Computers in Human Behavior 49 (2015) 130–137

Contents lists available at ScienceDirect

Computers in Human Behavior

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

Exploring the dimensions of nomophobia: Development and validation of a self-reported questionnaire

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ARTICLE INFO

Article history:
Available online 14 March 2015

Keywords:
Nomophobia
Dimensions of nomophobia
Nomophobia questionnaire
NMP-Q
Situational phobia

ABSTRACT

Nomophobia is considered a modern age phobia introduced to our lives as a byproduct of the interaction between people and mobile information and communication technologies, especially smartphones. This study sought to contribute to the nomophobia research literature by identifying and describing the dimensions of nomophobia and developing a questionnaire to measure nomophobia. Consequently, this study adopted a two-phase, exploratory sequential mixed methods design. The first phase was a qualitative exploration of nomophobia through semi-structured interviews conducted with nine undergraduate students at a large Midwestern university in the U.S. As a result of the first phase, four dimensions of nomophobia were identified: not being able to communicate, losing connectedness, not being able to access information and giving up convenience. The qualitative findings from this initial exploration were then developed into a 20-item nomophobia questionnaire (NMP-Q). In the second phase, the NMP-Q was validated with a sample of 301 undergraduate students. Exploratory factor analysis revealed a four-factor structure for the NMP-Q, corresponding to the dimensions of nomophobia. The NMP-Q was shown to produce valid and reliable scores; and thus, can be used to assess the severity of nomophobia.

1. Introduction

Information and communication technologies (ICT) have become an indispensable part of our lives (Lee, Tam, & Chie, 2013; Salehan & Negahban, 2013). With the proliferation of inexpensive mobile devices, we are now living in a mobile age in which mobile ICTs are vigorously and quickly adopted (Oulasvirta, Rattenbury, Ma, & Raita, 2012). In this mobile age, smartphones are considered the latest evolution of mobile ICTs (Oulasvirta et al., 2012).

The advances in mobile ICTs have paved the way for the worldwide adoption of mobile phones. Mobile phones have become so pervasive that the number of mobile-cellular subscriptions is expected to reach almost 7 billion by the end of 2014, approaching the world population with a penetration rate of 96% (International Telecommunications Union, 2014).

According to Pew Research Center's Mobile Technology Fact Sheet (2014), as of January 2014, 90% of the American adult population have some kind of a cell phone and 58% of American adults own a smartphone. Among adults who own a smartphone, 83% are aged 18–29, 74% are aged 30–49, 49% are aged 50–64, and 19% are aged 65 or older. Thus, smartphones are particularly popular among young adults. In fact, college students are regarded as the early adopters of smartphones (Lee, 2014).

The popularity of smartphones among college students is ascribable to the affordances they provide. Smartphones make it possible to perform a variety of daily tasks in one device, including, but not limited to, calling and texting people, checking and sending email messages, scheduling appointments, surfing the Internet, shopping, social networking, searching for information on the Internet, gaming, entertainment, etc. (Park, Kim, Shon, & Shim, 2013). Because smartphones are ubiquitous and provide numerous capabilities, Kang and Jung (2014) propose that smartphones go beyond serving communication, information and entertainment purposes. They state that smartphones enable people to "fulfill needs such as learning, individual capability, safety, and human relationships" (Kang & Jung, 2014, p. 377), which is attributed to the mobility of smartphones.

While the mobility of smartphones provides apparent benefits and enable individuals to satisfy their basic needs (Kang & Jung, 2014), it may also induce some problems associated with smartphone use. Previous studies have shown that smartphones may cause compulsive checking habits (Oulasvirta et al., 2012), that smartphones may lead to compulsive usage and increased distress

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http://dx.doi.org/10.1016/j.chb.2015.02.059
0747-5632/

(Lee, Chang, Lin, & Cheng, 2014; Matusik & Mickel, 2011), and that smartphones can be addictive (Chiu, 2014; Lee et al., 2014; Salehan & Negahban, 2013).

Another problem exacerbated by smartphones is nomophobia. Nomophobia, or no mobile phone phobia, is "the fear of being out of mobile phone contact" (SecurEnvoy, 2012, para. 1). The term, nomophobia, is an abbreviation for no-mobile-phone phobia, and it was first coined during a study conducted in 2008 by the UK Post Office to investigate anxieties mobile phone users suffer (SecurEnvoy, 2012). The 2008 study in the UK, conducted with over 2100 people, demonstrated that some 53% of mobile phone users suffered from nomophobia (Mail Online, 2008). The study also revealed that men were more prone to nomophobia than were women, with 58% of male participants and 48% of female participants indicating feelings of anxiety when unable to use their phone.

