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Text messaging: Are dependency and Excessive Use discretely different for Japanese university students?

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ABSTRACT

Text messaging may be excessive and young people may be dependent on it. We distributed the Self-perception of Text-message Dependency Scale (STDS), Hospital Anxiety and Depression Scale (HADS), Temperament and Character Inventory (TCI), and Relationship Questionnaire (RQ) to 223 Japanese university students in a two-wave study, separated by a 5-month interval. The STDS yielded a three-factor structure. The STDS scores across the two measurement occasions were stable across time (except for the Relationship Maintenance subscale). A hierarchical cluster analysis suggested a three-class structure interpreted as Normal Users, Excessive Users, and Dependent Users. Excessive Users and Dependent Users were characterized by a young age at initial mobile phone use, more frequent use of text messaging, higher Novelty Seeking, and better Other-Model patterns of adult attachment. Unlike Excessive Users, Dependent Users were characterized by lower Self-directedness, poorer Self-Model of adult attachment, and higher anxiety and depression. The Excessive Users, but not the Dependent Users, were characterized by high Reward Dependence and Co-operativeness. The present study demonstrated that the STDS has a robust factor structure, good construct validity, and temporal stability (except for Relationship Maintenance subscale); students could be classified into normal, excessive, and Dependent Users of the text messaging; and Dependent Users were characterized by Excessive Use and personality immaturity.

1. Introduction

Text messaging is most often used between private mobile phone users as a substitute for voice calls in situations where voice communication is impossible or undesirable. Young people, in particular, have increased the frequency of social communication and expanded their opportunities for establishing social relationships (Matsuda, 2000; Igarashi et al., 2005; Hong et al., 2012). However, text message use, if excessive, may lead to a number of problems. For example, some people may feel neglected or isolated if they do not receive an instant reply to a message they have sent, and this may increase their anxiety about being ostracized (Igarashi et al., 2005). Text messaging is 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 and Kowalski, 1995). In Japan, the increased use of text messaging has been reported to be negatively related to individuals' psychological well-being, as measured by levels of depression and anxiety (Lu et al., 2011).

There are behaviors that share psychological characteristics with psychoactive substance ingestion because they produce short-term reward that may engender persistent behavior despite awareness of adverse consequences, such as lack of control over the behavior. Hence, these behaviors are categorized as behavioral addictions (Grant et al., 2010). They include pathological gambling, kleptomania, compulsive buying, pathological skin picking, sexual addiction, excessive tanning, computer/video game playing, and Internet addiction. The term “addiction” is often used interchangeably with “dependency.” Excessive use of text messaging offers short-term rewards, is persistent, and leads to occasional lack of control. Thus, it can be regarded as a type of behavior dependency.

Abbreviations: HADS, Hospital Anxiety and Depression Scale; RQ, Relationship Questionnaire; SDS, Social Desirability Scale; STDS, Self-perception of Text-message Dependency Scale; TCI, Temperament and Character Inventory

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As a measure of text message dependency, Igarashi et al. (2008) developed the Self-perception of Text-message Dependency Scale (STDS). An exploratory factor analysis of the items in this instrument yielded a three-factor structure (Igarashi et al., 2008): Emotional Reaction, Excessive Use, and Relationship Maintenance. These may represent three facets of text messaging dependency.

The Emotional Reaction subscale measures excessive concerns about text messaging replies. Text messaging is an asynchronous form of communication, and people dependent on text messaging may feel rejection from the lack of an immediate response, which can invoke feelings of isolation as well as intense anxiety. The Excessive Use subscale involves self-perception regarding the compulsive use of text messages. We expected that, as compared with Emotional Reaction and Relationship Maintenance, Excessive Use would be associated more strongly with observable measures of text message use, including the frequency and total time spent on text messaging and checking replies from others. The Relationship Maintenance is composed of items related to fear of disruption of relationships in the absence of text messages. People high in Relationship Maintenance may yearn for intimate relationships yet feel anxious during direct communication, possibly due to poor self-image. The first aim of this study was to confirm the three-factor structure of the STDS suggested by Igarashi et al. (2008). A second aim of this study was to validate the Excessive Use subscale of the STDS in terms of the actual patterns of text messaging.

Youths who are dependent on text messaging may persist in such dependency. However, the temporal stability of STDS has never been investigated. In addition, it is possible that one facet of STDS will predict an increase or decrease of another facet. For example, people high in Emotional Reaction may be more likely to reduce face-to-face communication, thus relying solely on text messaging over a certain period, leading to high Excessive Use. Alternatively, these three facets are, although associated moderately at a given time point, are independent in terms of their temporal trajectory. Thus, this was the third research question addressed in this paper.

