Computers in Human Behavior 28 (2012) 1490–1496

Contents lists available at SciVerse ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Phantom vibrations among undergraduates: Prevalence and associated psychological characteristics

Michelle Drouin *, Daren H. Kaiser, Daniel A. Miller

Indiana University–Purdue University Fort Wayne, United States

ARTICLE INFO

Article history:
Available online 15 April 2012

Keywords:
Phantom vibrations
Text message dependence
Psychological characteristics
Young adults
Undergraduates

ABSTRACT

'Phantom vibration syndrome,' or perceived vibrations from a device that is not really vibrating, is a recent psychological phenomenon that has attracted the attention of the media and medical community. Most (89%) of the 290 undergraduates in our sample had experienced phantom vibrations, and they experienced them about once every two weeks, on average. However, few found them bothersome. Those higher in conscientiousness experienced phantom vibrations less frequently, and those who had strong reactions to text messages (higher in the emotional reaction subscale of text message dependence) were more bothered by phantom vibrations. These findings suggest that targeting individuals' emotional reactions to text messages might be helpful in combating the negative consequences of both text message dependency and phantom vibrations. However, because few young adults were bothered by these phantom vibrations or made attempts to stop them, interventions aimed at this population may be unnecessary.

1. Introduction

According to recent statistics from the Pew Foundation, 83% of Americans now have mobile phones, and 73% use text messaging (Smith, 2011). Young adults are the most prolific users of text messaging, averaging approximately 3200 text messages per month (*Mdn* = 1500 texts per month) (Smith, 2011). This represents a sharp increase in mobile communication over the past 5 years (Reardon, 2009; Smith, 2011) which has coincided with the emergence of problematic behaviors associated with mobile phone use (Bianchi & Phillips, 2005; Lindstrom, 2011; Lu et al., 2011). These include *text message dependence* (TMD), which is an overreliance on text messages in one's daily life (Igarashi, Motoyoshi, Takai, & Yoshida, 2008) and *phantom vibration syndrome* (PVS), or perceiving vibrations from a mobile device that is not really vibrating (Haupt, 2007; Rothberg et al., 2010). PVS has received attention from prominent media sources (Haupt, 2007; Williams, 2007) and numerous blogs, websites, and social networking groups feature PVS descriptions and discussions; however, little empirical research exists on the topic. In this study, we examine the experience of phantom vibrations among young adult undergraduates as well as the Big-Five personality characteristics and TMD variables related to the experience of phantom vibrations.

1.1. Phantom vibrations

There are some inconsistencies in the media and limited empirical research regarding the terms used to describe imagined vibrations from a mobile device (Haupt, 2007; Laramie, 2007; Rothberg et al., 2010). The term 'phantom vibration syndrome' (PVS) is probably the most commonly used term for this phenomenon; it has been used in the media (Haupt, 2007), on blogs and Facebook sites, and even in the scientific community (Rothberg et al., 2010). However, as Rothberg et al. (2010) acknowledges, PVS is not actually a syndrome, as the experience of mobile phone phantom vibrations does not (at present) signify a disease or disorder. Therefore, 'phantom ring' (Laramie, 2007) or more generally, 'phantom vibration' is probably a more appropriate term for this phenomenon.

Phantom vibrations have been classified as *either* sensations or perceptions, or sometimes *both* sensations and perceptions, even within the same article (Haupt, 2007; Rothberg et al., 2010). Although there may be sensations that trigger the experience of phantom vibrations (e.g., the feeling of clothing rubbing against one's skin, or a muscle twitching) (Rothberg et al., 2010), because these vibrations are 'phantom,' the term sensation is not really appropriate. Instead, phantom vibrations can be more appropriately classified as perceptions. Perception involves the interpretation of sensory stimuli. In the case of phantom vibrations, repeated exposure to actual vibrations from phone alerts (rings or text messages) leads to perceptual learning (Haupt, 2007). More specifically, individuals who use vibration mode learn to associate these vibrations with alerts of social communication. This is an

* Corresponding author. Address: Department of Psychology, Indiana University, Purdue University Fort Wayne, 2101 E. Coliseum Blvd., Fort Wayne, IN 46805, United States. Tel.: +1 260 481 6398.
E-mail address: drouinm@ipfw.edu (M. Drouin).

0747-5632/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.chb.2012.03.013

adaptive process, and as Rothberg et al. (2010) suggest, the experience of phantom vibrations does not appear to be pathological. If fact, because the younger participants in their sample were more likely to experience phantom vibrations, Rothberg et al. (2010) assert that phantom vibrations may actually be an indicator of the brain's plasticity—in this case, the ability to form schemas for the interpretation of sensory stimuli.

Despite the fact that the experience of phantom vibrations may be adaptive or indicative of perceptual learning, phantom vibrations still involve either a misinterpretation of sensory stimuli or, in the absence of sensory stimulation, a tactile hallucination (Rothberg et al., 2010). From a psychological perspective, it is interesting to explore why these misinterpretations or false perceptions occur. A recent study of medical personnel (Rothberg et al., 2010) investigated this issue by measuring both the prevalence of phantom vibration syndrome (PVS) as well as the user characteristics (e.g., demographic, device, mobile usage) that were related to the experience of phantom vibrations (i.e., frequency of those vibrations and how bothersome they were to the individual). The only other known study on the topic is a doctoral thesis (Laramie, 2007) that examined the incidence of phantom ring among adults and also explored the relationships between the experience of phantom ring and impulsivity, mobile phone problem use, and use of the mobile phone to modulate one's affect.

