Original Research

Tridimensional Personality of Adolescents With Internet Addiction and Substance Use Experience

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Objective: This study aimed to examine the differences in personality characteristics between adolescents with and without Internet addiction and substance use experience as defined by the Tridimensional Personality Questionnaire (TPQ), and to compare personality characteristics among groups of adolescents with both Internet addiction and substance use experience (comorbid group), those with only Internet addition (Internet addiction group), those with only substance use experience (substance experience group), and those without Internet addiction or substance use experience (control group).

Method: In the cross-sectional investigation, we recruited 3662 students (2328 boys and 1334 girls) from high schools in southern Taiwan. Our investigation was conducted using the TPQ, the Chen Internet Addiction Scale, and Questionnaires for Experience in Substance Use.

Results: Adolescents with Internet addiction were more likely to have substance use experience. High novelty seeking (NS), high harm avoidance (HA), and low reward dependence (RD) predicted a higher proportion of adolescents with Internet addiction. High NS, low HA, and low RD predicted a higher proportion of adolescents with substance use experience. Of the 4 groups, the Internet addiction group had the highest HA scores and the comorbid group had the lowest HA scores.

Conclusion: Adolescents with high NS and low RD should be provided with effective strategies for preventing Internet addiction and substance use. In addition, the Internet addiction group and the comorbid group should be provided with different preventative strategies focused on HA.

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Clinical Implications

- Adolescents with Internet addiction had a higher risk of substance use experience.
- Preventive strategies for Internet addiction and substance use should be provided for adolescents with high NA and low RD.
- Different preventive strategies focusing on HA should be provided to the Internet addiction group and to the comorbid group, respectively.

Limitations

- Our investigations relied on self-reported data from adolescents.
- Social restrictions on substance use may make adolescents unwilling to admit substance use, even in anonymous questionnaires.
- The study's cross-sectional design could not confirm causal relations between Internet addiction and personality.

Key Words: *Internet addiction, substance abuse, adolescents, personality, harm avoidance*

In recent years, Internet and computer use have become popular worldwide. However, this has also had a negative impact on some individuals and on society at large. The development of addiction to the Internet is the most prominent deleterious impact. Preoccupation with the Internet, like gambling, can interrupt daily life to the point that an individual neglects other productive and creative activities. Owing to the media characteristics of the Internet, its use has also been associated with other risky behaviour such as substance use (1,2). Substance use has been found to negatively affect adolescents' health (3); thus, identification of the risk factors of Internet addiction and substance use experience is of clinical significance as risky behaviour can be identified and preventive measures can be instituted.

Much attention has been paid to the predictive value of personality characteristics for addictive behaviours. Personality is reported to play an important role in the predisposition, precipitation, and perpetuation of substance use disorder (4). Many studies have shown the characteristics of an "addictive personality," which include impulsivity, sensation seeking, psychoticism, and a tendency toward social deviance (5–9). These results provide essential information for substance use prevention.

In contrast to reports on substance abuse, there have been few studies on behavioural addiction. Pathological gambling is the most commonly studied behavioural addiction and is thought to share similar clinical and neuropsychiatric presentations with substance use disorder (10–12). Internet addiction is a newly noted behavioural addiction (13). Ko and others proposed a diagnostic criteria for adolescent Internet addiction that is composed of Criteria A, B, and C. Criterion A contains 9 characteristic symptoms of Internet addiction, including preoccupation, uncontrolled impulse, more than intended use, tolerance, withdrawal, impairment of control, excessive time and effort spent on the Internet, and impairment of decision-making ability. Criterion B describes functional impairment secondary to Internet use. Criterion C lists the exclusive symptoms to eliminate the possibility of psychotic disorder and bipolar I disorder. The cut-off point with 6 symptoms of Criterion A had the best diagnostic accuracy (95.4%), with high specificity (97.1%) and accepted sensitivity (87.5%) (14).