It may be that only a certain percentage of people who use text messaging excessively develop psychological problems. Igarashi et al. (2008) studied Japanese high school students, and reported that text message frequency failed to predict psychological behavioral symptoms of the heavy use of text messaging after controlling for personality traits. Therefore, we expected that people with text message dependency would be the same as excessive users of text message in terms of STDS Excessive Use scores, but differ on the STDS Emotional Reaction and Relationship Maintenance scores. People with text message dependency may score higher on the Emotional Reaction and Relationship Maintenance factors than excessive users of text messaging. Alternatively, it may be that the difference between excessive users and dependent users is quantitative and the two cannot be discretely divided. Dependent users may be an extreme subset of excessive users. In this study, we used a cluster analysis to determine whether this difference is qualitative or quantitative.

Whereas excessive users of text messaging and people with text message dependency may not differ in frequencies of and hours spent on text messaging, they may differ in other psychological domains. The final aim of this study is, if the dependent and excessive users consist of discrete classes, to identify psychological correlates of these classes as well as normal (non-excessive) users.

As described earlier, people with text message dependency may be more likely to complain of depression and anxiety than excessive and normal users. Excessive users of text messaging may not differ from normal users in depression and anxiety.

Dependent users may be less mature in personality development. The links between excessive-use behaviors and the psychobiological model of personality (Cloninger, 1986) have been extensively studied. This model divides personality into temperament and character. In this model, temperament consists of four dimensions—Novelty Seeking, Harm Avoidance, Reward Dependence, and Persistence—while character consists of three—Self-directedness, Co-operativeness, and Self-transcendence. People low in personality maturation, as represented by reduced Self-directedness, may find it difficult to control their impulse to rely on text messaging and thus may be more likely to use it excessively and to respond less appropriately to the situation. Few empirical studies have examined the associations between personality traits and the three facets of text messaging dependency.

Individuals experiencing text message dependency may have a style of interpersonal relating that is characterized by a strong dependency on others as well as a strong fear that they may be rejected. Their fear of rejection grows stronger as they become closer to those with whom they wish to be intimate. Their adult attachment style may be the preoccupied type (Bartholomew and Horowitz, 1991). This is characterized by a sense of unworthiness of self (unlovability).

People with text message dependency and those who use text message excessively without psychological dependency may share personality traits that motivate them to use text messaging. These two groups of users may have a unique trait that distinguishes them from normal users. For example, people in these two groups share strong interests in new communication tools, such as text messaging. We expected that they would be characterized by a high level of Novelty Seeking, which is a source of excitement as in the case of alcohol (Cloninger, 1987; Zilberman et al., 2003, 2007) and gambling (Janiri et al., 2007; Nordin and Nylander, 2007; Shin et al., 2009).

Excessive users (without dependency) may be different from both normal and dependent users. They may be better at relating to people, which leads to a high volume of text message communications. Hence, we expected that they would be characterized by high Reward Dependence and Co-operativeness. They may also have a more positive evaluation of others (trustworthiness).

We focused on text message use in first-year university students because youngsters prefer text messages to direct telephone conversations (Igarashi et al., 2005) and are likely to show psychological maladjustment (Tomoda et al., 2000).

The aims of this study were as follows:

1. To confirm the three-factor structure of STDS suggested by Igarashi et al. (2008).
2. To validate the Excessive Use subscale of STDS in terms of actual patterns of text messaging.
3. To provide data on the temporal stability of each STDS subscale.
4. To examine whether the STDS subscales showed independent trajectories over a course of 5 months.
5. To examine weather excessive users and dependent user (higher in the Emotional Reaction and Relationship Maintenance scores) would consist of discrete classes.
6. To identify the psychological correlates of dependent users.

2. Method

2.1. Participants

We recruited students of a Japanese university in Kumamoto, Japan, to participate in a two-wave study. Questionnaires were distributed to new first-year students after they enrolled in college in May (T1) (new students begin university study in April in Japan) and again 5 months later (T2). Surveys were administered at the

beginning of each class period during the school day. A total of 223 students, between 18 and 29 years old, participated in the survey at T1. Their mean (S.D.) age was 18.4 (0.9) years. There were 75 men and 148 women. Men and women did not differ in their mean age. Of the students participating in the T1 study, 191 (86%) attended the class and returned the questionnaire in the T2 study. There were 64 men and 127 women at T2.

2.2. Measures

2.2.1. Text message dependency

The Self-perception of Text-message Dependency Scale (STDS: Igarashi et al., 2005) is a self-report scale that measures the way in which people perceive their use of text messages and their attitudes toward compulsive text messaging in the context of interpersonal relationships. This scale consists of three subscales: Emotional Reaction, Excessive Use, and Relationship Maintenance. For the current study, a short version of the STDS (Igarashi et al., 2008) was used. This consists of 15 items with a 5-point scale (1="Strongly disagree" to 5="Strongly agree"). Higher scores indicate greater dependency on text messaging. This scale was distributed at T1 and T2.