Another study conducted in the UK (SecurEnvoy, 2012) surveyed 1000 employees and showed that the number of people suffering from nomophobia increased from 53% to 66%. Unlike the 2008 study, the 2012 study found out that women were more susceptible to nomophobia, with 70% of the women compared to 61% of the men expressing feelings of anxiety about losing their phone or not being able to use their phone (SecurEnvoy, 2012). In terms of the relationship between age and nomophobia, the study found that young adults, aged 18–24 were most prone to nomophobia with 77% of them identified as nomophobic, followed by users aged 25–34 at 68%. Moreover, mobile phone users in the 55 and over group were found to be the third most nomophobic users.

In one of the very first research studies into nomophobia (King, Valença, & Nardi, 2010), nomophobia is considered a 21st century disorder resulting from new technologies. In this definition, nomophobia "denotes discomfort or anxiety when out of mobile phone (MP) or computer contact. It is the fear of becoming technologically incommunicable, distant from the MP or not connected to the Web" (King et al., 2010, p. 52). Thus, this definition seems to encompass not only mobile phones but computers, as well. In another study (King et al., 2013), nomophobia is defined as "a disorder of the modern world [that] has only recently been used to describe the discomfort or anxiety caused by the non-availability of an MP, PC or any other virtual communication device in individuals who use them habitually" (p. 141). Although their definition includes the unavailability of computers, they argue that computers are replaced by mobile phones, which presumably have smartphone capabilities, and tablets. Therefore, they state that their research focus is less on computers and more on virtual communication environments, including mobile phones (King et al., 2013, p. 142). Their definition implies a dependency on virtual environments for communication. In a recent study (King et al., 2014), nomophobia is defined as follows:

Nomophobia is the modern fear of being unable to communicate through a mobile phone (MP) or the Internet. ... Nomophobia is a term that refers to a collection of behaviors or symptoms related to MP use. Nomophobia is a situational phobia related to agoraphobia and includes the fear of becoming ill and not receiving immediate assistance (p. 28).

In this definition, King et al. (2014) seem to emphasize the inability to communicate through a mobile phone. Another point that is worth mentioning is the description of nomophobia as a situational phobia related to agoraphobia. While the previous definitions appear to embrace the feelings of anxiety resulting from the unavailability of such devices as computers or virtual communication devices, this recent definition is more related to mobile phones and denotes nomophobia as a situational phobia.

The present study discusses nomophobia in relation to smartphones. As King et al. (2010) propose, nomophobia is considered a modern age phobia and a byproduct of the interaction between individuals and new technologies. Over the last five years, smartphones have taken over the mobile phone market and have almost replaced the phrase "mobile/cell phone" With their numerous capabilities, smartphones facilitate instant communication, help people stay connected anywhere anytime, and provide people with constant access to information. Thus, people have become dependent on their mobile phones more than ever (Park et al., 2013), which, in turn, supposedly exacerbates the feelings of anxiety caused by being out of mobile phone contact. That connection is why nomophobia should be considered in relation to smartphones, which have the standard capabilities of a cell phone, (e.g., phone calls, texting, etc.) and have more advanced capabilities like internet access, applications, or sensors (Park et al., 2013).

Although there has been an increasing academic interest in investigating the problems emanating from smartphone use, research into nomophobia has been scarce (King et al., 2013, 2014). Thus, the purpose of this two-phase, exploratory mixed methods study was to explore the dimensions of nomophobia with the intent of using these findings to develop and validate a self-reported questionnaire to measure nomophobia among U.S. college students. To our best knowledge, this study is the first to devise a self-reported measure to assess the severity of nomophobia among college students.

2. Methods

This study adopted a mixed methods research design because it encompassed the collection, analysis and combination of both qualitative and quantitative data (Creswell & Plano Clark, 2011). Of all the various mixed methods research designs, this study utilized the two-phase, exploratory sequential design. The basic premise of this design is that the findings of the first, qualitative phase inform the development of the second, quantitative phase (Creswell & Plano Clark, 2011). This design is especially useful when developing and testing an instrument that helps explore a phenomenon about which little is known or there is no instrument available (Creswell & Plano Clark, 2011).

In this study, the first phase began with the qualitative exploration of nomophobia through focused interviews. Then the findings from this qualitative phase guided the development of the items to be used in the Nomophobia Questionnaire, hereinafter referred to as the NMP-Q. The NMP-Q was psychometrically validated in the second, quantitative phase. All the steps taken in each phase are explained in detail in the next sections.

