0.001$.

lower on the thrill and adventure seeking, experience seeking, and overall score of sensation seeking.

Within the entire subject pool, the regression of sensation seeking on Internet dependence indicated that only disinhibition is the significant predictor on scores of three addiction subscales: compulsive use and withdrawal, tolerance, and related problem: family, school, and health, as well as the overall score of Internet dependence (Table 6). To accurately predict the score of related problems: interpersonal and finance, both disinhibition and thrill and adventure seeking entered into the regression using stepwise (forward).

Meanwhile, for the Internet dependents, disinhibition successfully predicted tolerance, Internet related problem: interpersonal and finance, and overall IAST score. However, no any sensation seeking subscale predicted the Internet dependents' compulsive use and withdrawal syndromes as well as the problems of family, school, and health.

5. Conclusions and discussions

This study investigates a significant psychological feature of adolescence, sensation seeking, as well as adolescent's vulnerability to Internet dependence. The first finding indicated that the Internet dependent adolescents spent excessively long online—about 18 h weekly—that resembles the problem of Taiwanese young adults and college students documented in the previous studies. For example, Chen (1998) reported addicted Taiwanese college students spent an average of 19 h/week online, addicts in the study of Chou et al. (1999) spent 22 h/week, and Chao and Hsiao (2000) 20–25 h/week. Traditional-aged college students, living independently away from parental monitoring, experience a broad range of freedom to explore risky activities that might lead to addiction. In Taiwan as in the USA most high school students still live with parents but the Internet usage reported by high school dependents in this study has reached the range of college students. Concerning the social and culture context, Taiwanese high school students are expected to take an extremely competitive college entrance examination in which they must engage in intensive learning. The Internet dependents spent an average of 18 h weekly (or 2.6 h daily) on-line which is relatively long according to high school students' tight learning schedule in Taiwan.

Owing to the different sampling method adopted by this study and research conducted in the States, the comparisons of Internet usage are difficult and inadequate. Nonetheless, the weekly Internet usage reported by American Internet addicts or heavy users were extremely varied: 38.5 h in Young (1996b), 19 h in Brenner (1997), 13 h in Lavin et al. (2000), and 8.48 h in Morahan-Martin and Schumacher (2000). The above Internet addiction-related research conducted in the USA was accomplished through on-line surveys. The self-selected samples obtained from on-line research limit the orientation and capacity of investigations. For example, the investigator cannot select the participants to ensure the representativeness and generalizability. Although some researchers may contend that the most effective means

of approaching a true Internet addict is through on-line survey (because an addict must spend an enormous amount of time on-line), on-line research may draw only a proportion of people or addicts with certain characteristics.

The pathological online usage revealed by this study can be further compared with the time spent on watching TV among television addicts. In the studies of television addiction (Mcllwraith, 1990, 1998), about 10% of college students and adults labeled themselves as television addicts. Self-identified addicts watched a mean of 21 h of TV weekly while the ordinary people watched an average of 13 h weekly. Unfortunately, the current study did not ask participants to report their use of other kinds of technology (e.g. television, multimedia, or video-games). Therefore a direct comparison of addiction across different media is impossible and thus left some interesting questions unanswered, such as: for the Internet addicts, is their Internet use different from the use of other kind of technology? Or is there a general tendency toward various types of addiction? The result of Greenberg, Lewis, and Dodd (1999) provided some light to this direction. They examined whether there is an addictive personality among college students and found, contrary to previous studies, Internet addiction is correlated (moderate to high) to other types of substances addition (alcohol, caffeine, chocolate, and cigarettes) as well as activities addiction (gambling, television, and video games). The overlapping addictions suggest a common core of vulnerability to addictive substances and activities. However, little is known about how and why such an overlapping exists but it deserves continuous exploration for the future research.

The Internet dependents were characterized as more boys than girls, in higher grades, and obtaining longer Internet experience (32% of them had used the Internet at least 2 years). Almost 14% of the Internet dependents had used the Internet more than 3 years, at the time when they were still in junior high school (9th–11th grades as in the American high school). This demographic data either suggests the younger the individuals began to use the Internet the easier they were dependent or the dependents found lure of the Internet earlier than the non-dependents. This finding provided some evidences to support the results of Kraut et al. (1998). In a longitudinal investigation, Kraut at al. (1998) found that longer use of the Internet was related to declines in users' communication with family members, in the size of their social circle, and in psychological wellbeing.

