



Internet and mobile phone text-messaging dependency: Factor structure and correlation with dysphoric mood among Japanese adults

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ABSTRACT

Unhealthy use of the Internet and mobile phones is a health issue in Japan. We solicited participation in this questionnaire-based study from the employees of a city office in Kumamoto. A total of 92 men and 54 women filled in the Internet Addiction Questionnaire (IAQ), the Self-perception of Text-message Dependency Scale (STDS), and the Hospital Anxiety and Depression Scale (HADS). The prevalence of “light Internet addiction” and “severe Internet addiction” were 33.7% and 6.1% for men whereas they were 24.6% and 1.8% for women. The prevalence of “light mobile phone text-message addiction” was 3.1% for men and 5.4% for women. There were no cases of “sever text-message addiction”. We found a two-factor structure for the IAQ and a three-factor structure for the STDS. We also performed an EFA of the IAQ and STDS subscales, and this revealed a two-factor structure – Internet Dependency and Text-message Dependency. An STDS subscale, Relationship Maintenance, showed a moderate factor loading of the factor that reflected unhealthy Internet use. In a path analysis, Depression was associated with both Internet Dependency and Text-message Dependency whereas Anxiety was associated negatively with Text-message Dependency. These results suggest applicability of the IAQ and STDS and that Internet and Text-message Dependences are factorially distinct.

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1. Introduction

1.1. Communication technology and its excessive use

Until about 20 years ago, Internet access was limited to the government and to intellectual groups such as scientists, engineers, and mathematicians. Mobile phones were also unavailable to the broader public. However, the Internet and mobile phones have rapidly become important and widely available tools that are routinely used for a vast variety of purposes by a large number of people (e.g., Chou & Peng, 2007; Faulkner & Culwin, 2005; Leung, 2007). Broadband access, which allows for fast Internet transmission and thereby opens up even more possibilities, is now becoming increasingly available worldwide. The number of mobile phone users has been increasing at an astonishingly rapid pace. A recent trend in worldwide communication technology use has seen a marked shift from personal computer-based communication to mobile or cellular phone communication, especially using text-messages. According to the White Paper on Information and Com-

munications in Japan (Morahan & Schumacher, 1997), about 105 million Japanese (82% of the population) used mobile phones and 83% of subscribers accessed the Internet via mobile phones in 2007. Japanese adolescents prefer text-messages, including short message service (SMS) communications and emails, to direct telephone conversation because of the text-based indirectness, asynchronicity of communication, and cheaper cost (Igarashi, Motoyoshi, Takai, & Yoshida, 2005).

The exceedingly rapid growth of the Internet and mobile communication has been accompanied by questions about its impact, both positive and negative, on consumers and on broader society. One recurring concern involves Internet and mobile phone “addicts”, whose use of these technologies has become excessive and out-of-control and severely disrupts their lives. Although the widespread availability of mobile phones provides a convenient method of communication via text messages, it has been pointed out that some people exhibit so-called Text-message Dependency, an over-reliance on text-messaging in their daily lives (Masataka, 2005). For instance, one study found that Japanese women tended to feel nervous if they did not bring their mobile phones with them when they left home (Infoplant, 2007). Japanese youths are reported to be enthusiastic in text-messaging (Ishii & Wu, 2006). Yelowlees and Marks (2007) recently argued that a predisposition to Internet dependency would be more likely in individuals with

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social anxiety or impulse-control problems, among other issues. In other words, some people may feel the need to maintain their relationships via Internet use, and may even be afraid of isolation and disconnection from their peers if they do not maintain contact via Internet. Little empirical research, however, has been conducted to investigate the psychological processes whereby Text-message Dependency occurs.

1.2. Internet dependency

Warnings have been voiced as – Internet-related technology has gained a rapidly growing foothold. Terms such as Internet addiction, compulsive Internet use, problematic Internet use, compulsive computer use, computer addiction, and pathological Internet use are frequently encountered in both the popular and academic literature (Liu & Potenza, 2007; Mitchell, 2000). These terms represent compulsive overuse of the Internet and mood symptoms when deprived of it (Mitchell, 2000). Internet addiction may result in functional impairment. For example, students may be distracted when studying by irrelevant Internet surfing; people may use the Internet as an excuse for avoiding daily chores. (Young, 1998).

The term “Internet addiction disorder” was first used by Young and Rodgers (1998), who described Internet addiction as an impulse-control disorder that does not involve intoxication. Young and Rodgers (1998) listed diagnostic criteria for “Internet addiction” that were similar to those for chemical substance dependence. However, Internet addiction is not classified as a diagnosis in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV: American Psychiatric Association, 2000). However, no standardized definition of problematic use of the Internet is currently available.