Although the samples in these two studies were very different, the prevalence statistics for phantom vibrations were quite similar. In both studies, approximately two-thirds of the participants had experienced phantom vibrations with their electronic devices (mobile phones or pagers) (Laramie, 2007; Rothberg et al., 2010). With regard to the characteristics related to phantom vibrations among medical staff (Rothberg et al., 2010), the majority of participants experienced equal amounts of vibrations with mobile phones and pagers and started experiencing these vibrations within a month and a year of carrying the electronic device. With regard to their experience of phantom vibrations, most (88%) felt these vibrations weekly or monthly, and (93%) found the vibrations to be not at all or only slightly bothersome. Although only 2% of the medical staff found the phantom vibrations to be very bothersome, most of those who experienced phantom vibrations (61%) made attempts to stop them. Those who were successful in stopping the vibrations (65%) did so by switching the device off vibration mode or carrying the device in another location. Meanwhile, within the general population (Laramie, 2007), impulsivity, mobile phone problem use, and use of the mobile phone to modulate affect were all significantly and positively associated with the experience of phantom ring. Phantom ring was also more common among participants who used their mobile phones more: those who had experienced phantom ring used about twice as many mobile phones minutes and sent about five times as many texts as those who had not experienced phantom ringing.

These studies are useful as preliminary investigations into the phantom vibration phenomenon, but the interpretation of the results is limited by the samples and the variables explored. In terms of sample limitations, neither study focused on young adults, who, in light of the prevalence of mobile phone use and text messaging in this population, might be more likely to experience phantom vibrations (Laramie, 2007). Moreover, the most recent study (Rothberg et al., 2010) involved medical professionals only, who would likely not be representative of the general public in terms of their personality characteristics or in the significance or salience of the messages they receive. In terms of variables explored, only the doctoral thesis (Laramie, 2007) examined personality characteristics related to the experience of phantom vibrations, but these characteristics were limited to mobile phone use (including problem use and affect modulation) and impulsivity. However, no models were explored in this study, so it is difficult to determine whether these variables made independent and direct contributions to the experience of phantom vibrations.

One promising direction for examining the personality characteristics that are related to the experience of phantom vibrations is to explore the relationships between phantom vibrations and individuals' Big-Five (Costa & McCrae, 1992) or Five-Factor Model (FFM) (Digman, 1990) personality characteristics. This approach has been used previously to examine the psychological characteristics that relate to text message dependency (TMD). Igarashi et al. (2008) developed a conceptual model of TMD that suggested that an individual's personality characteristics would relate to three aspects of text message dependency: excessive use, emotional reaction, and relationship maintenance. They focused on the Big-Five personality dimensions of extraversion and neuroticism, which are sometimes referred to as the "Big Two" or the E-lN model (Eysenck, 1991) because of the regularity and frequency with which they emerge and their importance in the prediction of positive and negative emotionality, respectively. In their sample of Japanese teenagers, Igarashi et al. (2008) found that extraversion and neuroticism were both significantly and positively related to the *emotional reaction* TMD subscale (i.e., the strength of the emotional response to received text messages). Additionally, extraverts were prone to excessive use of mobile phones, and neuroticism was associated with the relationship maintenance TMD subscale (i.e., the use of mobile phones to maintain social relationships).

Thus, in their final model, both extraversion and neuroticism were related to text message dependency, but the authors suggested that these associations arose for theoretically different reasons (Igarashi et al., 2008). For those high in extraversion, TMD likely emerges as a result of extraverts' desire to forge and maintain relationships (Igarashi et al., 2008). Because mobile phones, and text messaging specifically, are used to build and sustain social relationships (Lenhart, Ling, Campbell, & Purdell, 2010; Licoppe, 2004; Van Kleemput, 2010), and extraverts typically have more friendships to maintain (Eysenck & Eysenck, 1985; McCrae & John, 1992), extraverts would be more inclined to develop a dependence on text messaging. On the other hand, for those high in neuroticism, who have an exaggerated fear of rejection and sensitivity to others' reactions (Eysenck & Eysenck, 1991; McCrae & John, 1992), text message dependence may emerge because of their insecurities about the communication medium and their relationships. These TMD variables, in turn, served as mediators for psychological and behavioral symptoms of dependency. In their model of text message dependence, the 'symptoms' of dependency were (1) using text messages to escape personal problems and (2) worrying that life would be empty without text messages.

1.2. Proposed conceptual model of phantom vibrations

Within the framework of the present study, two variables could be classified as "symptoms" related to the experience of phantom vibrations: the *frequency* of experiencing phantom vibrations and how *bothersome* those vibrations are. We expected these variables to be directly related to one another (i.e., those who experienced more phantom vibrations would find them more bothersome). However, we also expected, in line with Igarashi et al. (2008), that text message dependency might mediate the relationship between personality factors (extraversion and neuroticism) and psychological or behavioral symptoms (in this case, frequency and bothersomeness of phantom vibrations).