2.2.2. Actual pattern of text messaging use

We asked the following questions: (1) the age at which students started using mobile phones, (2) the frequency of text messaging during the previous week, (3) hours spent text messaging per day, (4) monthly fees spent on mobile phone communication, and (5) the frequency of checking for replies to messages they had sent each day.

2.2.3. Social desirability

Possible questionnaire bias by socially desirable response style was rated by the Japanese version (Kitamura and Suzuki, 1986) of the Social Desirability Scale (SDS: Crowne and Marlowe, 1960). This consists of 10 items on a 4-point scale. Higher scores indicate a greater tendency to answer in a socially acceptable manner.

2.2.4. Depression and anxiety

The Hospital Anxiety and Depression Scale (HADS: Zigmond and Snaith, 1983) is a self-report screening instrument for negative moods. It was developed to identify people with physical illness who also 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, with the anxiety and depression subscales having seven items each. We used the Japanese version of the HADS (Kitamura, 1993), whose positive psychometric properties have been previously reported (Matsudaira et al., 2009).

2.2.5. Personality

The Temperament and Character Inventory (TCI: Cloninger et al., 1993) was used to measure the four temperament domains —Novelty Seeking, Harm Avoidance, Reward Dependence, and Persistence—and the three character domains—Self-directedness, Co-operativeness, and Self-transcendence. This was translated into Japanese (Kijima et al., 2000) with the permission of Professor Cloninger. The TCI and its predecessor, the Tridimensional Personality Questionnaire, have been widely used in Japanese populations (e.g., Naito et al., 2000; Yoshino et al., 1994). There are studies on the internal consistencies and factor structures of the Japanese versions (Kijima et al., 2000; Takeuchi et al., 2011; Tomita et al., 2000).

2.2.6. Adult attachment

The Relationship Questionnaire (RQ) (Bartholomew and Horowitz, 1991) is a self-report measure of adult attachment styles. The RQ is composed of four paragraphs, each describing one of the four attachment styles—Secure, Fearful, Preoccupied, and Dismissing. Each participant was asked to rate the extent to which the descriptions reflected their relationship with their partner. If they had no definite partner, they were asked to imagine a close opposite-sex person in answering the question. Good reliability (Bartholomew and Horowitz, 1991) and validity (Griffin and Bartholomew, 1994a, 1994b) have been reported for the English version. Participants replied using a 7-point scale (1="Does not apply to me at all" to 7="Applies to me very much"). Bartholomew authorized the Japanese translation. The Self-Model and Other-Model scores were calculated according to Bartholomew and Horowitz (1991).

$$\text{Self} - \text{Model} = \text{Secure} - \text{Fearful} - \text{Preoccupied} + \text{Dismissing}$$

$$\text{Other} - \text{Model} = \text{Secure} - \text{Fearful} + \text{Preoccupied} - \text{Dismissing}$$

2.3. Statistical analysis

We performed an exploratory factor analysis of the 15 STDS items. Principal axis factoring was used for factor extraction with PROMAX rotation. The number of factors was determined by a scree test (Cattell, 1966) after confirming that the factors' eigenvalues were all over 1.0.

Subscale scores were calculated by adding all the scores that loaded highly on each factor. The subscale scores were correlated with the SDS scores in order to examine how the participants' responses were influenced by socially desirable response styles. The subscale scores were then correlated with the actual patterns of text message use. Because all of the subscale scores obtained from the exploratory factor analysis were correlated with the SDS scores, correlations between each of the STDS subscale scores and each of the external validator scores were controlled for by the SDS scores.

To examine temporary stability of the STDS items, each of the STDS subscale and item scores at T1 and T2 were correlated. We also examined whether the scores of each STDS subscale and item differed between T1 and T2.

Further, in order to examine the effects of each STDS subscale score at T1 on each of the STDS subscale scores at T2, we composed a structural regression path using structural equation analysis. We posited in this model that each of the subscale scores at Time 1 would predict the scores of all the subscales at Time 2. We also posited that all the subscale scores at each measurement occasion would be correlated with each other. We set the covariance between the error variables of each STDS item at the two measurement occasions. The fit of the model with the data was examined in terms of χ^2 (CMIN), comparative fit index (CFI), and root mean square error of approximation (RMSEA). According to conventional criteria, a good fit would be indicated by CMIN/d.f. < 2, CFI > 0.97, and RMSEA < 0.05 and an acceptable fit by CMIN/d.f. < 3, CFI > 0.95, and RMSEA < 0.08 (Schermelleh-Engel et al., 2003).