2.1. Phase I: Qualitative exploration

The first, qualitative phase of the study was aimed at exploring the dimensions of nomophobia as described by college students. To this end, a phenomenological approach to qualitative exploration was undertaken. Phenomenology, as a qualitative inquiry approach, involves the exploration of a phenomenon through individuals' narrative descriptions of their own lived experience pertaining to that specific phenomenon (Moustakas, 1994; Sokolowski, 2000). Hence, semi-structured interviews were conducted with a sample from the population to gain a thorough understanding of the dimensions of nomophobia based on the lived experiences of the interviewees.

2.1.1. Participants

Participants for the interviews were purposively selected with the aim of identifying the students who had heavily depended on their smartphone. For this purpose, using snowballing strategies, a screening questionnaire was distributed through email messages. The screening questionnaire included questions about smartphone ownership, duration of ownership, and smartphone use. Moreover,

the questionnaire adapted eight items from a previously validated questionnaire, Test of Mobile Phone Dependence (TMD), developed by Chóliz (2012). This questionnaire was used to identify the respondents who heavily depended on their smartphones by calculating a dependence score for all respondents using their responses to the TMD items. The selection of the respondents was based upon the following criteria: (a) the respondent owned a smartphone for a year or more; (b) the respondent had a mobile data plan providing access to the Internet via the smartphone; (c) the respondent spent more than an hour using his or her smartphone and (d) the respondent had a dependence score, calculated using the responses to the TMD items, greater than the mean of the scores of all respondents. Respondents who met these criteria were contacted through email and were invited for an interview. As a result, nine undergraduate students (four males, five females), aged 19–24, were recruited as participants for the interviews.

2.1.2. Procedures

Semi-structured interviews were conducted with the participants. All the interviews took place in a university office on campus. When the interviewees arrived at the designated location, they were introduced to the study and then asked to read and sign the Informed Consent Form if they agreed to be interviewed and audio-recorded. After the interviews' permission was granted, all the interviews were audio-recorded and the interviewees were assured that their identity would be kept confidential and that no associations between their identity and audio recording would be made.

During the interviews, an interview guide was followed to make sure that all the interviewees were given the same information about the study and were asked the same questions. The interview guide consisted of questions varying from general questions about college students' smartphone use habits (e.g., *for what purposes do you usually use your smartphone?*) to their feelings when out of reach of their smartphones (e.g., *how would you feel if you left your smartphone at home and had to spend your day without it?*, and *would you feel anxious if you could not use your smartphone for some reason when you wanted to do so?*).

2.1.3. Data analysis

All the interview recordings were transcribed verbatim. These transcriptions were analyzed following the phenomenological data analysis steps as described by Moustakas (1994). Having thoroughly and repeatedly read all the transcriptions, significant statements about the interviewees' experience, or horizons, were extracted from each interviewee's transcription. Through thematic clustering, these horizons were grouped into meaning units (Creswell, 2012). Consequently, the textural description of the interviewees' experience was produced. Next, a structural description of the interviewees' experience was written and it was used as a basis to construct the essence of the phenomenon of nomophobia through the interviewees' narrative descriptions of their experience (Miles & Huberman, 1994). As a result of the phenomenological analysis of the qualitative data gathered in this phase, four dimensions of nomophobia were identified, which are elaborated in the Findings and Results section.

2.2. Interim phase: Questionnaire development

The interim phase of the study was devoted to the development of the NMP-Q. Specifically, this phase of the study was aimed at building on the findings from the first, qualitative stage to design and develop the NMP-Q. Hence, it was the interim phase in which the first, qualitative phase was connected to the second, quantitative phase.

The questionnaire was devised following the scale development guidelines proposed by DeVellis (2003). The findings of the first, qualitative phase of the study were invaluable in that they provided an in-depth description of the dimensions of nomophobia in the words of the interviewees. Within each dimension, there were several recurrent components mentioned by the interviewees. Taking into consideration the importance of each component, for each dimension, several items were carefully constructed using the statements of the interviewees from the transcriptions. This resulted in a list of 23 items, covering the four dimensions of nomophobia. Three items were paraphrased versions of other items.

A 7-point Likert scale, with 1 being "Strongly Disagree" and 7 "Strongly Agree", was chosen as the rating scale for the questionnaire because the items were presented as declarative statements and the intent was to have respondents indicate the degree of their agreement or disagreement with each statement.

The questionnaire was reviewed by two experts for content validity. These experts evaluated the items for their clarity, importance, and relevance. The results of the expert review indicated that all 23 items were relevant to nomophobia and important for the questionnaire. Based on the experts' comments and feedback, three paraphrased items were removed from the questionnaire because the experts indicated that they were overlapping with the original items. Also, some minor changes were made in word choices and sentence structure to improve the clarity of the items.