We expected that phantom vibrations would be related to text message dependency (rather than other types of mobile phone dependency) because Americans use their mobile phones for text messaging much more frequently than they use them for voice calls (Smith, 2011). For example, young adults (the focus of the present study) send 109.5 messages per day (*Mdn* = 50 messages

per day), but they make only 17.1 voice calls per day (*Mdn* = 7 voice calls per day) (Smith, 2011). Thus, the alerts that individuals in the US receive on their phone are much more likely to be text message alerts than phone call alerts. Moreover, for those who are especially reliant on text messages to navigate their social relationships (i.e., those who are text message dependent), it is more likely that they would receive many messages, keep their phone in vibration mode to be alerted to those messages, and also develop heightened sensitivity to mobile phone vibrations because of repeated exposure. All of these factors could increase the likelihood of experiencing phantom vibrations.

Additionally, we expected that the same psychological characteristics that were associated with text messaging dependency in Japanese teenagers (i.e., extraversion and neuroticism) (Igarashi et al., 2008) would also be related to text message dependency in our young adult sample. This proposed association aligns nicely with recent research that showed that those high in extraversion or neuroticism are more likely to have addictive tendencies related to mobile phone, internet, or computer use (Bianchi & Phillips, 2005; Cao & Su, 2007; Mehroof & Griffiths, 2010; Wilson, Fornasier, & White, 2010).

With regard to specific aspects of text message dependency that might relate to the experience of phantom vibrations, we expected that the *emotional reaction* (ER) component of TMD, or the feelings of anxiety or disappointment when text messages are not received (Igarashi et al., 2008), might be a mediator between psychological variables and phantom vibration symptoms (frequency and bothersomeness of phantom vibrations). It is logical to assume that an individual's psychological characteristics (e.g., extraversion, neuroticism, or conscientiousness) may relate to their emotional reactions to social alerts (in this case, text messages). Igarashi et al. (2008) gives support to this notion, as both extraversion and neuroticism (the two psychological characteristics measured) were related to the emotional reaction aspect of TMD in their sample. Interestingly, Igarashi et al. (2008) suggested that these strong emotional reactions to text message may arise from two very different motivations: an intense desire to maintain social relationships in the case of extraversion, and fear of threat (Schneider, 2004) or insecurity in relationships in the case of neuroticism.

In terms of the mediating effects between the emotional reaction component of TMD and phantom vibration symptoms, we expect that high levels of anxiety about received messages (i.e., high levels of emotional reaction) may lead to a greater sensitivity to the actual vibrating sensations that signal a new message. This heightened sensitivity may, in the absence of actual vibrations, predispose a person to misinterpretation of sensory stimuli or imagined vibrations, resulting in the perception of mobile phone vibrations that are not really there. Therefore, we anticipated that those who have strong reactions to their messages (either because of their desire to maintain relationships or their fear of losing them), would report more *frequent* phantom vibrations. The emotional reaction component of TMD might also be related to how *bothersome* phantoms vibrations are to an individual. Because of the strong emotions those high in extraversion and neuroticism have invested in potential messages (i.e., they feel they need them to maintain social relationships), imagined vibrations that do not actually signal a message may be more bothersome to these individuals. Additionally, because neuroticism is associated with both negative emotionality and sensitivity to environmental stimuli (Costa & McCrae, 1992; Eysenck & Eysenck, 1985; Larsen & Ketelaar, 1989; Schneider, 2004), we also expected a direct positive relationship between neuroticism and the person's appraisal of how bothersome the phantom vibrations are.

As an addition to our conceptual model, we predicted that another Big-Five characteristic—conscientiousness—would be related to phantom vibration symptoms both directly, and indirectly through TMD. Those who are higher in conscientiousness are careful, organized, and self-disciplined. Recent studies have shown that they are also less prone to addictive tendencies, such as internet addictions (Kuss & Griffiths, 2011; Wilson et al., 2010). Therefore, we expected an inverse relationship between conscientiousness and text message dependence. We also expected a direct, inverse relationship between conscientiousness and frequency of phantom vibrations. Conscientious individuals are both self-disciplined and goal-directed (McCrae & Costa, 1987); therefore, when focused on a task (e.g., school or work), we expected that conscientious individuals would be so attuned to the task at hand that they may be less attentive than those who are low in conscientiousness to extraneous stimuli, such as real or imagined mobile phone vibrations. Our proposed model is summarized in Fig. 1.