In order to examine whether the students would fall into discrete classes in terms of the STDS item scores, all the 15 STDS items were entered into a hierarchical cluster analysis with Ward's method as the clustering method and squared Euclidian distances as the distance measure. The number of clusters was determined by the inverse scree technique (Lathrop and Williams, 1987). As cases or clusters are combined successively, within-class variation shows a slow growth. The number of clusters is established when a sudden 'jump' of within-class variation occurs.

The participants who belonged to each cluster were compared in terms of the scores of the three STDS subscales. We then used

one-way analysis of variance with post hoc comparison of Tukey to compare them in other correlates to identify the characteristics of cluster-analysis derived groups.

All the statistical analyses were conducted using the SPSS version 20.0 and Amos 20.0.

2.4. Ethical considerations

This project was approved by the Ethical Committee of Kumamoto University Graduate School of Life Sciences.

3. Results

3.1. Factor structure of the STDS

An exploratory factor analysis yielded a three-factor structure (Table 1). The STDS items with high (> 0.3) factor loading on the first factor comprised all the items categorized as Relationship Maintenance by Igarashi et al. (2008). The STDS items with high factor loading on the second factor consisted of those classified as Excessive Use by Igarashi et al. (2008). Finally, the STDS items with high factor loading on the third factor were those categorized as Emotional Reaction by Igarashi et al. (2008). None of the STDS items loaded highly (> 0.3) on more than one factor. The three factors were moderately correlated with each other: Relationship Maintenance with Excessive Use, $r=0.48$; Relationship Maintenance with Emotional Reaction, $r=0.44$; and Excessive Use with Emotional Reaction, $r=0.22$. The STDS subscale scores were slightly negatively correlated with SDS scores: Relationship Maintenance, $r=-0.18$ ($p<0.05$); Excessive Use, $r=-0.13$ (n.s.); and Emotional Reaction, $r=-0.08$ (n.s.).

3.2. Concurrent validity

As measures of concurrent validity of the STDS, we found that the Excessive Use scores were associated with a younger age at initial mobile phone use, more frequent use of text messaging during the previous week, and more frequent checking for text message replies (Table 2). The Excessive Use scores were also associated with higher mobile phone bills. On the other hand, the Relationship Maintenance and Emotional Reaction scores were associated only with the frequency of text messaging during the previous week.

Table 1
Means and S.D.s of the Self-perception of Text-message Dependency Scale items and the scale's factor structure.

Item no.	Items	Mean (S.D.)	Skewness	Commonality	Factors		
					I	II	III
7	I feel disappointed if I don't get a reply to my message immediately.	2.25 (1.19)	0.72	0.74	**0.87**	−0.01	−0.02
8	I feel anxious when people don't immediately reply to my text message.	2.31 (1.22)	0.77	0.76	**0.86**	−0.00	0.03
9	I often check my mailbox to see if I have a new text message.	2.06 (1.04)	1.02	0.65	**0.76**	0.14	−0.06
6	After sending a text message, I check my mailbox repeatedly to see if I have received a response.	2.43 (1.14)	0.7	0.58	**0.70**	0.09	0.04
10	I consider myself a quick typist on mobile phones.	2.03 (1.17)	1.11	0.52	**0.68**	−0.07	0.14
2	I sometimes send text messages while engaging in a conversation with another person.	2.55 (1.12)	0.53	0.63	−0.05	**0.82**	−0.03
4	I use text messages even while I am talking with friends.	2.11 (1.02)	0.92	0.56	−0.06	**0.75**	0.09
1	I often exchange many text messages in a short period of time.	2.85 (1.20)	0.35	0.57	0.06	**0.74**	−0.08
3	I sometimes spend many hours text messaging.	3.02 (1.28)		0.60	0.14	**0.71**	−0.01
5	I feel disappointed if I don't receive any text messages.	2.76 (1.26)	0.23	0.38	0.02	**0.60**	0.03
12	I can't form any new relationships without using text messages.	1.45 (0.86)	2.31	0.88	−0.11	0.05	**0.97**
11	I can't maintain new friendships without text messages.	1.48 (0.86)	2.07	0.64	−0.02	0.12	**0.77**
13	I think my relationships would fall apart without text messages.	1.32 (0.72)	2.82	0.41	0.11	−0.09	**0.60**
14	Without text messages, I would not be able to contact friends whom I can't meet on a daily basis.	2.25 (1.39)	0.71	0.27	0.07	0.02	**0.46**
15	Without using text messages, I can't say what is on my mind.	1.34 (0.69)	2.58	0.21	0.26	−0.23	**0.33**

Factor loadings > 0.3 are in bold.