Criterion A of Internet addiction demonstrates clinical symptoms similar to the criteria of substance dependence and pathological gambling of the DSM-IV (10). In addition, Internet addiction has been correlated with personality characteristics, high sensation seeking, and disinhibition (15). These traits were also reported to be associated with substance use disorder. Evaluation and comparison of the personality traits associated with Internet addiction and substance use is essential for developing Internet addiction prevention strategies that are based on a well-established model of substance use prevention. To our knowledge, however, no study has compared the personality characteristics of adolescents who are addicted to the Internet with those who suffer from substance use.

Cloninger (16) proposed 3 dimensions of human temperament based on NS, HA, and RD. NS is hypothesized to be a heritable tendency for intense exhilaration or excitement to novel stimuli. HA is a heritable tendency to respond intensely to signals of aversive stimuli. RD is a heritable tendency to respond intensely to signals of reward (particularly verbal signals of social approval and sentiment) and to maintain or resist extinction of rewarded behaviour. The tridimensional personality model may provide a basis for analyzing the interaction between behavioural traits and environmental stimuli to predict personal proneness to an addictive behaviour (17,18). However, we could find no studies that examined the relation between personality characteristics on the TPQ and Internet addiction.

This study has 2 purposes. First, we examined the differences in personality characteristics on the TPQ between adolescents with and without Internet addiction, as well as those with and without substance exposure. Second, we compared the personality characteristics among adolescents with both Internet addiction and substance use experience (comorbid group), with only Internet addiction (Internet addiction group), with only substance use experience (substance experience group), and without Internet Addiction or substance use experience (control group).

Abbreviations used in this article

ANOVA	analysis of variance
CIAS	Chen Internet Addiction Scale
HA	harm avoidance
LSD	Fisher Least Significant Difference test
NS	novelty seeking
OR	odds ratio
Q-ESU	Questionnaires for Experience in Substance Use
RD	reward dependence
SD	standard deviation
TPQ	Tridimensional Personality Questionnaire

Method

Participants

For evaluation, we selected 7 of 87 junior high schools, 6 of 33 senior high schools, and 4 of 20 vocational high schools at Kaohsiung City and County in Taiwan. The selected schools included 8, 5, and 3 schools from urban, suburban, and rural areas, respectively. We randomly selected 2 classes from each

grade in these schools. We recruited 3662 students (2328 male and 1334 female students). Their mean age was 15.48 years (SD 1.65, range 11 to 21). There was a significant sex difference between eligible students and the population of high school students ($\chi^2 = 212.39$, $P < 0.001$) because we selected more classes in senior and vocational high schools, where there were more male students and more technologically oriented classes. After we obtained informed consent, we invited all the students in the selected classes to anonymously complete a questionnaire. We omitted 250 participants because 23.2%, 29.2%, and 54.8% of them did not complete the CIAS, the Q-ESU, and the TPQ, respectively. The excluded participants were more likely to be male ($\chi^2 = 22.8$, $P < 0.001$) and older ($t_{295} = 3.14$, $P = 0.002$) than other participants. For the final statistical analysis, we used data for the 3412 (93.2%) participants (2134 boys and 1278 girls). The study was approved by the Institutional Review Board of Kaohsiung Municipal Hsiao-Kang Hospital.

Measurement Instruments

Tridimensional Personality Questionnaire. The Chinese version of the TPQ contains 100 self-administered true or false questions designed to measure the NS, HA, and RD dimensions of personality (19). The 1-month test–retest reliability was 0.58 to 0.77. It also had acceptable construct validity (8).

Chen Internet Addiction Scale. The CIAS contains 26 items on a 4-point Likert scale that assesses 5 dimensions of Internet related problems: compulsive use, withdrawal, tolerance, interpersonal and health problems, and time management problems. The internal reliability of the scale and the subscales in the original study ranged from 0.79 to 0.93 (20). According to the diagnostic criteria of Internet addiction (14), the 63 out of 64 cut-off point of the CIAS had the highest diagnostic accuracy (87.6%), accepted sensitivity (67.8%), and specificity (92.6%) (21). Accordingly, we classified individuals with CIAS scores of 64 or more as the Internet addiction group.

Questionnaires for Experience in Substance Use. The Q-ESU asked whether participants currently used tobacco, alcohol, or areca (betel nut) on a regular basis or whether they had ever used or experimented with cannabis, amphetamines, glue, heroin, 3,4-methylenedioxymethamphetamine, or ketamine (22).