A number of studies have been conducted with the goal of determining the prevalence of problematic use of the Internet (Aboujaoude, Koran, & Gamel, 2006; Cao & Su, 2007; Johansson & Götestam, 2004; Kim, Grant, Eckert, Faris, & Hartman, 2006). A comparison of the results of these studies is complicated, however, due to the diversity of assessment tools used. A measure of such Internet use widely employed thus far is the Internet Addiction Questionnaire (IAQ: Wang, 2001). The IAQ possesses good internal consistency, but it has often been used to study students or adolescents in school-based surveys or Internet users in online surveys. Few studies have examined adult populations.

The IAQ is a 10-item self-report measure of Internet addiction. Wang (2001) performed an exploratory factor analysis (EFA) of the IAQ items that yielded two-factors, interpreted as Virtual Identity and Uncontrollability. The factor structure of psychological measures is often influenced by the participants' culture. Thus, introducing the IAQ to Japan requires verification of the measure's factor structure in the Japanese culture.

1.3. Mobile phone text-messaging dependency

Despite a growing number of people using text-messaging as a means of communication, its psychological impact on users has not been widely studied. Igarashi and Yoshida (2003) studied Japanese university students entering universities to find that greater importance of the text messages to precollege friends was associated with an increase in loneliness after entering into universities.

As a measure of the excessive use of and dependency on mobile phone text-messaging, Igarashi, Motoyoshi, Takai, and Yoshida (2008) developed a 15-item self-report measure – the Self-perception of Text-message Dependency Scale (STDS). They performed an exploratory factor analysis (EFA) of the STDS items, which yielded three-factors, interpreted as Relationship Maintenance (RM), Excessive Use (EU), and Emotional Reaction (ER).

Their first factor – RM – concerns the role of text-messaging in maintaining relationships by presenting an alternative to face-to-face communication. Text messages are most frequently used among adolescents and there is evidence that adolescents in particular yearn for close relationships and experience strong anxiety in the face of failed communications (Leary & Kowalski, 1995). To moderate the obstacles presented by face-to-face situations, adolescents may prefer indirect communication via text messages. This may result in compulsive use of text messages and associated psychological or behavioral symptoms.

The second factor of the STDS – EU – pertains to the excessive use of text messages. Heavy message users spend a substantial amount of time exchanging messages throughout the day and may perceive themselves as being unable to control this behavior.

The third factor – ER – involves emotional reactions to text messages. Because text-messaging is an asynchronous form of communication, people with Text-message Dependency pay excessive attention to message replies. The non-dependent user would attribute a delay in response to one of numerous unavoidable causes, such as the receiver being busy at work or already being engaged in a conversation with another person. However, if individuals with Text-message Dependency do not instantly receive a reply to their message, they may feel neglected or isolated, and their anxiety about being ostracized may increase. It is these perceptions, then, rather than the actual quantity of text messages, that could potentially cause psychological or behavioral symptoms (Igarashi et al., 2008).

Whereas excessive use of Internet and text-message communication has raised social concern and may share psychological correlates. Few investigations have focused on the factor structure of both Internet and text-message communication simultaneously. The present study aims to clarify this point.

1.4. Correlation between anxiety, depression and dependency

Excessive and inappropriate use of the Internet and mobile phones has been compared by clinicians and researchers to substance (e.g., alcoholism, nicotine) and behavior (e.g., pathological gambling) addiction (Mitchell, 2000). They have in common that fact that they may negatively impact a person's psychological adjustment. For example, depressive disorder has been reportedly associated with problematic use of the Internet (Ha, Yoo, & Cho, 2006; Kim, Ryu, & Chon, 2006; Yang & Tung, 2007; Yen, Ko, Yen, Chang, & Cheng, 2009). One panel study (Kraut et al., 1998) examined the social and psychological impact of the Internet over the first one to 2 years of online use. The results showed that an increase in Internet use had a negative impact on individuals' psychological well-being (depression, loneliness and daily life stressors) and social interaction and communication both with family members and the individuals' wider social circle. Other studies have also linked problematic Internet use with negative emotions such as loneliness (Morahan & Schumacher, 1997), helplessness, guilt, and anxiety (Egger & Rauterberg, 1996).