Table 2
Means and S.D.s of the Self-perception of Textmessage Dependency Scale subscale scores and their correlations with external validators.

	Mean (S.D.)	Emotional Reaction	Excessive Use	Relationship Maintenance
Mean (S.D.)	–	11.07 (4.8)	13.28 (4.7)	7.86 (3.3)
skewness	–	0.79	0.47	1.75
Text message use				
Age when first started using mobile phones	14.9 (1.4)	−0.05 [−0.07]	−0.29*** [−0.31***]	−0.02 [−0.03]
Frequency of text messaging last week (times)	95.2 (111.9)	0.19** [0.18*]	0.51*** [0.50***]	0.21** [0.18*]
Hours spent text messaging per day	2.5 (3.7)	0.10 [0.07]	0.33*** [0.29***]	0.06 [0.03]
Monthly fees spent on mobile phone use (Japanese yen)	7985 (3107)	0.10 [0.05]	0.25*** [0.29***]	0.05 [0.08]
Daily frequency of checking replies to messages (number of times)	23.2 (43.9)	0.12 [0.10]	0.34*** [0.35***]	0.12 [0.13]

Partial correlation coefficients controlled by the STDS scores are in [ ].

* $p<0.05$.
** $p<0.01$.
*** $p<0.001$.

Table 3
Test–retest correlations of the Self-perception of Text-message Dependency Scale items and subscale scores.

		Correlation between T1 and T2	T1 mean (S.D.)	T2 mean (S.D.)	*t*
Emotional Reaction score		0.70***	10.8	11.0	0.97
7	I feel disappointed if I don't get a reply to my message immediately.	0.52***	2.23 (1.13)	2.25 (1.05)	0.34
8	I feel anxious when people don't immediately reply to my text message.	0.57***	2.26 (1.15)	2.30 (1.05)	0.49
9	I often check my mailbox to see if I have a new text message.	0.51***	2.02 (0.98)	2.15 (1.07)	1.76
6	After sending a text message, I check my mailbox repeatedly to see if I have received a response.	0.51***	2.36 (1.09)	2.37 (1.02)	0.21
10	I consider myself a quick typist on mobile phones.	0.58***	1.97 (1.09)	1.99 (1.09)	0.29
Excessive Use score		0.75***	13.1	13.3	1.18
2	I sometimes send text messages while engaging in a conversation with another person.	0.52***	2.50 (1.07)	2.49 (1.10)	0.14
4	I use text messages even while I am talking with friends.	0.49***	2.07 (0.97)	2.14 (1.00)	1.01
1	I often exchange many text messages in a short period of time.	0.62***	2.81 (1.19)	2.91 (1.12)	1.29
3	I sometimes spend many hours text messaging.	0.65***	2.96 (1.28)	2.95 (1.32)	0.13
5	I feel disappointed if I don't receive any text messages.	0.77***	2.71 (1.21)	2.85 (1.27)	2.40*
Relationship Maintenance score		0.58***	7.7	7.8	0.26
12	I can't form any new relationships without using text messages.	0.51***	1.41 (0.79)	1.39 (0.68)	0.40
11	I can't maintain new friendships without text messages.	0.47***	1.45 (0.80)	1.45 (0.71)	0.09
13	I think my relationships would fall apart without text messages.	0.29***	1.31 (0.66)	1.42 (0.84)	1.84
14	Without text messages, I would not be able to contact friends whom I can't meet on a daily basis.	0.56***	2.24 (1.33)	2.20 (1.21)	0.54
15	Without using text messages, I can't say what is on my mind.	0.40***	1.31 (0.61)	1.32 (0.62)	0.11