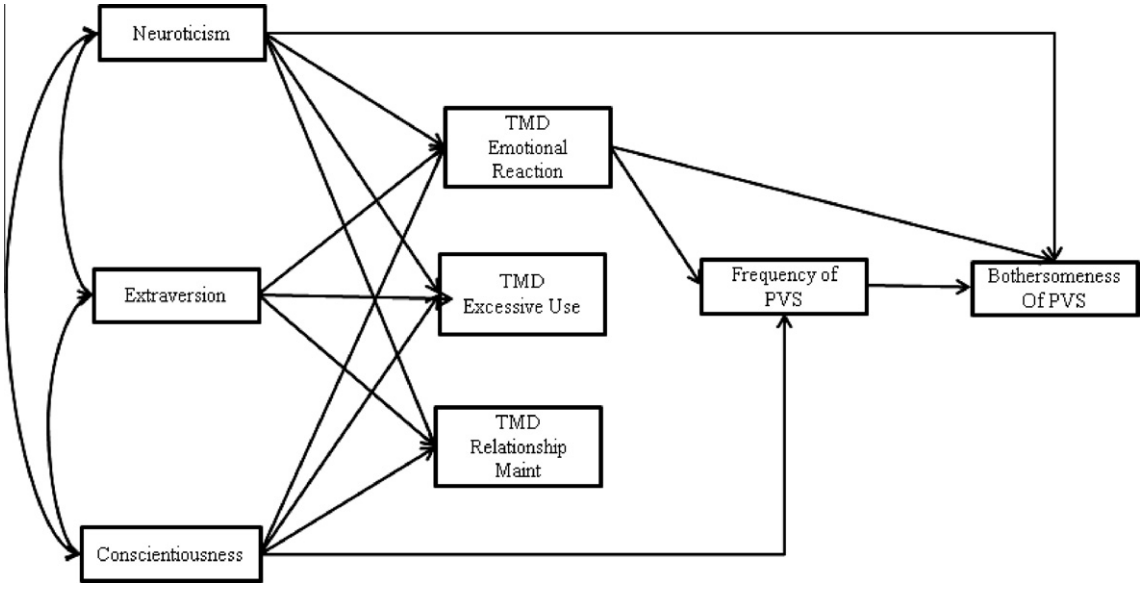

Fig. 1. The psychological process of phantom vibrations.

1.3. The present study

The aims of this study were twofold. First, we wanted to provide descriptive statistics about the experience of phantom vibrations among young adult undergraduates. Second, we wanted to determine whether the Big-Five personality characteristics of extraversion, neuroticism, and conscientiousness were related to the phantom vibration symptoms of *frequency* and *bothersomeness* either directly, or indirectly through text message dependency variables.

2. Method

2.1. Participants

Participants were 290 undergraduate students (68 men and 220 women) students from a mid-sized midwestern US university. Participants were recruited from introductory psychology classes (more than 30 + majors were represented in this sample) and received a research credit for participation. The average age of the participants was 21.2 years (SD = 5.5). With regard to ethnicity, 238 were White, 24 were African American or Biracial, 11 were Hispanic, eight were Asian, and eight indicated their ethnicity as "other." All participants indicated that they regularly carried a mobile phone.

2.2. Procedure

Participants were recruited for a "Cell Phone Usage Study" in Fall, 2011 via the subject pool for elementary psychology courses. All participants completed online consent forms and were then given access to an online anonymous survey.

2.3. Measures

The survey included demographic questions (e.g., age, sex, and race) and surveys related specifically to our hypotheses, as detailed below.

2.3.1. Phantom vibrations survey

Participants were asked about their experience of phantom vibrations. As measures of symptoms, those who indicated that they had experienced phantom vibrations were asked how frequently they experienced these vibrations on a scale from 1 = *never* to 6 = *more than daily* and how bothersome they found the vibrations from 1 = *not at all* to 4 = *very*. They were also asked about the device on which they felt these phantom vibrations, how long they had been carrying it before experiencing the vibrations, and whether they had tried or succeeded in stopping the vibrations.

2.3.2. Big-Five inventory

Participants completed the 44-item Big-Five Inventory (BFI) Benet Martinez & John, 1998 that measured their agreement with statements beginning with "I see myself as someone who is..." and ending with a variety of characteristics that typify different personality dimensions, such as "talkative" (extraversion), "does a thorough job" (conscientiousness), and "worries a lot" (neuroticism). Participants rated their agreement with statements on a scale from 1 = *disagree strongly* to 5 = *agree strongly*. The subscales showed good internal consistency (Cronbach's alpha): Extraversion $\alpha = .89$; Neuroticism $\alpha = .81$; and Conscientiousness $\alpha = .74$.

2.3.3. Text-message dependency

The short-version of self-perception of text-message dependency scale (Igarashi et al., 2008) was used to examine participants' views of three dimensions of their own TMD. The emotional reaction subscale measures sensitive reactions to text messages (e.g., "I feel disappointed if I don't get a reply to my message immediately"). The excessive use subscale measures compulsive behavior associated with text messaging (e.g., "I use text-messages even while I am talking with friends"). The relationship maintenance subscale measures dependence on text messaging for maintaining social relationships (e.g., "I think my relationships would fall apart without text messages"). Participants rated their agreement with statements on a 1 = *strongly disagree* to 5 = *strongly agree* scale. The subscales showed high internal consistency (Cronbach's alpha): Emotional Reaction $\alpha = .84$; Excessive Use $\alpha = .82$; and Relationship Maintenance $\alpha = .79$.

3. Results

To examine the prevalence of phantom vibrations and the characteristics related to the experience of phantom vibrations in this young adult undergraduate sample, we first conducted simple descriptive and correlational analyses. Then, to evaluate our proposed conceptual model for phantom vibration symptoms, we performed a structural equation modeling analysis on the three personality subscales (Benet Martinez & John, 1998), the three text message dependency subscales (Igarashi et al., 2008), and our likert-scale measures of the phantom vibration behavioral/psychological symptoms (frequency of phantom vibrations and bothersomeness of phantom vibrations).

3.1. Descriptive statistics

Table 1 displays the frequency distributions for the phantom vibration variables. Approximately 89% of the sample had experienced phantom vibrations, and 40% experienced these vibrations at least once a week. Most had experienced the phantom vibrations between one and five months after getting their mobile phone. Most (91%) considered these phantom vibrations to be "only a little" or "not at all" bothersome; accordingly, few made attempts to stop these vibrations.