Text messages are most frequently used by adolescents, a population that yearns to build close relationships and experiences strong anxiety in the face of potential communication failures (Leary & Kowalski, 1995). As noted above, people with Text-message Dependency can devote an excessive amount of attention to message replies, incorrectly assuming that the lack of an immediate response is due to negative, personal reasons. This can lead to feelings of neglect or isolation and increased anxiety about being ostracized (Igarashi et al., 2005). Thus, we expected that anxiety and depression would be associated with mobile phone text message use.

As noted, depression has been studied in terms with its association with Internet or text-messaging dependency in several studies (Ha et al., 2007; Young, 1997; Young & Rodgers, 1998).

However, we considered that anxiety might be associated with such dependency on modern information technology. For example, people who use text-messaging excessively may feel anxious while waiting for replies and fear that they would not be answered. Anxiety, which often shares a proportion of variance with depression, has rarely been studied in its association with addictive behaviors. This paper attempts to look into the correlation between both anxiety and depression and Internet and mobile phone text-messaging addictions simultaneously.

To recapitulate the research questions posed in this study:

- (1) What are the factor structures of the Japanese versions of the IAQ and STDS in the general Japanese population?
- (2) How prevalent are the problematic uses of Internet and text-messaging?
- (3) Are the factors of the IAQ and STDS subscales discrete from one another?
- (4) What are the association between Depression and Anxiety and Internet and text-messaging dependency?

2. Methods

2.1. Participants

In this questionnaire-based study we solicited participation from the employees of City Office of Uto, Kumamoto. Of 265 employees of whom we requested participation, 213 (80%) returned the questionnaire, and usable data were available from 146 (69%) participants (92 men and 54 women). Ages ranged between 22 and 59, with a mean (SD) of 42.4 (10.4) years.

2.2. Measurements

Internet Addiction Questionnaire (IAQ; Wang, 2001): In our study we used the short version of the IAQ scale. The IAQ scale is on a 5-point Likert scale (0" hardly ever true and 5" almost always true) to probe the symptoms of the Internet dependency. For this scale, Wang (2001) proposed two subscales: "Maladjustment" and "Uncontrollability". The maladjustment subscale measures maladjustment due to use of the Internet (e.g., "I have gotten into trouble with my employer or school because of being online."). The uncontrollability subscale measures the extent to which individuals demonstrate control over their Internet use. (e.g., "When I am away from school I usually look for an alternative method of getting on the net."). Wang classified the IAQ scores into the following categories: 0 symptoms indicate no Internet addiction; 1 to 12, light Internet addiction; and 12 or more denotes severe Internet addiction. The internal consistency as assessed by Cronbach's α was 0.85 in this study.

Self-perception of Text-message Dependency Scale (STDS; Igarashi et al., 2005): This is a self-report scale that measures the way in which people perceive their usage of text messages along with their attitudes towards compulsive text-messaging in the context of interpersonal relationships. This scale consists of three subscales: ER, EU, and RM. The ER subscale measures sensitive responses to text messages (e.g., "I feel disappointed if I don't receive any text messages"). The EU subscale involves self-perception about compulsive usage of text messages (e.g., "I sometimes spend many hours on text messages"). The RM is composed of items related to fear of disruption of relationships in the absence of text messages (e.g., "I cannot maintain new friendships without text messages"). For the current study, a short version of the self-perception of Text-message Dependency Scale (Igarashi et al., 2005) serves to measure the way in which people perceive their usage of text messages along with the extent of their attitude toward compulsive use of text messages in the context of interper-

sonal relationships. Respondents were asked to rate each of the items on a 5-point scale anchored by strongly agree to strongly disagree. The STDS total score ranges from the minimum score 15 to maximum score 75. Igarashi et al. (2005) classified the STDS scores into the following categories: 15–45 symptoms indicate no text-message addiction; 46–60, light text-message addiction; and 61 or more denotes severe text-message addiction.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983): The HADS is a self-report screening instrument for negative moods. It was developed to identify people with physical illness who present with anxiety and depressive disorders. To discern somatic symptoms of anxiety and depression from those caused by physical illness, the HADS taps only the affective and cognitive aspects of anxiety and depression. The HADS consists of 14 items; the anxiety (HADS-A) and depression (HADS-D) subscales each include seven items. We used the Japanese version of the HADS (Kitamura, 1993). In our study, the internal consistencies of each factor of the HADS (measured by Cronbach's α coefficients) were .79 (HADS-D), .80 (HADS-A), respectively.