Statistical Analysis

The participants who fit the diagnostic cut-off point of the CIAS were classified as Internet addicts. Since the most common pattern of substance use in community adolescents is experimental or recreational use that does not usually meet the DSM-IV criteria for substance use or dependence (23) and since any pattern of illicit substance use by adolescents is potentially hazardous, lifetime illicit substance use is usually used to define the adolescents who are in the at-risk group (23,24). Conversely, having used alcohol or tobacco is common among adolescents (23); thus, it is appropriate to examine current and regular tobacco and alcohol use to define an at-risk group of adolescents (25, 26). In this study, we defined subjects with substance use experience as adolescents who had a lifetime experience of illicit substance use or who regularly used alcohol, tobacco, or areca, as determined by the Q-ESU.

We compared the personality characteristics on the TPQ of the adolescents with and without Internet addiction and substance use experience, using *t* tests and logistic regression. We used ANOVA and post hoc tests with Fisher LSD tests to further compare the personality characteristics on the TPQ of the comorbid group, the Internet addiction group, the substance experience group, and the control group. All statistical analyses were performed with the SPSS computer program (Version 10.0, SPSS Inc, 2005). We considered any *P* value less than 0.05 significant.

Results

Table 1 compares demographic characteristics, experience with substance use, and personality characteristics on the TPQ of adolescents with and without Internet addiction. Adolescents with Internet addiction were more likely to be male ($\chi^2 = 114.29$, $P < 0.001$), to be students at vocational schools ($\chi^2 = 64.16$, $P < 0.001$), to be older ($t_{1206} = 5.10$, $P < 0.001$), and to have experienced substance use ($\chi^2 = 59.08$, $P < 0.001$). Adolescents with Internet addiction had higher scores on the NS ($t_{1180} = 7.67$, $P < 0.001$) and HA ($t_{3410} = 2.63$, $P = 0.009$) dimensions and lower scores on the RD dimension ($t_{3410} = -5.75$, $P < 0.001$) than those without Internet addiction.

Table 2 compares between the demographic characteristics and personality characteristics of adolescents with and without substance use experience. Adolescents with substance use experience were more likely to be male ($\chi^2 = 62.43$, $P < 0.001$), to be students at vocational schools ($\chi^2 = 42.72$, $P < 0.001$), to be older ($t_{3401} = 5.37$, $P < 0.001$), and to have Internet addiction ($\chi^2 = 59.08$, $P < 0.001$). Adolescents with substance use experience had higher scores on the NS dimension ($t_{3410} = 7.03$, $P < 0.001$) and lower scores on the HA ($t_{3410} = -4.23$, $P < 0.001$) and RD ($t_{3410} = -4.13$, $P < 0.001$) dimensions than those without substance use experience.

Table 2 shows the results of the logistic regression model used to predict Internet addiction and substance use experience. Sex, age, and school were controlled in the model. Higher NS (OR 1.06 to 1.11), higher HA (OR 1.02 to 1.05), and lower RD (OR 0.93 to 0.97) significantly predicted Internet addiction, but NS was the most significant predictor for Internet addiction. Higher NS (OR 1.07 to.13), lower HA (OR 0.96 to 0.995), and lower RD (OR 0.92 to 0.98) significantly

Table 1 Comparisons of demographic characteristics, experience with substance use, and personality characteristics between adolescents with and without Internet addiction (*n* = 3412)

Characteristic	Internet addiction		χ^2 or *t*	*P*
	Yes (*n* = 706)	No (*n* = 2706)		
Sex, *n* (%)				
Male participants	564 (79.9)	1570 (58.0)	114.29	< 0.001
Female participants	142 (20.1)	1136 (42.0)		
School, *n* (%)				
Junior high school	247 (35.0)	1182 (43.7)	64.16	< 0.001
Senior high school	189 (31.7)	898 (33.2)		
Vocational high school	270 (38.2)	626 (23.1)		
Substance use experience, *n* (%)				
Yes	115 (16.3)	190 (7.0)	59.08	< 0.001
No	591 (83.7)	2516 (93.0)		
Age, mean (SD)	15.7 (1.5)	15.4 (1.7)	5.1	< 0.001
TDQ, mean (SD)				
NS	18.2 (4.3)	16.8 (4.7)	7.67	< 0.001
HA	18.2 (6.1)	17.5 (6.5)	2.63	0.009
RD	16.4 (3.7)	17.3 (3.8)	–5.75	< 0.001

predicted substance use experience. Higher NS was also the most significant predictor of substance use experience.