Table 2 displays the descriptive statistics as well as the correlations and intercorrelations between the personality variables, TMD

Table 1
Frequency distributions for phantom vibration experience variables.

Frequency of phantom vibrations[a]	
Never	31 (11%)
Once a month	95 (33%)
Once every 2 weeks	49 (17%)
Once a week	77 (27%)
Daily	33 (11%)
More than daily	5 (2%)
Bothersomeness of vibrations	
Not at all	113 (41%)
A little	140 (50%)
Bothersome	20 (7%)
Very	5 (2%)
How long had cell phone before PV	
Less than 1 month	44 (17%)
1–5 months	90 (34%)
6–12 months	70 (27%)
More than 12 months	60 (23%)
Made attempt to stop vibrations	
Yes	39 (14%)
No	244 (86%)
Successful at stopping vibrations	
Yes	16 (42%)
No	22 (58%)

[a] All phantom vibrations pertain to cell phones; no participants indicated that they used pagers. PV = phantom vibrations.

variables, and the symptoms of phantom vibrations (frequency and bothersomeness). As predicted, neuroticism was positively related to the bothersomeness of phantom vibrations, and conscientiousness was negatively related to both the frequency of phantom vibrations and how bothersome those vibrations were.

3.2. Path analysis

SEM analysis, using AMOS 19, was conducted to test the model displayed in Fig. 1. In this model, extroversion, neuroticism, and conscientiousness were the exogenous variables, which were allowed to covary. Meanwhile, TMD (emotional reaction, excessive use, and relationship maintenance) and phantom vibration symptoms (frequency and bothersomeness) were the endogenous variables. For simplicity, the endogenous variables' error terms were not included in Fig. 2, but were set in the model. Also, because of the relatively strong intercorrelations, we set correlations among error variables of the three TMD factors. The model fit the data well χ^2 (8, N = 290) = 8.74, p = .365; NFI = .98; TLI = .990; RMSEA = .02 (90% CI = .00, .07). All parameter estimates are shown in Fig. 2. Additionally critical ratios of differences (CRDs) between parameters were calculated by AMOS to compare the differences between standardized path coefficients (β). All participants were included in this analysis, so that the first part of the model would accurately represent the entire cohort and not just those who had experienced phantom vibrations.

With regard to the relationships between the TMD and personality factors, both neuroticism and extraversion had significant *positive* effects on emotional reaction, but the effect of neuroticism was larger than the effect of extraversion, β = .32 vs. β = .13; CRD = −3.08, p < .01. Additionally, conscientiousness had a significant *negative* effect on emotional reaction, β = −.14, p < .05. In terms of excessive use, both neuroticism (β = .28, p < .01) and extraversion (β = .27, p < .01) had significant *positive* effects that did not differ in magnitude (CRD < 1); however, there was not a significant effect of conscientiousness on perceptions of excessive use. Finally, in terms of relationship maintenance, there was a significant *positive* effect of neuroticism (β = .23, p < .01) and a significant *negative* effect of conscientiousness (β = −.22, p < .01). The effect of extraversion on relationship maintenance was not significant.

With regard to the relationships between the phantom vibration symptoms (frequency and bothersomeness) and all other variables in the model, there were only three significant pathways. First, there was a significant negative effect of conscientiousness on the frequency of phantom vibrations, β = −.15, p < .05. The path analysis showed no other significant relationships with frequency. Second, emotional reaction had a significant positive effect on the bothersomeness of phantom vibrations, β = .15, p < .05. Interestingly, although both emotional reaction (r = .23, p < .01) and excessive use (r = .18, p < .01) had significant zero-order correlations with bothersomeness, emotional reaction was the only unique predictor of bothersomeness. Finally, as predicted, the bothersomeness of phantom vibrations was significantly related to the frequency of these vibrations, β = .24, p < .01.

In terms of psychological characteristics, neither conscientiousness (β = −.12, p < .05) nor neuroticism (β = .19, p < .01) had direct effects on bothersomeness, despite the fact that their zero-order correlations (r = −.12, p < .05 and r = .19, p < .01, respectively) were significant. This reduction in the significance of the direct effects of neuroticism and contentiousness in the full model indicates that these effects are mediated. The effect of neuroticism on bothersomeness is mediated by emotional reaction (Sobel Test, z = 2.11, p < .05); whereas the effect of conscientiousness on bothersomeness is mediated by both frequency of phantom vibrations (Sobel Test z = 2.25, p < .05) and emotional reaction (Sobel Test z = 2.52, p < .05).

4. Discussion

In the present study, we examined the prevalence of phantom vibration symptoms (frequency and bothersomeness) and the Big-Five psychological characteristics and text message dependence variables associated with these symptoms in a sample of young adult undergraduates. Overall, the results of this study extend upon the limited research on phantom vibrations and validate previous research on text message dependence.