2.3. Statistical analyses

First, we calculated the mean, SD, and skewness of each IAQ item. We also examined the distribution of the total IAQ score. Because most of the IAQ items were found to be strongly positively skewed, we log-transformed the IAQ item scores. Using the log-transformed scores, we performed an EFA of the IAQ items. The number of factors was determined by the scree test (Cattell, 1966). The factor structure was rotated using the PROMAX method, an oblique rotation, because we thought that extracted factors would be correlated with each other. We performed the same analyses for the STDS items. Then we performed an EFA of all the subscales of the IAQ and STDS.

After correlating the subscale scores of the IAQ, STDS, and HADS, we set up a structural regression analysis. We used two-step modeling method (Klein, 2005, p. 216). In a two-step modeling, a structural regression (SR) model is first specified as a confirmatory factor analysis (CFA) measurement model. In the present study, we specified the two-factor structure of the IAQ and STDS subscales. After determining this CFA fit the data, we then went to construction of a SR model in which Depression and Anxiety were posited to be associated with the latent constructs derived from the IAQ and STDS subscales. We set correlations between Depression and Anxiety as well as between the error variables of the latent constructs derived from the IAQ and STDS subscales. The fit of the model with the data was examined in terms of chi-squared (CMIN), comparative fit index (CFI), and root mean square error of approximation (RMSEA) and its 90% confidence interval. According to conventional criteria, a good fit would be indicated by CMIN/df < 2, CFI > 0.97, and RMSEA < 0.05, and an acceptable fit by CMIN/df < 3, CFI > 0.95, and RMSEA < 0.08 (Schermelleh-Engel, Moosbrugger, & Müller, 2003).

We conducted all statistical analyses using the Statistical Package for the Social Sciences (SPSS) version 16.0.

2.4. Ethical consideration

The present research project was approved by the Ethical Committee of Kumamoto University Graduate School of Biosciences.

3. Results

3.1. Internet use

The prevalence of "light Internet addiction" was 33.7% for men and 24.6% for women, and the prevalence of "severe Internet

Table 1
Means and SDs of items of the IAQ and its factor structure.

Item No.	Items	Mean (SD)	Skewness	Skewness after log-transformation	Factors	
					I	II
9	I have gotten into trouble with my employer or school because of being online.	.06 (.29)	5.19	4.68	1.00	-.12
10	I have missed classes or work because of online activities.	.06 (.29)	5.19	4.68	1.00	-.12
5	I have tried to prevent others from knowing how much time I spend on the net.	.11 (.43)	4.47	3.74	.84	-.04
8	I have tried to spend less time on the net, but have found it difficult to cut back.	.21 (.69)	3.72	3.16	.70	.06
6	My grades have declined because I have been putting more time into net-related activities.	.13 (.41)	3.33	2.94	.66	.27
4	Others, whom I trust, have told me I spend too much time on the net.	.17 (.53)	3.54	2.88	.56	.32
3	When I am away from school I usually look for an alternative method of getting on the net.	.23 (.69)	3.71	2.70	-.24	.95
1	I have spent more than three continuous hours on the net at least twice in the last four weeks.	.76 (1.26)	1.57	1.26	-.07	.86
2	More than once I have been late for other appointments because I was spending time on the net.	.21 (.62)	3.45	2.67	.09	.78
7	If I have not logged on in a while, I find it difficult to not think about what is waiting for me.	.14 (.46)	3.83	3.20	.32	.62
% of variance explained				62.6%	10.3%	

Factor analysis was conducted after log-transformation of the IAQ items.

Table 2
Means and SDs of items of the STDS and its factor structure.

Item No.	Items	Mean (SD)	skewness	Skewness after log-transformation	Factors		
					I	II	III
15	Without using text messages, I can't say what is on my mind	.14 (.51)	4.74	3.52	.98	-.28	.01
12	I can't form any new relationships without using text messages	.14 (.45)	3.69	2.95	.91	.05	-.11
13	I think my relationships would fall apart without text messages	.19 (.58)	3.42	2.79	.89	-.03	.06
11	I can't maintain new friendships without text messages	.25 (.67)	3.15	2.43	.78	.14	.01
14	Without text messages, I would not be able to contact friends whom I can't meet on a daily basis	.32 (.77)	2.50	2.04	.74	.20	.02
4	I use text messages even while I am talking with friends	.22 (.57)	3.62	2.31	-.03	.94	-.10
2	I sometimes send text messages while engaging in a conversation with another person	.38 (.69)	2.30	1.32	-.11	.93	.01
3	I sometimes spend many hours text-messaging	.32 (.69)	2.65	1.83	-.17	.81	-.08
5	I feel disappointed if I don't receive any text messages	.48 (.88)	1.86	1.37	.12	.69	.15
1	I often exchange many text messages in a short period of time	.53 (.80)	1.89	.97	.05	.69	.18
7	I feel disappointed if I don't get a reply to my message immediately	.90 (1.05)	1.20	.43	.06	-.10	.96
8	I feel anxious when people don't immediately reply to my text message	.87 (.97)	1.18	.35	.06	.03	.90
6	After sending a text message, I check my mailbox repeatedly to see if I have received a response	.68 (.87)	1.50	.59	-.13	-.05	.87
9	I often check my mailbox to see if I have a new text message	.65 (.91)	1.69	.80	-.05	.10	.82
10	I consider myself a quick-typist on mobile phones	.57 (.92)	1.73	1.07	.30	.21	.43
% of variance explained				54.2%	12.3%	7.7%	