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

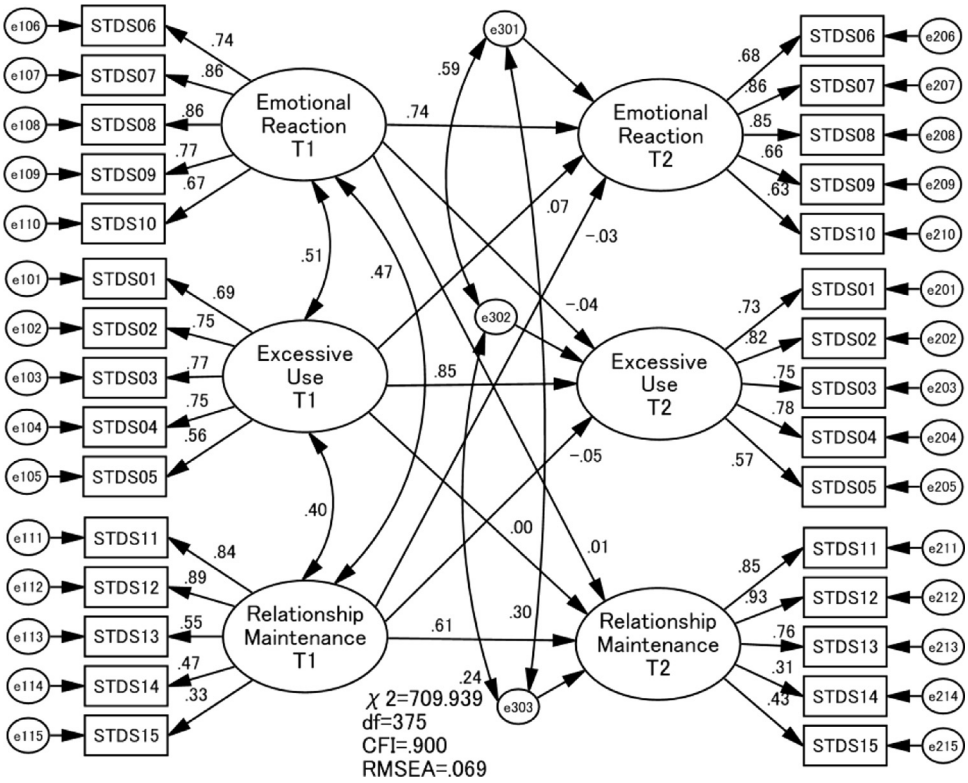

Fig. 1. Structural regression analysis of T1 STDS subscale scores predicts T2 STDS subscale scores. Path estimates are standardized. Covariances between error variables of each STDS item at the two measurement times (such as covariance between the error variable of the STDS item 1 at T1 and the corresponding error variable at T2) were calculated but not shown in the figure so as to maximize visual clarity. STDS, Self-perception of Text-message Dependency Scale; T1, the first assessment occasion; T2, the second assessment occasion.

3.3. Test–retest reliability and temporal stability

There was no difference in the STDS subscale and item scores between T1 and T2 except for Item 5, and all were correlated across the two assessment occasions (Table 3). The correlations between T1 and T2 were fair for Emotional Reaction and Excessive Use subscale scores but poor in Relationship Maintenance scores.

A structural regression path showed a fairly acceptable fit with the data: CMIN/d.f.=1.89, CFI=0.900, and RMSEA=0.069 (90% CI=0.061–0.077). Each STDS subscale score at T1 strongly predicted its corresponding subscale score at T2. However, each STDS

subscale score at T1 failed to predict the T2 score of the other subscale scores (Fig. 1).

3.4. Cluster analysis of the STDT

The inverse scree test suggested that the number of clusters could be set at 3 (Fig. 2). As the test moved from a three-cluster structure to two- and one-cluster structures, a sudden "jump" of within-class variance occurred. In the three-cluster model, the second cluster was the greatest, including 92 participants, whereas the first was the smallest, including 54 participants.

The scores of the STDS subscales showed statistically significant differences between the three clusters (Table 4). A one-way ANOVA with post hoc comparisons (Tukey) showed that the second cluster was characterized by the lowest scores of the three STDS subscales. We named this cluster Normal Users. The third cluster was characterized by the highest scores of the Relationship Maintenance and Emotional Reaction factors. This means that they are more likely to be concerned about replies from persons they have sent messages and to find it difficult to maintain interpersonal relationships without the aids of text messaging. Because the participants in this cluster were psychologically most distressed (together with higher anxiety and poorer Self-Model, see Table 5), we named this cluster Dependent Users. The first cluster was between the second and third clusters in terms of Relationship Maintenance and Emotional Reaction, but had the highest Excessive Use score. Because the people in this cluster were characterized by overly excessive use of text messaging, but psychologically less distressed, we named this cluster Excessive Users.

Finally, we compared these three clusters–Normal Users, Excessive Users, and Dependent Users–in terms of text message use, depression and anxiety, personality, adult attachment, and demographic features (Table 5). First, Normal Users were the most likely to have a later start in mobile phone use, used text messaging and checked replies the least frequently, spent the least hours, and had the lowest monthly fees. Excessive Users and Dependent Users were almost the same in these text message use variables.

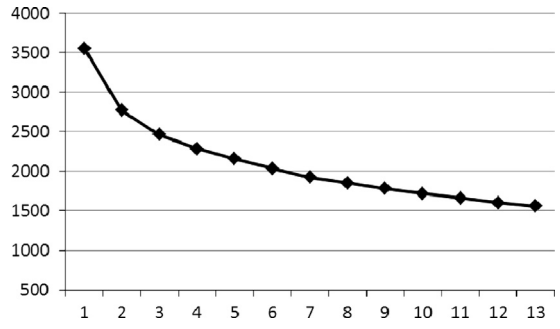

Fig. 2. The reverse scree plot of the cluster analysis of the STDS items.