In terms of prevalence of phantom vibrations, a much greater percentage of our participants had experienced phantom vibrations than what has been found in previous research (Laramie, 2007; Rothberg et al., 2010). In fact, nearly all of the young adult participants in our sample had experienced phantom vibrations. This disparity with past research may be due to sample differences (both age and subculture). In our study, we focused on young adults, who have been shown to be heavy users of mobile phone technologies (Lenhart, 2010; Smith, 2011). Moreover, these were undergraduates in the midwestern US, who may be different from older adults in the western part of the US and would very likely be different from doctors, nurses, and other types of medical personnel. The higher incidence of phantom vibrations in this sample might also be attributable to the dramatic increases in mobile phone use (both overall use and text messaging specifically) that have occurred over the past few years in the US (Lenhart, 2010; Reardon, 2009; Smith, 2011). As previous research has shown, those who use their phones more often are more likely to experience these phantom vibrations (Laramie, 2007).

Despite these differences in prevalence statistics, one important point of convergence between our findings and previous research

Table 2
Descriptive statistics for and correlations among personality, TMD, and phantom vibration symptom variables.

Variables	1	2	3	4	5	6	7	8
1. Extraversion	–							
2. Conscientiousness	.17**	–						
3. Neuroticism	−.26**	−.27**	–					
4. TMD Emotional Reaction	.02	−.21**	.33**	–				
5. TMD Excessive Use	.18**	−.10	.23**	.53**	–			
6. TMD Relationship Maint.	−.12*	−.29**	.30**	.49**	.42**	–		
7. Frequency of PV	.04	−.16**	.06	.16**	.16**	.16**	–	
8. Bothersomeness of PV	−.06	−.12*	.19**	.23**	.18**	.09	.27**	–
M	3.34	3.67	2.97	3.04	3.57	2.17	3.20	1.70
SD	0.76	0.51	0.67	1.00	0.86	0.76	1.17	0.68

Note: For Big-Five and TMD variables (measures 1–6), participants answered on a scale of 1–5. For bothersomeness of PV (phantom vibrations), participants answered on a scale of 1–4 and for frequency of PV, participants answered on a scale of 1–6.

* p < .05.

*** p < .01.

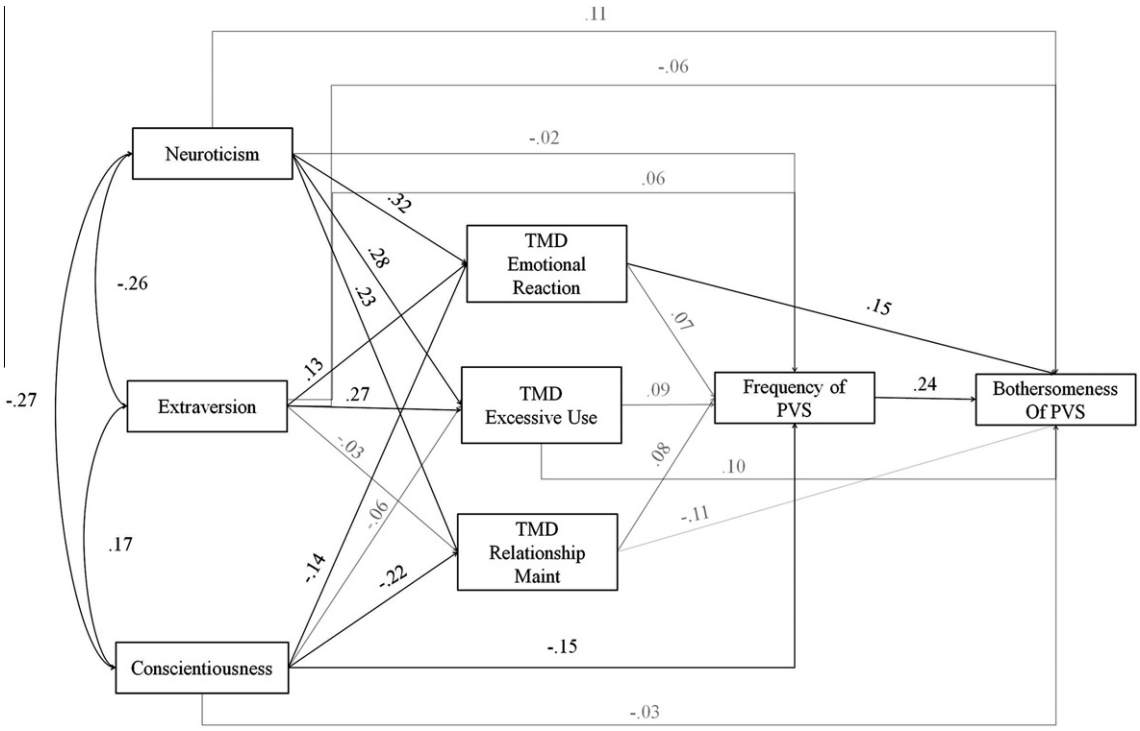

Fig. 2. Results of SEM analysis. Significant parameters ($p < .05$) are presented in boldface.

(Rothberg et al., 2010) is that few of the participants in this sample classified the phantom vibrations as bothersome. Only 9% of the young adults in our sample and 7% of the medical personnel in the Rothberg et al. (2010) found these phantom vibrations bothersome. This is an interesting finding, because it implies that phantom vibrations are neither physically nor psychologically bothersome to most who experience them. However, as Rothberg et al. (2010) suggest, phantom vibrations could be classified as tactile hallucinations, and typically hallucinations are associated with pathology. Because so few of the participants in this sample or the Rothberg et al. (2010) sample were bothered by the phantom vibrations, this suggests that these imagined vibrations are not viewed as pathological. Presumably, if individuals considered these imagined vibrations 'pathological tactile hallucinations,' they would feel bothered that they had them. Instead, it is likely that individuals consider these phantom vibrations a normal part of the human–mobile phone interactive experience. In order to explore this issue further, future studies should aim to delineate bothersomeness into its psychological and physical dimensions and also examine individuals' perspectives on what behaviors and/or perceptions should be classified as 'normal' and 'abnormal' with regard to human–mobile phone interactivity.