Factor analysis was conducted after log-transformation of the STDS items.

addiction" was 6.1% for men and 1.8% for women but this difference did not reach statistical significance ($\chi^2 = 16.97$, $df = 18$, $p = .53$).

An EFA of the IAQ items yielded two-factors (Table 1). The IAQ items with a high factor loading on the first factor included items such as "I have missed classes or work because of online activities", "I have gotten into trouble with my employer or school because of being online", and "I have tried to prevent others from knowing how much time I spend on the net". In the original report (Wang, 2001), they interpreted this factor as Virtual Identity, but we think this factor is more proper to be interpreted as "Maladjustment". The IAQ items with a high factor loading on the second factor included items such as "When I am away from school I usually look for an alternative method of getting on the net", "I have spent more than three continuous hours on the net at least twice in the last four weeks", and "More than once I have been late for other appointments because I was spending time on the net". As in the original report (Wang, 2001), we interpreted this factor as Uncontrollability. The factors in this scale corresponded to those in the original scale. We created new subscales: Maladjustment and

Uncontrollability by adding the scores of items belonging to each factor. The Cronbach's α coefficients of the subscales were .87 and .76, respectively. They were similar to Wang's findings (2001). The two-factors were correlated $r = 0.63$.

3.2. Mobile phone text-message communication

The prevalence of "light mobile phone text-message addiction" was 3.1% for men and 5.4% for women but this difference did not reach statistical significance ($\chi^2 = 26.75$, $df = 30$, $p = .63$). There were no cases of "severe text-message addiction".

An EFA of the STDS items yielded a three-factor structure (Table 2). This was virtually the same as that originally reported by Igarashi et al. (2005, 2008). The first, second, and third factors were interpreted as Relationship Maintenance (RM), Excessive Use (EU), and Emotional Reaction (ER), respectively. We created three subscales: RM, EU, and ER accordingly. In our study, the internal consistencies of each factor of the STDS (measured by Cronbach's α coefficients) were .90 (RM), .90 (EU), and .91 (ER). The correlation

Table 3
Factor structure of the subscales of the IAQ and STDS.

Subscales	Factor	
	1	2
1. IAQ Maladjustment	-.08	.96
2. IAQ Uncontrollability	.06	.88
3. STDS RM	.68	.26
4. STDS EU	.93	-.08
5. STDS ER	.93	-.06
% of variance explained	58.8%	21.3%

IAQ, Internet Addiction Questionnaire; SPTMD, Self-perception of Text-message Dependency Scale; ER, Emotional Reaction; EU, Excessive Use; RM, Relationship Maintenance.

coefficient was $r = 0.52$ for RM and EU, $r = 0.56$ for RM and ER, and $r = 0.56$ for EU and ER.

3.3. SR of the IAQ, STDS, and Depression and Anxiety

Before constructing a SR model, we performed an EFA of the IAQ and STDS subscales. This revealed a two-factor structure (Table 3).

The three STDS subscales showed high factor loading on the first factor whereas the two IAQ subscales showed high factor loading on the second factor. An STDS subscale, RM, showed a moderate factor loading of the second factor.

According to the result of the EFA of the IAQ and STDS subscales, we performed a CFA of these subscales. First, we set a model in which two latent variables (Internet Dependency and Text-message Dependency) had paths towards the subscales of IAQ and STDS, respectively. This model fit the data: chi-squared = 13.73, $df = 4$, CFI = .970, RMSEA = 0.127 (90% confident interval = 0.058 – 0.203). To this model, we added a path from Internet Dependency to RM because RM had a moderate factor loading on the factor on that the IAQ subscales had high factor loadings (Fig. 1). This revised model showed better fit with the data: chi-squared = 1.55, $df = 3$, CFI = 1.000, RMSEA = 0.000 (90% confident interval = 0.000 – 0.106). The chi-squared was 12.18 with df of 1. This difference was significant at $p < .01$. Thus the revised model was significantly better than the original model (Klein, 2005, p. 146–147).