Dependent Users differed from Excessive Users in HADS Anxiety scores with Dependent Users scoring higher in Anxiety. Dependent Users also scored higher in depression, but they did not differ from Excessive Users in this category. In terms of personality, Dependent Users were characterized by high Novelty Seeking and low Self-directedness. Excessive Users were characterized by high Novelty Seeking, Co-operativeness and reward Dependence. Dependent Users showed worse Self-Model of adult attachment than Normal Users and Excessive Users. Both Excessive Users and Dependent Users showed better Other-Model. Finally, age or gender did not distinguish the three clusters.

4. Discussion

This study found that the three-factor structure of the STDS was the same as in the original report (Igarashi et al., 2008). This research also demonstrated a relationship between Japanese college students' text message dependency and their actual pattern of text messaging. Among the three subscales of the STDS, only Excessive Use was strongly associated with all items pertaining to text message use; students who scored high in Excessive Use used text messaging more frequently, spent more hours doing so, checked replies more frequently, and had higher mobile phone bills. In addition, they first started using mobile phones at a younger age. Only the frequency of text messaging during the previous week was associated with Emotional Reaction and Relationship Maintenance.

A cluster analysis showed that within-class variation "jumped" when the number of clusters was moved from three to two, suggesting that the number of clusters may be three. The three classes, as expected, corresponded to patterns of the STDS scores. Thus, the Excessive Users were characterized by high Excessive Use scores while the Dependent Users were characterized by high Emotional Reaction and Relationship Maintenance scores. The Dependent Users had higher Excessive Use scores than the Normal Users, but were lower than the Excessive Users. Therefore, Excessive Use of text message is not *sine qua non* of text message dependency, but it is an important element.

Excessive use of text message found in the Excessive Users and Dependent Users was associated with starting to use mobile phones at an earlier age, more frequent use of text messaging and checking replies, more hours spent text messaging, and higher mobile phone bills. They also scored higher in the Novelty Seeking and Other-Model categories. The former was in accordance with our expectation. People high in Novelty Seeking are exploratory and curious; they are impulsive and enthusiastic. Hence, they may be more likely to be involved in frequent text message communication. This is, however, not directly related to text message dependency. Text message dependency needs, as a personality correlate, low Self-directedness. People low in Self-directedness tend to be immature and fragile; they are purposeless and

Table 4
The STDS subscale scores of the three cluster analysis-derived groups.

Cluster	*n*	Relationship Maintenance	Excessive Use	Emotional Reaction
Cluster 1	54	6.6 (1.7)	16.8 (2.9)	10.5 (2.8)
Cluster 2	92	6.0 (1.3)	9.5 (2.3)	7.6 (2.3)
Cluster 3	77	10.9 (3.6)	15.3 (4.6)	15.6 (4.6)
Total	223	7.9 (3.3)	13.3 (4.7)	11.1 (4.8)
One-way ANOVA		F (2, 220)=70.8***	F (2, 220)=114.1***	F (2, 220)=155.5***
Tukey post hoc comparison		2 < 1 < 3	2 < 3 < 1	2 < 1 < 3

Standard deviation in brackets.

*** $p < 0.001$.

Table 5
The three clusters and correlates.