We further classified the participants into comorbid, Internet addiction, substance experience, and control groups. Table 4 shows the differences in personality on the TPQ among these 4 groups as analyzed by ANOVA. There were significant differences in NS ($F_{3,3408} = 20.74$, $P < 0.001$), HA ($F_{3,3408} = 40.27$, $P < 0.001$), and RD ($F_{3,3408} = 13.99$, $P < 0.001$) across the 4 groups. LSD post hoc tests showed that the comorbid group, the substance experience group, and the Internet addiction group had significantly higher NS scores than the control group. The comorbid group had significantly higher NS scores than the Internet addiction group. The Internet addiction group had significantly higher HA scores than control group. The control group had significantly higher HA scores than the substance experience and the comorbid groups. The comorbid group, the substance experience group, and the Internet addiction group had significantly lower RD scores than the control group.

Discussion

Previous studies have reported that high NS is associated with adolescent substance use (8,27). Sensation seeking, which is a trait similar to NS, has also been associated with Internet dependence and higher Internet use (15,28). This study revealed that high NS is the most significant predictor for Internet addiction and substance use experience in adolescents. Since NS is thought to reflect the brain's incentive, or behaviour activation, system and is associated with the dopamine system (29), individuals with high NS readily engage in new interests and activities but tend to neglect details and are quickly distracted or bored (16). Internet activities, especially online games, provide a highly varied virtual environment that satisfies the adolescents' NS needs. Adolescents with high NA might engage in Internet activity with higher motivation and arousal responses. Therefore, high NS may predispose an individual to heavy Internet use. This is similar to the effect of high NS on substance use experience, as reported in this study and Cloninger's research (30).

Associations between substance use, NS, and dopamine function have been reported (31). The mesocorticolimbic dopamine system, originating from the ventral tegmental area and projecting toward a wide range of the limbic structure, is associated with NS (29). The association between high NS and Internet addicts may reveal that, as in substance addiction, Internet addiction is possibly associated with an impaired dopamine system.

HA is thought to reflect variation in the brain's punishment, or behaviour inhibition, system, which includes the septohippocampal system, with serotonergic projections from the raphe nuclei in the brain system. Individuals with low HA are confident, optimistic, carefree, uninhibited, and

Table 2 Comparisons of demographic characteristics and personality characteristics between adolescents with and without substance use experience (*n* = 3412)

	Substance use experience			
Characteristic	Yes (*n* = 305)	No (*n* = 3107)	χ^2 or *t*	*P*
Sex, *n* (%)				
Male participants	255 (83.6)	1879 (60.5)	62.43	< 0.001
Female participants	50 (16.4)	1228 (39.5)		
School, *n* (%)				
Junior high school	99 (32.5)	1330 (42.8)	42.72	< 0.001
Senior high school	78 (25.6)	1009 (32.5)		
Vocational high school	128 (42.0)	768 (24.7)		
Internet addiction, *n* (%)				
Yes	115 (37.7)	591 (19.0)	59.08	< 0.001
No	190 (62.3)	2516 (81.0)		
Age, mean (SD)	15.9 (1.7)	15.4 (1.7)	5.37	< 0.001
TDQ, mean (SD)				
NS	18.8 (4.4)	16.9 (4.6)	7.03	< 0.001
HA	16.2 (6.2)	17.8 (6.4)	–4.23	< 0.001
RD	16.3 (3.6)	17.2 (3.8)	–4.13	< 0.001

energetic (16). Low HA is reportedly associated with early substance use and frequent alcohol use in adolescents (27,32). In the present study, low HA scores predicted substance use experience. The results correspond to previous reports and assumptions that high HA inhibits risk behaviour with negative results. In this study, high HA predicted Internet addiction. Since the Internet provides an anonymous virtual world, adolescents usually perceive less responsibility and harm from it than they do from the real world. Consequently, the online disinhibition effect (33) may relax adolescents with high HA in real life and make them vulnerable to Internet addiction.