Interestingly, although the bothersomeness statistics for the present study and Rothberg et al. (2010) study were very similar, significantly fewer young adults than medical personnel made attempts to stop the phantom vibrations (14% vs. 61%). In our sample, the percentage of those who found the vibrations bothersome (9%) and those who made attempts to stop them (14%) are relatively equal, which is expected, as bothersomeness of vibrations and making attempts to stop them are sensibly related. However, the finding that fewer college students than medical personnel made attempts to stop the vibrations might be attributable to other factors. For example, the age or psychological characteristics of the participants, or the growing prevalence of mobile phone problematic behaviors, might have contributed to desensitization to phantom vibrations in the present sample. It also might be that medical personnel are more attuned to or informed about misinterpretations of sensory stimuli and tactile hallucinations. Therefore, although they do not find them particularly bothersome, they may still consider phantom vibrations a deviation from 'normal' perceptual experience and therefore want to stop them. Again, this is a direction for future study.

In terms of the psychological characteristics that underlie the experience of phantom vibrations, our hypothesis—that psychological characteristics would be both directly and indirectly (through TMD variables) related to the experience of phantom vibrations—was supported. Correlational analyses supported nearly all of our predictions; however, SEM revealed that only conscientiousness was a direct predictor of phantom vibration symptoms, and it predicted only frequency of vibrations. In line with our hypotheses, those who are higher in conscientiousness reported fewer vibrations, possibly because they are more attentive to ongoing tasks and less likely to perceive real or imagined vibrations. Meanwhile, neuroticism was not a direct predictor of bothersomeness in the model; instead, the relationship between neuroticism and bothersomeness was mediated by the emotional reaction subscale of TMD. Therefore, aside from the frequency of phantom vibrations overall, the emotional reaction subscale of TMD (i.e., the strength of emotions that are associated with text messages) was the only predictor of bothersomeness of phantom vibrations. Emotional reaction was also the only subscale of TMD that was significantly related to each of the psychological characteristics (extraversion, neuroticism, and conscientiousness).

Considered together, these findings fit well within the existing literature. Conscientious young adults are less likely to be addicted to text messaging, just as they are less likely to be addicted to other forms of online activities (Kuss & Griffiths, 2011; Wilson et al., 2010). Consequently, they are less likely to experience the symptoms of this type of addiction, such as phantom vibrations. Meanwhile, young adults who have stronger emotional reactions to text messages (e.g., feeling disappointed when messages are not received) are more bothered by phantom vibrations, just as they are more likely to have negative psychological consequences of text message dependency (e.g., thinking life is empty without text

messages) (Igarashi et al., 2008). Thus, emotional reactivity in response to real or perceived social stimuli appears to be associated with the more negative aspects (e.g., addictive tendencies) of mobile phone use. It may be that this emotional reactivity is also related to other types perceptual "hallucinations," such as thinking that someone is calling out your name or, among those with anxiety sensitivity, perceiving innocuous sensory stimuli as potentially threatening. Thus, text message addiction and phantom vibrations may just be contemporary versions of social sensitivity or social anxiety. Future studies might explore this link more directly.

Although most people do not find phantom vibrations bothersome, a subset of the population, particularly those who find them extremely bothersome, might want to stop these vibrations (Rothberg et al., 2010). Our research suggests that interventions or treatments aimed at either TMD or phantom vibrations might begin by targeting individuals' emotional reactions to the text messages they receive. Tempering emotional reactions to text messages with, for example, relaxation techniques or cognitive behavioral therapy, may lessen individuals' sensitivity to actual messages and therefore lessen the likelihood of experiencing phantom vibrations.

4.1. Limitations and conclusion

The limitations of this study relate mostly to the sample and our reliance on retrospective self-report data. With regard to our sample, it is possible that our findings would not be generalizable to other young adults or even to undergraduates in different subcultures. However, our aim was not to define and understand every facet of the phantom vibration experience, but rather it was to begin to explore the prevalence of phantom vibrations and the variables that relate to the experience of phantom vibrations in a population where heavy mobile phone use is commonplace. Moreover, with regard to our use of retrospective self-report data, at present the technology does not exist to measure individuals' perceptions of phantom vibrations in 'real time.' That said, social and behavioral tracking software is being developed that may help measure mobile phone behaviors more directly, and specific programs aimed at phantom vibrations may exist in the future. These technologies may provide further validation to all types of mobile phone and computer research. Additionally, sophisticated medical technology, like brain imaging, might be able to help us better understand the sensation and perceptual processes that contribute to the experience of phantom vibrations; however, considering how few people find these vibrations bothersome, a venture such as this is unlikely to occur.

In conclusion, the experience of phantom vibrations appears to be common among young adult undergraduates. Those who are conscientious are less likely to experience phantom vibrations, and those who have strong emotional reactions to their text messages are more likely to be bothered by them. However, considering how few of the young adults in this sample were bothered by these phantom vibrations and how few make attempts to stop them, treatments aimed at lessening the frequency or bothersomeness of phantom vibrations may not be worthwhile, except for a small subset of the population.