After the expert review, the questionnaire was reviewed by an English language editor to make sure that there were no structural errors in the items and the wording of the items was appropriate. Based on the editor's feedback, some wording changes were made to improve the consistency among and clarity of the items. For instance, the language expert recommended the use of "email messages" instead of "emails."

Finally, representatives of the population (two undergraduate students who were naïve to the study) piloted the 20-item questionnaire to ensure that all the items were comprehensible. The two students indicated that the items were meaningful to them, and that they had no difficulty in reading and understanding the items. As a result of this step, a penultimate questionnaire with 20 items was created.

DeVellis (2003) recommends that other relevant measures be administered to check for construct validity. For this purpose, the 8-item Mobile Phone Involvement Questionnaire (MPIQ) developed by Walsh, White, and Young (2010) was administered together with the NMP-Q. The MPIQ was just used for purposes of analysis and is not part of the NMP-Q.

2.2.1. Pilot study

Before the main study, a pilot study of the penultimate NMP-Q was conducted with a convenience sample of 86 undergraduate students from the population, who were not included in the sample for the main study. The sample consisted of 11 male students (12.8%) and 75 female students (87.2%) aged 18–24 with a mean age of 19. The NMP-Q was administered in a large undergraduate class. Rather than identifying the factor structure of the questionnaire, the purpose of the pilot study was to see whether the NMP-Q produced reliable scores because the sample size was relatively small to perform exploratory factor analysis; and thus, to make informed decisions about the factor structure of the questionnaire.

The pilot study demonstrated that the NMP-Q held good internal consistency, with a Cronbach's alpha value of .918. Therefore, it was concluded that the questionnaire was appropriate for use in the main study; and thus, the second phase of the study was initiated.

2.3. Phase II: Quantitative validation

The purpose of the second, quantitative phase of the study was to psychometrically validate the penultimate NMP-Q with a large sample and investigate the extent to which the NMP-Q generated valid and reliable scores. For this purpose, the NMP-Q was administered to a sample representative of the undergraduate students at a large Midwestern university in the U.S.

2.3.1. Sample

To improve the representativeness of the results, a stratified sample was selected for the main study. In particular, proportionate stratification was used and college was chosen as the strata. Since the university where this study was conducted had six colleges offering different undergraduate programs, the population was divided into six strata. The proportionate stratification was calculated on the basis of the enrollment statistics of the university for the last 4 years (2010–2014). This ascertained that the number of students selected for the sample from each stratum (i.e., college) was proportionate to the number of students in each college at the university level or in the population.

A sample size of 300 students was chosen for statistical analysis purposes because it is commonly accepted as a sufficiently large sample to perform exploratory factor analysis (Comrey & Lee, 1992; DeVellis, 2003; Tabachnick & Fidell, 2013). Hence, the sample in the main study consisted of 301 undergraduate students, 135 males and 166 females, with a mean age of 20. 15.3% of the students ($n = 46$) were from the College of Agriculture and Life Sciences, 13.6% ($n = 41$) were from the College of Business, 7% ($n = 21$) were from the College of Design, 24.6% ($n = 74$) were from the College of Engineering, 15% ($n = 45$) were from the College of Human Sciences, and 24.6% ($n = 74$) were from the College of Liberal Arts and Sciences. Of 301 undergraduate students, 14.6% ($n = 44$) reported checking their smartphone every five minutes, 25.2% ($n = 76$) every ten minutes, 23.9% ($n = 72$) every twenty minutes, 18.9% ($n = 57$) every thirty minutes, 12.0% ($n = 36$) every hour time and 5% ($n = 15$) every two hours or more.

2.3.2. Data collection

Students were invited to participate in the study on a voluntary basis through a brief in-class announcement, explaining the purpose of the study and procedures for data collection. Having been introduced to the study, the students were asked to complete the NMP-Q provided that they voluntarily agreed to take part in the study.

2.3.3. Instruments

The Nomophobia Questionnaire and Mobile Phone Involvement Questionnaire (Walsh et al., 2010) were employed in the present study.