	Total ($N=223$)	Cluster 2 Normal Users ($n=92$)	Cluster 1 Excessive Users ($n=54$)	Cluster 3 Dependent Users ($n=77$)	One-way ANOVA	Post hoc comparison
Text message use						
Age when started mobile phones	14.9 (1.4)	15.2 (1.2)	14.7 (1.2)	14.7 (1.6)	F (2, 220)=3.3*	2 > 1
Frequency of text messaging last week (times)	95.2 (111.9)	41.2 (40.2)	129.4 (122.0)	136.2 (135.3)	F (2, 212) =21.2***	2 < 1 < 3
Hours spent text messaging per day	2.5 (3.7)	1.6 (3.5)	3.5 (4.7)	2.9 (3.0)	F (2, 210)=4.4*	2 < 1
Monthly fees on mobile phone (Japanese yen)	7985 (3107)	7309 (2491)	8729 (3968)	8230 (2914)	F (2, 210)=3.9*	2 < 1
Frequency of checking replies to messages per day (times)	23.2 (43.9)	11.3 (14.2)	24.2 (18.2)	36.8 (69.4)	F (2, 209)=7.1**	2 < 3
Depression and anxiety						
HADS Depression	4.3 (3.0)	3.8 (2.7)	4.3 (2.8)	4.9 (3.3)	F (2, 220)=3.0	2 < 3
HADS Anxiety	5.4 (3.6)	4.5 (3.4)	5.1 (2.9)	6.8 (3.9)	F (2, 220)=9.6***	2, 1 < 3
Personality						
Novelty Seeking	26.9 (7.3)	24.7 (7.1)	28.6 (7.3)	28.4 (7.0)	F (2, 218)=7.7**	2 < 1, 3
Harm Avoidance	34.3 (7.6)	33.4 (8.0)	33.8 (7.5)	35.8 (7.1)	F (2, 218)=2.2	–
Reward Dependence	31.8 (5.9)	30.5 (6.1)	32.9 (5.3)	32.6 (6.0)	F (2, 218) =3.8*	2 < 1
Persistence	16.6 (3.7)	16.8 (3.9)	16.5 (3.8)	16.3 (3.3)	F (2, 218)=0.5	–
Self-directedness	38.9 (8.6)	41.5 (8.6)	38.1 (9.1)	36.3 (7.5)	F (2, 218) =8.4***	2 > 3
Co-operativeness	50.6 (7.7)	50.0 (8.3)	52.4 (7.0)	50.0 (7.4.)	F (2, 218) =2.0	2, 3 < 1
Self-transcendence	17.3 (6.6)	16.6 (7.0)	17.7 (5.5)	17.9 (6.9)	F (2, 218) =0.9	–
Adult attachment style						
Self-Model	−0.04 (3.5)	0.1 (3.4)	0.5 (3.7)	−1.4 (3.1)	F (2, 202) =5.7**	2, 1 > 3
Other-Model	2.3 (3.2)	1.5 (3.4)	2.9 (2.7)	2.8 (3.2)	F (2, 202) =4.2*	2 < 1, 3
Demographics						
Gender (men 1; women 2)	1.7 (0.5)	1.6 (0.5)	1.8 (0.4)	1.7 (0.5)	F (2, 220)=2.8	–
Age	18.4 (0.9)	18.3 (0.6)	18.3 (0.6)	18.5 (1.3)	F (2, 220)=0.8	–

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

ineffective. It has been reported that low Self-directedness is related to depression and anxiety. The Dependent Users were also characterized by higher depression and anxiety (different from the Excessive Users), and had a poorer Self-Model.

Non-dependent excessive users were characterized by high Reward Dependence and Co-operativeness. This suggests that this class includes people who are more socially tolerant, empathic, helpful, and compassionate. Thus, they may be more likely to have peers to communicate with.

The present data may be compared with those related to other types of behavioral addiction. For example, Korean adolescents with problematic Internet use were scored *higher* in Self-directedness and Co-operativeness and *lower* in novelty Seeking and Self-transcendence (Cho et al., 2008). High Novelty Seeking and Harm Avoidance as well as low Self-directedness and Co-operativeness are usually reported as characteristic of pathological gamblers (Cunningham-Williams et al., 2005; Martinotti et al., 2006; Janiri et al., 2007; Nordin and Nylander, 2007; Shin et al., 2009). Differences of personality trait patterns between these conditions may require further clarification.

Many limitations might have influenced the results of this study. We relied on participants' personal reports for details about text message dependency, actual patterns of text messaging, personality, psychological adjustment, and adult attachment. Thus, this study is subject to shared observer bias. Moderate correlations between SDS scores and the three subscales of the STDS demonstrate this possibility. Other informants, such as peers and family members, should ideally be recruited in future studies. Subjects' text messaging patterns can be objectively examined by checking telephone company records. Attachment may be studied by using a structured interview designed to assess such experiences. Such procedures may, however, be impractical or overly expensive.

We should also be cautious about defining students in Cluster 3 as text-messaging dependent. As compared to those categorized as Excessive Users, they were scored high in Relationship Maintenance and Emotional Reaction scores and higher in anxiety and poorer in Other-Model. These may support our speculation. However, because this was a cross-sectional study, follow-up studies of participants are required to examine different patterns of excessive use of text-messaging as well as psychosocial functioning.

The participants in this research were Japanese university students, which limits generalizability. Further research is needed to show whether our conclusions can be applied to a more general population.

Despite these methodological drawbacks, the present study demonstrated that the STDS has a robust factor structure and temporal stability (except for Relationship Maintenance); the Dependent Users of text message are qualitatively different from Excessive Users. These findings may be used for further studies related to text messaging in Japan.

Contributors

Lu, Chen, and Kitamura designed the study. Nagata carried out data collection. Lu, Katoh, and Kitamura were involved in the management of the data base. Lu, Nagata, and Kitamura were responsible for performing statistical analysis. Lu wrote the first draft of the manuscript. All authors contributed to and approved the final manuscript.

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