Acknowledgements

We would like to thank Stephanie Lochbihler and Jenna Sturges, volunteer research assistants whose efforts were integral to the completion of this study.

References

Benet Martinez, V., & John, O. P. (1998). Los Cinco Grandes across cultures and ethnic groups: Multitrait multimethod analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729–750.

Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *CyberPsychology & Behavior, 8*, 39–51.

Cao, F., & Su, L. (2007). Internet addiction among Chinese adolescents: Prevalence and psychological features. *Child: Care, Health, & Development, 33*, 275–281. http://dx.doi.org/10.1111/j.1365-2214.2006.00715.x.

Costa, P. T., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences, 13*, 653–665.

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology, 41*, 417–440.

Eysenck, H. J. (1991). Dimensions of personality: 16: 5 or 3? criteria for a taxonomic paradigm. *Personality and Individual Differences, 12*, 773–790.

Eysenck, H. J., & Eysenck, S. B. G. (1985). *Personality and individual differences: A natural science approach*. New York: Plenum.

Eysenck, H. J., & Eysenck, S. B. G. (1991). *Manual of the Eysenck personality scales (EPS Adult)*. London: Hodder & Stoughton.

Haupt, A. (2007, June 12). Good vibrations? Bad? None at all? USA Today. <http://www.usatoday.com/news/health/2007-06-12-cellphones_N.htm>.

Igarashi, T., Motoyoshi, T., Takai, J., & Yoshida, T. (2008). No mobile, no life: Self-perception and text-message dependency among Japanese high school students. *Computers in Human Behavior, 24*, 2311–2324. http://dx.doi.org/10.1016/j.chb.2007.12.001.

Kuss, D. J., & Griffiths, M. D. (2011). Online social networking and addiction – A review of the psychological literature. *International Journal of Environmental Research and Public Health, 8*, 3528–3552.

Laramie, D. (2007). Emotional and behavioral aspects of mobile phone use [PhD thesis]. Alliant International University.

Larsen, R. J., & Ketelaar, T. (1989). Extraversion, neuroticism, and susceptibility to positive and negative mood induction procedures. *Personality & Individual Differences, 10*, 1221–1228.

Lenhart, A., Ling, R., Campbell, S. & Purdell, K. (2010). Teens and mobile phones. Pew internet & American life project <http://pewinternet.org/Reports/2010/Teens-and-Mobile-Phones.aspx> 20.04.10.

Licoppe, C. (2004). 'Connected' presence: The emergence of a new repertoire for managing social relationships in a changing communication technoscape. *Environment and Planning D: Society and Space, 22*, 135–156. http://dx.doi.org/10.1068/d3231.

Lindstrom, M. (2011, September 30). You love your iPhone. Literally. New York Times. <http://www.nytimes.com/2011/10/01/opinion/you-love-your-iphone-literally.html?_r=1>.

Lu, X., Watanabe, J., Liu, Q., Uji, M., Shono, M., & Kitamura, T. (2011). Internet and mobile phone text-messaging dependency: Factor structure and correlation with dysphoric mood among Japanese adults. *Computers in Human Behavior, 27*, 1702–1709. http://dx.doi.org/10.1016/j.chb.2011.02.009.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52*, 81–90.

McCrae, R. R., & John, O. (1992). An introduction to the five-factor model and its applications. *Journal of Personality, 60*, 174–214.

Mehroof, M., & Griffiths, M. D. (2010). Online gaming addiction: The role of sensation seeking, self-control, neuroticism, aggression, state anxiety, and trait anxiety. *CyberPsychology, Behavior, & Social Networking, 13*, 313–316. 10.1089=cyber.2009.0229.

Reardon, M. (2009, April 2). Text messaging explodes in America. CBS News. <http://www.cbsnews.com/2100-503063_162-4471183.html>.

Rothberg, M. B., Arora, A., Hermann, J., Kleppel, R., St Marie, P., & Visintainer, P. (2010). Phantom vibration syndrome among medical staff: A cross sectional survey. *BMJ, 341*, c6914. http://dx.doi.org/10.1136/bmj.c6914.

Schneider, T. R. (2004). The role of neuroticism on psychological and physiological stress responses. *Journal of Experimental Social Psychology, 40*, 795–804. http://dx.doi.org/10.1016/j.jesp. 2004.04.005.

Smith, A. (2011, September 19). Americans and text messaging. Pew internet & American life project. <http://pewinternet.org/~/media//Files/Reports/2011/Americans%20and%20Text%20Messaging.pdf>.

Van Kleemput, K. (2010). I'll see you on IM, text, or call you': A social network approach of adolescents' use of communication media. *Bulletin of Science, Technology & Society, 30*, 75–85. http://dx.doi.org/10.1177/0270467610363143.

Williams, C. (2007, October 17). 'Phantom' Cell Phone Sensations: Mind Over Matter. ABC News. <http://abcnews.go.com/Health/story?id=3740984&page=1#.Tzq_DVFAIUo>.

Wilson, K., Fornasier, S., & White, K. M. (2010). Psychological predictors of young adults' use of social networking sites. *Cyberpsychology, Behavior, & Social Networking, 13*, 173–177. 10.1089=cyber.2009.0094.