Nomophobia Questionnaire (NMP-Q): The questionnaire was composed of three main sections: demographics, smartphone use, and nomophobia questionnaire. The Demographics section was specifically designed for undergraduate students and included age, sex, year of study, major, and college. The Smartphone Use section was constructed based on the findings from the interviews. It included duration of smartphone ownership, data plan ownership, average time spent daily using the smartphone, frequency of checking, number of phone calls made/received per day, number of text messages sent/received per day, number of email messages sent/received per day, number of applications on the smartphone, purposes for which the smartphone is used, and contexts in which the smartphone is used. The nomophobia questionnaire section included the 20 items developed as a result of the first, qualitative phase, as seen in Table 1. All 20 items in NMP-Q are rated using a 7-point Likert scale, with 1 being "Strongly Disagree" and 7 being "Strongly Agree" only at the extremes. Total scores are calculated by summing up responses to each item, resulting in a nomophobia score ranging from 20 to 140, with higher scores corresponding to greater nomophobia severity. NMP-Q scores are interpreted as follows: an NMP-Q score of 20 indicating the absence of nomophobia; an NMP-Q score greater than 20 and less than 60 corresponding to a mild level of nomophobia; an NMP-Q score greater than or equal to 60 and less than 100 corresponding to a moderate level of nomophobia; and an NMP-Q score greater than or equal to 100 corresponding to a severe nomophobia.

Mobile Phone Involvement Questionnaire (MPIQ): In addition to the NMP-Q, the 8-item MPIQ (Walsh et al., 2010) was administered. MPIQ was also rated using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). MPIQ was used to check for construct validity of the NMP-Q.

2.3.4. Data analysis

Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) 20. To explore the underlying factor structure of the NMP-Q, exploratory factor analysis (EFA) was performed on the dataset. A principal component analysis with varimax rotation was performed on the 20 items in the questionnaire. Varimax rotation, which is the most commonly used orthogonal technique, minimizes factor complexity with maximized variance of factor loadings (Tabachnick & Fidell, 2013). The reason for the use of an orthogonal rotation technique emanated from the need for orthogonal factors in other analyses (e.g., correlation test).

To determine how homogeneous the items in the NMP-Q were (DeVellis, 2003), internal consistency reliability was examined using Cronbach's alpha as the internal consistency reliability coefficient. In addition, the relationship between the NMP-Q and MPIQ was investigated using a parametric correlation coefficient (the Pearson product-moment correlation). The degree of the correlation between the scores provided evidence of similarity between the NMP-Q and MPIQ (DeVellis, 2003); and thus, served as a means of checking for construct validity of the NMP-Q.

3. Findings and results

3.1. Findings of phase I: Understanding the dimensions of nomophobia

Four themes emerged from the interviews as the dimensions of nomophobia. These dimensions are: (1) not being able to communicate, (2) losing connectedness, (3) not being able to access information and (4) giving up convenience.

The first theme that emerged as a dimension of nomophobia, *not being able to communicate*, refers to the feelings of losing instant communication with people and not being able to use the services that allow for instant communication. The items under this theme are related to the feelings of not being able to contact people and to be contacted. In this regard, one of the female participants with the pseudonym Tracy, a 22-year-old senior in Kinesiology, said that she would feel anxious if she was out of contact: "I just blew through my first 300 min a couple of days ago. I was like "Now how are people gonna call me?" Even that makes me have a feeling of anxiety."

Losing connectedness was the second dimension of nomophobia. The items grouped under this theme are related to the feelings of losing the ubiquitous connectivity smartphones provide, and being disconnected from one's online identity, especially on social media. Participants described how this connectivity is an indispensable part of their lives. Astrid, a 22-year-old senior in Microbiology, stated that one of the benefits of her smartphone was that it helped her stay connected: "I think it allows me to stay up-to-date with

Table 1
The 20 items in the NMP-Q.

1. I would feel uncomfortable without constant access to information through my smartphone
2. I would be annoyed if I could not look information up on my smartphone when I wanted to do so
3. Being unable to get the news (e.g., happenings, weather, etc.) on my smartphone would make me nervous
4. I would be annoyed if I could not use my smartphone and/or its capabilities when I wanted to do so
5. Running out of battery in my smartphone would scare me
6. If I were to run out of credits or hit my monthly data limit, I would panic
7. If I did not have a data signal or could not connect to Wi-Fi, then I would constantly check to see if I had a signal or could find a Wi-Fi network
8. If I could not use my smartphone, I would be afraid of getting stranded somewhere
9. If I could not check my smartphone for a while, I would feel a desire to check it
If I did not have my smartphone with me,
10. I would feel anxious because I could not instantly communicate with my family and/or friends
11. I would be worried because my family and/or friends could not reach me
12. I would feel nervous because I would not be able to receive text messages and calls
13. I would be anxious because I could not keep in touch with my family and/or friends
14. I would be nervous because I could not know if someone had tried to get a hold of me
15. I would feel anxious because my constant connection to my family and friends would be broken
16. I would be nervous because I would be disconnected from my online identity
17. I would be uncomfortable because I could not stay up-to-date with social media and online networks
18. I would feel awkward because I could not check my notifications for updates from my connections and online networks
19. I would feel anxious because I could not check my email messages
20. I would feel weird because I would not know what to do