We then proceeded to calculate means and SDs of the scores of the IAQ and STDS, HADS Depression and Anxiety, and demographics (age and gender). We also estimated correlations between them

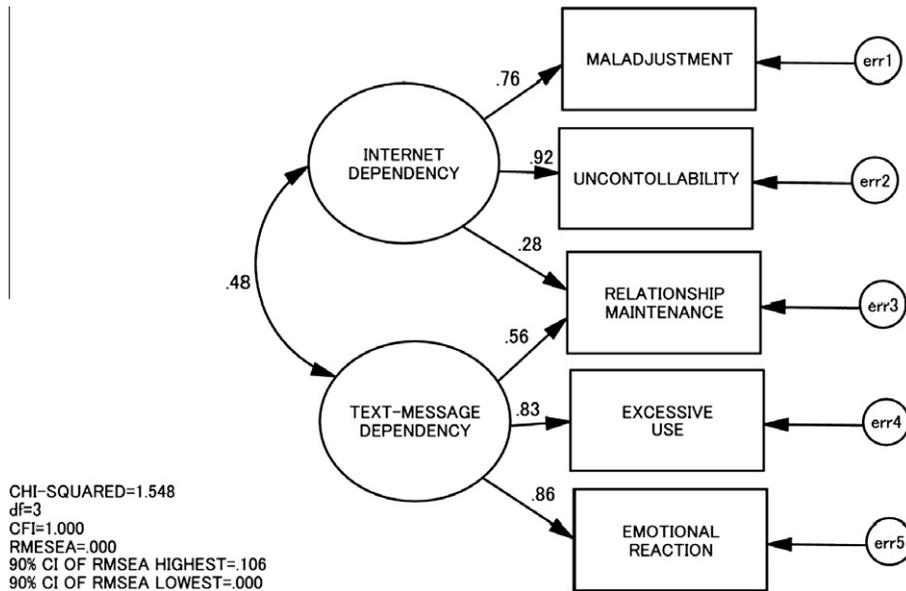


Fig. 1. Confirmatory factor analysis of the subscales of the IAQ and STDS CFI, comparative fit index; RMSEA, root mean square error of approximation.

Table 4
Correlations between the subscales of the IAQ, STDS and HADS.

	1	2	3	4	5	6	7	8	9
1. IAQ Maladjustment	–								
2. IAQ Uncontrollability	.70***	–							
3. STDS RM	.43***	.51***	–						
4. STDS EU	.30***	.36***	.61***	–					
5. STDS ER	.29***	.39***	.59***	.72***	–				
6. HADS-D	.36***	.27**	.31***	.31***	.32***	–			
7. HADS-A	.25**	.18*	.16*	.02	.07	.58***	–		
8. Age	-.12	-.15	-.32***	-.54***	-.44***	-.21*	.02	–	
9. Gender (men = 1; women = 2)	-.08	-.17*	-.03	.08	.03	-.06	-.02	-.06	–
Mean	.43	.69	.60	1.14	2.13	4.64	4.86	42.5	1.4
SD	1.24	1.29	1.39	1.63	2.04	3.31	3.84	10.5	0.5

IAQ, Internet Addiction Questionnaire; SPTMD, Self-perception of Text-message Dependency Scale; ER, Emotional Reaction; EU, Excessive Use; RM, Relationship Maintenance; HADS-D, Depression; HADS-A, Anxiety.

Significant correlation coefficients are in bold.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