The dependents expressed that the Internet negatively influences many aspects of their lives. While they perceived significantly stronger negative Internet influences on daily routines, school performance, and parental relations than the non-dependents, both Internet dependents and non-dependents regarded Internet use as positively affecting peer relations. This finding confirmed Kandell's (1998) suggestion that the Internet can be used to enhance the developmental needs as to obtain and maintain meaningful interpersonal relationships and intimacy. Unexpectedly, all of the subjects, Internet dependent or not, reported that Internet usage positively influenced teacher relations. Apparently, Taiwanese high school teachers have not yet realized the problems that their students may encounter in using the Internet. Perhaps they value the Internet as the flawless super highway and underestimate its negative effects on adolescents as ordinary people.

Consider a situation in which various subgroups of Internet dependents are categorized by the most intensive activities they have engaged, such as Internet games, discussion about certain themes (Star Trek), pornography, or virtual sex (Greenfield, 2000; Griffiths, 2000; Hamburger & Ben-Artzi, 2000). One of the Internet activities, establishing non-face-to-face social network, might be a fascinating and demanding pitfall leading to problematic Internet use for many adolescents because such activity helps fulfill their developmental needs. However, this study did not ask participants to specify the websites they visit and so the contents of the sites that adolescent visit are still unclear. Future study is needed before further conclusion can be made.

Besides, our results indicate that Internet dependents obtained significantly higher scores of disinhibition and overall sensation seeking than the Internet non-dependents; meanwhile, they obtained similar scores on life experience seeking, as well as thrill and adventure seeking. Regression analyses revealed parallel results. Disinhibition is the most important predictor of Internet dependence for either the entire subject group or the Internet dependents. It is obvious that seeking thrill or novelty experiences cannot explain why Taiwanese high school students excessively use the Internet.

The personality study about TV addicts may provide a broader view on technology addicts and help us to understand Internet abuse or misuse. Mcllwraith (1998) reported that adult self-labeled TV addicts tend to be more neurotic, introverted, and easily feel bored. They are more likely using TV to distract themselves from unpleasant thoughts, regulate moods, and fill time. For the high school Internet dependents in the current study, the adolescent strive of ignoring or against social constraints explain the underlying motivation in hanging around online; whereas for the adult TV addicts in Mcllwraith's study, less willing to tolerate boredom leads to viewing more television. Such differences may be raised from age differences, culture differences between American and Taiwanese, various patterns of Internet and TV use, or different personality between Internet addicts and TV addicts.

Inhibition regards behavioral constraints produced through inner self-conscious states such as anxiety about social situations or worries about public evaluation (Zimbardo, 1977). Disinhibition is then the reverse term of the same factor describing how people reduce public self-awareness, less concern about the judgement of others. Thus, doing so involves ignoring conventional constraints.

Non-face-to-face and anonymity characterize the Internet's interactive environment. In such an environment, social cues are easily removed. Moreover, a nickname provides Internet users a way to create new social cues. Therefore, Joinson (1999) stated that normal constraints and rules of social interaction may not exist on the Internet. Excessive Internet use among Taiwanese high school adolescents may reflect their motivation to strive for personal identity through breaking social inhibition. In adolescent ages, youth who strive for independence may struggle too hard and reach the fringes of anti-establishment (Kaplan, 1988). We believe that such developmental need is an important reason that Taiwanese high school adolescents become Internet dependent. With the very same motivation, previous studies have demonstrated many adolescents engaging in risks, such as taking drugs, alcohol, or engaging in unsafe sex.

This finding contradicts the findings of Lavin et al. (2000). They investigated relatively more mature subjects, university students in late adolescence, in a different culture, the United States. According to their results, Internet dependents obtained significantly lower scores on thrill and adventures seeking, excitement seeking, and overall sensation seeking than non-dependents. Unfortunately, both Lavin et al. (2000) and the current study did not ask participants to specify the contents and the sites they visit, so it is impossible to examine whether Internet dependents visit highly stimulating sites more often. However, such investigation may provide more evidences for the examination of relation between sensation seeking and excessive Internet use. We therefore suggest future study use content analysis or interview to identify whether Internet dependents and ordinary users visit different sites, whether they browse or search for messages with various degree of stimulation. The differential findings of these two studies may be attributed to either age or cultural differences. Further studies are needed to clarify this issue.

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