my friends and all of that." She went on to explain how her smartphone facilitated her ability to stay connected to her friends. Moreover, participants described how important it was for them to make sure that they saw the notifications from their smartphones and their desire to check their smartphones for notifications. They appeared to view notifications as a way of ensuring connectedness: if they received notifications, it meant they stayed connected to their online identity and networks. Lily, a 20-year-old sophomore in Elementary Education, said she would feel the desire to check her smartphone immediately when receiving a notification: "If I hear it go off then I had that need of "what is it? what is the notification?" If I could, I would check." Additionally, participants described the feelings of discomfort when losing this connectedness. Tracy said: "my smartphone is very important because of that connectedness." She continued to explain how hard it was to go backward and live without a smartphone. In the same vein, Olivia, a 21-year-old junior in Agricultural Education, elucidated how she was used to having her smartphone with herself all the time. When asked how she would feel if she did not have her smartphone with her, Olivia said:

> "Because you are used to having it in your pocket or in your hand and it is like you are always touching your pockets, looking for it and like situations like on the bus or if I am sitting outside the classroom, waiting for the class to start, I don't know what to do with myself 'cause in that situation I'd be probably on my phone."

The third dimension was labeled *not being able to access information*. The items under this theme reflect the discomfort of losing pervasive access to information through smartphones, being unable to retrieve information through smartphones and search for information on smartphones. Participants' portrayal of how they used their smartphones to access information revealed the importance of having access to information through their smartphones in their lives. Since it is a very essential component of their smartphone use, young adults reported problems when they could not access information through their smartphones. When discussing how she used her smartphone to access information, Olivia mentioned how it enabled her to instantly access information and touched upon how she would feel if she did not have that instant access:

> "I like having information at my fingertips like if I don't know the answer of something, I wanna know it right away. So I'm gonna use my smartphone to look it up. [] And if I couldn't answer a question right away, without that access to the Internet I feel like that would make me uncomfortable."

The fourth theme identified as a result of the qualitative analysis was *giving up convenience*. The items grouped under this theme are related to the feelings of giving up the convenience smartphones provide and reflect the desire to utilize the convenience of having a smartphone. Participants touched upon how they made sure that they had their smartphone's battery charged at all times. John, a sophomore in Supply Chain Management, described his smartphone as "a peace of mind." John appeared to associate having a charged battery in his smartphone with being free of stress and anxiety. He explained his desire for having a charged battery in his smartphone as follows:

> "[] If it does go dead, that's the sort of thing when it is like "I need to charge my phone right now". Especially, if I'm not at home and it dies, it is just an uncertainty of like what if I forgot my keys? [] If it does die, you lose a peace of mind."

3.2. Results of phase II

3.2.1. Exploratory factor analysis

As an initial solution, PCA was performed on the 20 items in the questionnaire before rotating the factors to estimate the factorability of the correlation matrix and the likely number of factors.

Initially, the correlation matrix was examined for correlations among the items. Since there were numerous correlations among the items exceeding .30, it was concluded that the use of PCA was appropriate for the matrix (Tabachnick & Fidell, 2013). To further investigate the factorability of the matrix, Bartlett's test of sphericity was used to examine partial correlations in addition to bivariate correlations. Moreover, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was examined to assess the sampling adequacy during the analysis. Barlett's test of sphericity was significant (χ^2 (190) = 4266.807, $p < .01$), which rejected the null hypothesis that the correlations in the correlation matrix were zero and that the matrix was an identity matrix. As for the adequacy of sampling, the KMO index was .941, which is greater than the minimum acceptable value of .60 (Tabachnick & Fidell, 2013). Thus, the results of these tests indicated that the factor analysis was appropriate.

As a result of the initial solution, four factors explaining 69.6% of variance were extracted with initial eigenvalues larger than 1, as can be seen in Table 2. Eigenvalues can be used to determine the likely number of factors to be extracted. Factors with eigenvalues greater than 1 are considered important and therefore retained because they account for a significant amount of variance (Field, 2009; Tabachnick & Fidell, 2013). Moreover, the scree plot of the eigenvalues and factors supported that a four-factor structure was a reasonable estimate because the eigenvalues started descending below 1 after that point.