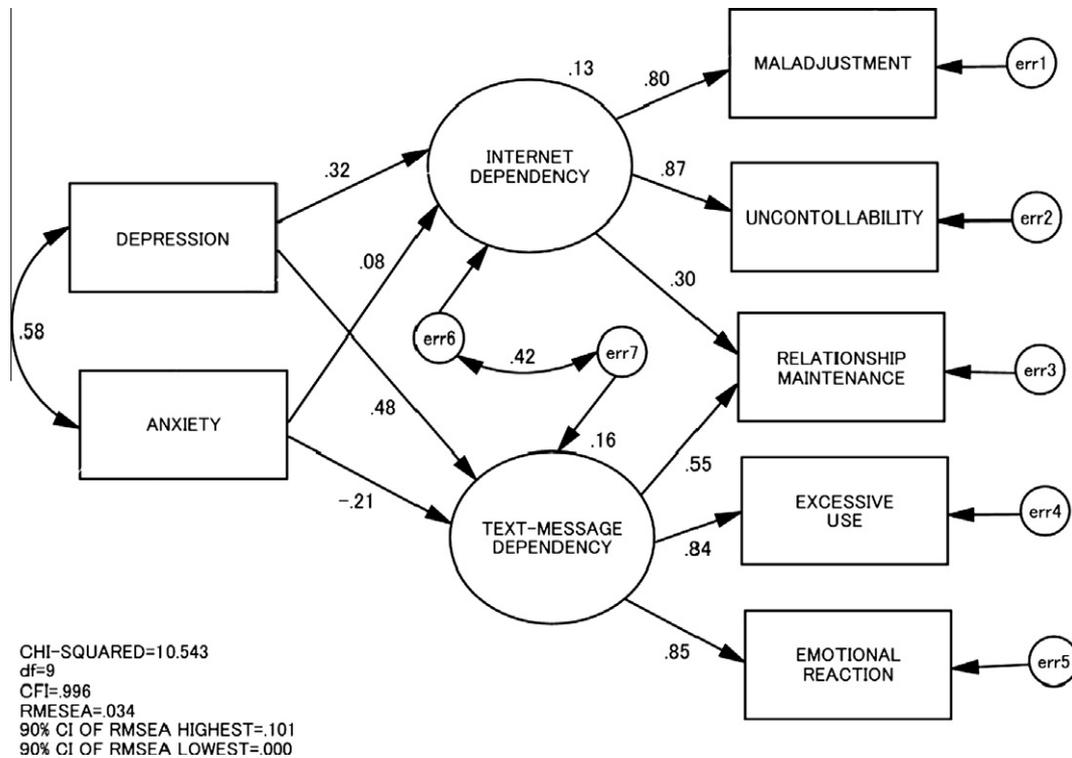


Fig. 2. Path model describing Depression, Anxiety, Internet Dependency, and Text-message Dependency CFI, comparative fit index; RMSEA, root mean square error of approximation.

(Table 4). As expected almost all the variables were significantly correlated with each other. HADS-D scores correlated significantly with all IAQ and STDS subscale scores, while HADS-A scores correlated with all IAQ subscale scores but only the STDS RM subscale score. Younger age was associated with the three STDS subscale scores. IAQ Uncontrollability was slightly associated with male gender.

In the SR model, we set paths from Depression and Anxiety to Internet Dependency and Text-message Dependency (Fig. 2). We also set correlation between Depression and Anxiety. The model fit the data: chi-squared/df = 1.17, CFI = .996, RMSEA = 0.034 (90% confidence interval = 0.000 – 0.101). It was revealed that Depression was associated significantly to both Internet Dependency and Text-message Dependency whereas Anxiety was associated only with Text-message Dependency negatively.

4. Discussion

In the current study, the Japanese IAQ and STDS were found to support the same factor structure of the Internet and excessive use items and text-messaging as in the original reports. Although the two types of dependencies were correlated with each other, an EFA revealed that these were discrete categories of dependency.

In our knowledge, this study is the first report on the prevalence of excessive Internet and mobile phone text message usage in a Japanese employee population. Our study suggests that psychological dependency on Internet and mobile phone text-messaging in Japan is not limited to students but also affects adults. This study showed that in the present population 34% of men and 25% of women showed mild Internet addiction and 6.1% for men and 1.8% for women showed pathological use of the net. In Wang's (2001) study on Australian university students, 28% of them were classified as having "light Internet addiction" and 4% as having "severe Internet addiction". The figure among the Japanese adults was similar as the Australian students.

Unlike previous reports showing higher male to female ratios (e.g., Johansson & Götestam, 2004; Wang, 2001; Yen, Ko, Yen, Wu, & Yang, 2007), the present study found no gender difference in internet use and mobile phone text-messaging. These gender differences may be due to different measures used, different age groups, or cultural differences. The participants of the present study were adults while those of the previous reports were mainly young students.

The findings that age was negatively correlated with the three subscales of mobile phone text-messaging but not with Internet use suggest that heavy reliance on mobile phone text-messaging may decrease as people get older but this may not be the case for Internet use. In this study correlations between Internet dependency and text-messaging dependency subscales were found. We speculated these results suggest that there is a general tendency for some people to be addicted towards electronic communication technologies irrespective of what these are and yet there may be different mechanisms, not yet identified, that function to lead to dependence on either of the two modern communication technologies. An EFA support this notion showing a two-factor structure.