RD is thought to reflect variations in the brain system that facilitates the acquisition of conditioned signals or reward or relief from punishment (16). In the present study, low RD scores significantly predicted Internet addiction and substance use experience. Adolescents with low RD are impaired in their responsiveness to verbal approval and social reinforcement, and they have poor persistence (16). They demonstrate little tolerance for unpredictable frustrations in real life. Immediate and predictable achievement from Internet activity such as online gaming could therefore provide satisfactory resources for novelty and esteem without unpredictable frustration. Consequently, low RD predicted the development of Internet addiction.

The personality characteristics of adolescents with Internet addiction included high NS, high HA, and low RD. Adolescents with substance use experience had high NS, low HA, and low RD. Kuo and others (8) reported similar results for adolescents with substance use. ANOVA analysis revealed that the comorbid group had significantly higher NS and lower HA than the Internet addiction group. The comorbid group and the Internet addiction group had significantly lower and higher HA than the control group, respectively. This shows that individuals in the comorbid group had personalities that distinctly differed from those in the Internet addiction group. There were no differences between the substance experience group and the comorbid group. Similar to the antisocial personality defined by the TPQ (16), the substance experience and comorbid groups had higher NS, lower HA, and lower RD. This indicated that the comorbid group and the substance experience group might be classified as one group that is different from the Internet addiction group.

Since the comorbid group have personalities that differ from the Internet addiction group, they may have different reasons for using the Internet. Individuals in the Internet addiction group, with high HA scores, may use Internet activity to avoid stress and to alleviate fear of real life harm. They use the Internet because they feel it is a safe way to satisfy their needs. Thus they experience little risky or problematic behaviour in real life. Conversely, individuals in the comorbid group may

Table 3 Odds ratios of the TPQ (NS, HA, and RD) for Internet addiction and substance use experience, controlling for sex, school, and grades

	Internet addiction			Substance use experience		
Personality type	Wald χ^2	*P*	OR (95%CI)	Wald χ^2	*P*	OR (95%CI)
NS	65.63	< 0.001	1.08 (1.06–1.11)	46.18	< 0.001	1.10 (1.07–1.13)
HA	25.15	< 0.001	1.04 (1.02–1.05)	5.88	< 0.02	0.98 (0.96–0.995)
RD	18.11	< 0.001	0.95 (0.93–0.97)	11.76	< 0.001	0.95 (0.92–0.98)

Table 4 Comparisons of TPQ score among participants with Internet addiction only, with substance use experience only, with both Internet addiction and substance use experience, and without Internet addiction or substance use experience

Personality type	Mean (SD)	Degrees of freedom	*F*	*P*	Post hoc analysis (LSD)
NS					
Control subjects	16.7 (4.6)	3, 3408	20.74	< 0.001	Comorbid > internet addicts > control subjects
Internet addiction	18.0 (4.2)				Substance use experience > control subjects
Substance use experience	18.6 (4.5)				
Comorbid	19.3 (4.3)				
HA					
Control subjects	17.6 (6.4)	3, 3408	40.27	< 0.001	Internet addicts > control subjects > substance use experience
Internet addiction	18.6 (5.9)				Internet addicts > control subjects > comorbid
Substance use experience	16.3 (6.2)				
Comorbid	16.1 (6.4)				
RD					
Control subjects	17.4 (3.8)	3, 3408	13.99	< 0.001	Control subjects > Internet addicts
Internet addiction	16.5 (3.7)				Control subjects > substance use experience
Substance use experience	16.6 (3.6)				Control subjects > comorbid
Comorbid	15.8 (3.5)				

Comorbid = the comorbidity of Internet addiction and substance use experience

Control subjects = participants without Internet addiction or substance use experience

use Internet activity to satisfy their NS. They may be impulsive or aggressive in real life and they try risky behaviour both online and in real life. Hence, the Internet addiction group and comorbid group need different intervention strategies. Adolescents with low HA should receive more attention in the form of preventive strategies for substance use.