Having determined the estimated number of factors, a second run of PCA with varimax rotation was performed to enhance the interpretability of the factors. As can be seen from Table 2, after rotation Factor I – *not being able to communicate* – accounted for 22.9% of item variance, Factor II – *losing connectedness* – accounts for 18.5% of item variance, Factor III – *not being able to access information* – accounts for 14.3% of item variance, and Factor IV – *giving up convenience* – accounts for 13.9% of item variance. Considering the substantial proportion of variance accounted for by each factor, it was concluded that the factors were important for the questionnaire (Tabachnick & Fidell, 2013).

Loadings of all items on each factor are shown in Table 3. To facilitate interpretation of the table, items are ordered and grouped by factor loadings. A factor loading of .45 was used as a cutoff value. Table 4 provides a summary of the results of the exploratory factor analysis and reliability analysis of all items.

As can be seen in Table 3, the results of the second run of PCA showed that each item loaded on a single factor, and that the loadings on other factors were generally very low, except for Item 7 and Item 15. Item 7 had a loading value of .669 on Factor IV – giving up convenience – and of .421 on Factor II – losing connectedness. Similarly, Item 15 had a loading value of .646 on Factor I – not being able to communicate – and of .425 on Factor II – losing connectedness. Due to the fact that their loadings on the primary factors were more salient and thus explained more variance, and that with a cutoff value of .45, their loadings on the secondary factors would not be considered, these items were considered to load on their primary factors.

Table 4 lists the communality values for each item. With PCA, the initial communality for all items is 1, and the decision as to whether the variance is predictable by the underlying factor is made by examining the communalities after factor extraction. As seen in Table 4, the extract communality values are reasonably high for all items, suggesting that the items loading on each factor can be well predicted by the respective factors.

When Table 4 is closely examined, it can be seen that the majority of the items had excellent or very good loadings on a single factor and some had good loadings. This factor structure, which has several variables correlating with each factor and only one factor correlating highly with each variable, is referred to as "simple structure" (Thurstone, 1947). The presence of simple structure supports the adequacy of rotation (Tabachnick & Fidell, 2013).

Table 2
Eigenvalues and total variance explained by factors before and after rotation.

	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
Factor I	9.979	49.894	49.894	4.575	22.877	22.877
Factor II	1.653	8.264	58.158	3.695	18.477	41.354
Factor III	1.264	6.318	64.476	2.863	14.317	55.671
Factor IV	1.022	5.110	69.586	2.783	13.915	69.586

Table 3
Loadings of all items in each factor.

Items	Factor			
	I	II	III	IV
Item 11	**.861**	.148	.119	.200
Item 13	**.836**	.258	.262	.172
Item 12	**.782**	.228	.276	.238
Item 14	**.778**	.206	.162	.278
Item 10	**.753**	.197	.331	.234
Item 15	**.646**	.425	.228	.213
Item 16	.242	**.838**	.110	.206
Item 17	.235	**.835**	.169	.220
Item 18	.180	**.800**	.202	.287
Item 19	.390	**.512**	.272	.046
Item 20	.214	**.523**	.326	.295
Item 2	.208	.084	**.830**	.259
Item 4	.211	.142	**.734**	.340
Item 1	.254	.342	**.668**	.088
Item 3	.324	.288	**.605**	.119
Item 5	.204	.304	.197	**.708**
Item 8	.294	−.027	.200	**.672**
Item 7	.165	.421	.134	**.669**
Item 6	.197	.384	.195	**.623**
Item 9	.375	.272	.284	**.473**

Factor loadings > .45 are in bold

3.2.2. Reliability analysis

As can be seen from Table 4, Cronbach's alpha reliability coefficient for internal consistency of the questionnaire is .945, indicating that the questionnaire has good internal consistency (DeVellis, 2003; Field, 2009; Nunnally, 1978). In fact, an alpha value of .945 is considered excellent (George & Mallery, 2011). In order to assess the internal consistency of the items under each factor, Cronbach's alpha was computed separately for each factor. The alpha coefficients of Factor I – not being able to communicate – (6 items), Factor II – losing connectedness – (5 items), Factor III – not being able to access information – (4 items) and Factor IV – giving up convenience – (5 items) were .939, .874, .827, and .814, respectively (see Table 4). They were all above the commonly accepted minimum value of .7 (Nunnally, 1978), suggesting that they demonstrate good internal consistency.