The present study showed links between excessive use of the Internet and mobile phones and depression. This was in line with past research. Two models may account for the association. First, Kraut et al. (1998) has reported that Internet use results in negative effects on psychological well-being, which may indicate that Internet addiction would lead to depression. The negative impact, however, decreased in the follow-up study (1998).

Second, the Internet could help an individual develop a "virtual self" that would permit them, in essence, to leave the real world (Yen et al., 2007). As the self-medication model for substance use disorders indicates, adolescents with depression may modify their emotional condition via Internet use or text-messaging because it is perceived as less harmful than illegal substances and is more available. It can provide them with positive feelings, respect from others, and the pleasure of control, which may compensate for

imperfections in real life. However, if their depression is not well treated, they could spend more and more time on the Internet and develop a true addiction (Yen et al., 2007).

While public sentiment about Internet and text-messaging is negative, there are some studies reporting beneficial effects of such electronic communication. For example, Shaw and Grant (2002) studied psychological responses of participants engaging in five chat sessions with an anonymous partner. They found that Internet chat decreased loneliness and depression and increased perceived social support and self-esteem. Igarashi and Yoshida (2003) found that among first-year university students the frequency of text-messaging at beginning of the first semester was correlated with lower feelings of loneliness at the end of the semester. Because of the cross-sectional nature of the present study, causality cannot be inferred from our study. Conclusion of the direction of causality between depression and Internet use or text-messaging needs further prospective studies.

The present study indicated that anxiety, too, was linked to Internet dependency. In zero-order correlations, anxiety was correlated with the two IAQ subscales. Among the three subscales of the STDS only RM was associated with anxiety. The link between anxiety and preference to text-messaging to direct face-to-face communication was reported by Reid and Reid (2007). However, SR model using a SEM showed that whereas depression was positively associated with both Internet and Text-message Dependencies, anxiety was associated *negatively* only with Text-message Dependency. This suggests that the positive link between anxiety and RM is spurious due to confounding effects via depression. Second, it suggests that after controlling the effects of depression, lower anxiety is related with text-message dependence. The HADS is a measure of general anxiety and depression rather than a measure of current state of anxiety and depression. Because, in people high in Text-message Dependency, mobile phone text-message communication is central to their life of interpersonal relationships, they may feel less anxious unless they feel fearful when not replied immediately over the text-message on occasions. Alternatively, people with lower anxiety may feel less fearful to be over-involved in “virtual communication” using text-messaging. Again, we are not sure about the direction of causality. Future replication studies should use a prospective design to clarify this issue.

The limitations of this study should be noted. We should be cautious about the interpretation of the results because of the cross-sectional nature of the study. As noted, the causal relationship between depressive or anxious mood and excessive use of the Internet or mobile phone text-messaging remains to be clarified. Replication of this study should be conducted in a longitudinal design (e.g., Thomeé, Eklöf, Hustafsson, Nilsson, & Hagberg, 2007). The strength of this study is that the sample is a local civil servant population. Many previous studies used a student population (e.g., Ha et al., 2007; Johansson & Götestam, 2004; Yen et al., 2009) or a population recruited by newspaper advertisement (e.g., Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000). On the other hand, the participants' dysfunction, if any, would be minimal: the magnitude of their excessive use of the Internet and mobile phones was likely to be in an acceptable range. The results may differ in a clinical population.

Another drawback of this study is the lack of assessment of functional impairment of the participants. Such information may have clarified the extent to which Internet and mobile phone text-messaging influenced the employees' daily functioning.

This study treated Internet and text-messaging use regardless of the purpose of their use. However, people use them for individual purposes. For example, patterns rather than the amount of time used for computer were associated with adolescent lifestyle (Ho & Lee, 2001). This should be taken into consideration in future studies (Davis, 2001).

We defined cut off point of excessive use of Internet according to Wang's (2001) report. While psychometric properties of such a cutoff point such as sensitivity and specificity should be provided, Wang (2001) did not perform such a study. A psychometric study of the IAT should be further conducted.

5. Conclusion

This population-based study showed that the factor structures of two measures of addiction of electronic communication – the Internet Addiction Questionnaire and the Self-perception of Text-Message Dependency Scale – were the same as originally reported and that Internet dependence and at-risk Internet use and text-messaging were not confined to adolescents but prevalent among adults. A structural equation modeling showed that depression was associated with excessive Internet use and text-messaging as the primary means of communication but anxiety was associated with less dependence on text-messaging.

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