Although there is a lack of evidence to clarify the causal relation between personality and Internet addiction and substance use, we suggest 2 models to explain why the comorbid group is distinctly different from the Internet addiction group.

The first model indicates that vulnerable personality characteristics increase the risk of Internet addiction and substance use experience. Individuals in the comorbid and Internet addiction groups were attracted to the Internet because of their personality characteristics (high NS and low RD). The Internet addiction group, however, did not engage in substance use because of high HA. Adolescents with contrary HA therefore comprise the Internet addiction group, and the HA characteristic determines the risk of substance use problems.

In the second model, personality differences are the result of substance use. Substance use has been reported to damage the frontal lobe (34), which impairs the inhibiting function; hence, adolescent substance use lowers HA. This effect shows why the comorbid group had different personality characteristics from the Internet addiction group. Which model most appropriately explains the results of this study may be evaluated with a prospective study.

Our results should be interpreted in light of several limitations. First, all of our investigations relied on self-reported data from adolescents. Second, social restrictions on substance use may predispose adolescents to hiding substance use even in anonymous questionnaires. Third, the cross-sectional research design of the present study could not confirm causal relations between Internet addiction and personality even if the personality were presumed stable. Fourth, the study population included more boys, although the sex effect was controlled in regression analysis. Finally, the missing data include more boys and older participants. The effects of sex and age in the missing data need to be further studied.

Conclusion

High NS, high HA, and low RD are significant predictors for Internet addiction. This suggests that effective preventive strategies providing healthy activities that satisfy adolescents' NS needs, as well as behaviour interventions that provide consistent and practical rewards to motivate adolescents with low RD, are essential. High NS, low HA, and low RD predict substance use experience. Individuals in the comorbid group have distinctly different personalities, compared with those in the Internet addiction group, and the comorbid group members share similar personality characteristics with adolescents with substance use experience. Different preventive strategies focusing on HA should be provided to the Internet addiction group and comorbid group, respectively. Strategies to prevent substance abuse should be provided to adolescents with high NS, low HA, and low RD to protect them from exposure to harmful substances.

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Résumé : La personnalité tridimensionnelle des adolescents présentant une dépendance à Internet et une expérience d'utilisation de substance

Objectif : Cette étude visait à examiner les différences des caractéristiques de la personnalité entre des adolescents avec et sans dépendance à Internet et une expérience d'utilisation de substance, comme le définit le questionnaire de personnalité tridimensionnelle (TPQ), et à comparer les caractéristiques de la personnalité chez des groupes d'adolescents ayant la dépendance à Internet et une expérience d'utilisation de substance (groupe comorbide), ceux qui ont seulement la dépendance à Internet (groupe de dépendance à Internet), ceux ayant seulement une expérience d'utilisation de substance (groupe d'expérience de substance) et ceux n'ayant ni dépendance à Internet ni expérience d'utilisation de substance (groupe témoin).

Méthode : Dans l'enquête transversale, nous avons recruté 3 662 élèves (2 328 garçons et 1 334 filles) d'écoles secondaires du sud de Taiwan. Nous avons mené notre enquête à l'aide du TPQ, de l'échelle de dépendance à Internet de Chen, et de questionnaires d'expérience d'utilisation de substance.

Résultats : Les adolescents ayant une dépendance à Internet étaient plus susceptibles d'avoir une expérience d'utilisation de substance. La recherche de nouveauté (RN) élevée, la prudence craintive (PC) élevée et la dépendance à la récompense (DR) faible prédisaient une proportion plus élevée d'adolescents ayant une dépendance à Internet. Une RN élevée, une faible PC et une faible DR prédisaient une proportion plus élevée d'adolescents ayant une expérience d'utilisation de substance. Sur les 4 groupes, le groupe de dépendance à Internet avait les scores de PC les plus élevés et le groupe comorbide avait les scores de PC les plus faibles.

Conclusion : Il faudrait fournir aux adolescents ayant des RN élevés et des DR faibles des stratégies pour prévenir la dépendance à Internet et l'utilisation de substance. Il faudrait aussi fournir au groupe de dépendance à Internet et au groupe comorbide différentes stratégies de prévention axées sur la PC.