To assess the reliability of each item, corrected item-total correlation and Cronbach's alpha if item deleted values were taken into consideration. Corrected item-total correlation is a measure of the extent to which an item correlates with all the other items in a questionnaire, excluding the item itself (DeVellis, 2003). As seen in Table 4, all corrected item-total correlations were greater than .40, showing that all items correlate with the total. Cronbach's alpha if item deleted refers to the Cronbach's alpha value of the total items if a given item were to be excluded from the questionnaire. The comparison of the Cronbach's alpha if item deleted to Cronbach's alpha reliability coefficient for internal consistency of the questionnaire (.945) reveals that there is no item whose deletion will result in an increase in the Cronbach's alpha of all items. Hence, we concluded that no item needed to be deleted from the questionnaire, as suggested by Field (2009).

3.2.3. Construct validity

A Pearson product-moment correlation coefficient was computed to assess the relationship between the scores of the participants on the NMP-Q and MPIQ. NMP-Q scores and MPIQ scores were strongly and directly correlated, $r(299) = .710$, $p < .01$. The strong correlation between the two scores provided evidence of similarity between the two questionnaires (DeVellis, 2003), and thus ensured the construct validity of NMP-Q.

Table 4
Exploratory factor analysis and reliability analysis of all items.

Items	Factor loading	Communality after extraction	Corrected item-total correlation	Cronbach's alpha if item deleted	Alpha
Factor I – Not being able to communicate					.939
Item 11	.861	.818	.675	.942	
Item 13	.836	.864	.774	.941	
Item 12	.782	.797	.764	.941	
Item 14	.778	.751	.714	.942	
Item 10	.753	.770	.751	.941	
Item 15	.646	.694	.756	.941	
Factor II – Losing connectedness					.874
Item 16	.838	.815	.682	.942	
Item 17	.835	.829	.706	.942	
Item 18	.800	.795	.703	.942	
Item 19	.512	.490	.592	.944	
Item 20	.523	.512	.629	.943	
Factor III – Not being able to access information					.827
Item 2	.830	.807	.600	.943	
Item 4	.734	.719	.628	.943	
Item 1	.668	.635	.618	.943	
Item 3	.605	.569	.619	.943	
Factor IV – Giving up convenience					.819
Item 5	.708	.674	.643	.943	
Item 8	.672	.578	.503	.945	
Item 7	.669	.671	.634	.943	
Item 6	.623	.612	.641	.943	
Item 9	.473	.520	.654	.943	
Overall Cronbach's alpha					.945

4. Discussion and conclusion

This two-phase, exploratory sequential mixed methods study sought to explore the dimensions of nomophobia, and to design and develop a questionnaire to measure nomophobia. In doing so, this study extended nomophobia research by exploring the dimensions of nomophobia and devising a validated nomophobia questionnaire.

The items in the NMP-Q were developed based on the findings of the first, qualitative phase of the study that revealed the dimensions of nomophobia. The items were written using the statements that were recurrently made by the interviewees. Then the NMP-Q was validated with a sample of college students through exploratory factor analysis, which revealed a four-factor structure for the NMP-Q. These factors corresponded to the dimensions of nomophobia identified as a result of the first phase and were named accordingly; that is, not being able to communicate, losing connectedness, not being able to access information and giving up convenience.

Based on the results of the reliability analysis, the internal consistency coefficient, Cronbach's alpha, for all the items in the NMP-Q was .945. Cronbach's alpha values for the four dimensions were .939, .874, .827, and .814, respectively. Thus, this study empirically supports that the NMP-Q demonstrates good internal consistency, and that the NMP-Q generates reliable scores.

The four-factor solution (i.e., not being able to communicate, losing connectedness, not being able to access information and giving up convenience) obtained as a result of the exploratory factor analysis corroborates the connection of the four dimensions to the theoretical construct of nomophobia, and thus ensures the construct validity of the NMP-Q (DeVellis, 2003). The comparison of the scores obtained from the NMP-Q with those of Mobile Phone Involvement Questionnaire (MPIQ) indicates that there is a significantly strong correlation between the scores, $r(299) = .710$, $p < .01$. The MPIQ has been previously proved to produce valid scores (Walsh et al., 2010). Also, the strong correlation between the scores of NMP-Q and MPIQ provides evidence for the similarity between the questionnaires and suggests that they should behave in similar ways (DeVellis, 2003). Hence, this suggests that the NMP-Q generates valid scores.

In line with King et al. (2010), this study purports that nomophobia, or no mobile phone phobia, can be considered a modern age phobia introduced to our lives with the rapid proliferation and adoption of smartphones. Within the scope of this study, nomophobia is defined as the fear of not being able to use a smartphone or a mobile phone and/or the services it offers. It refers to the fear of not being able to communicate, losing the connectedness that smartphones allow, not being able to access information through smartphones, and giving up the convenience that smartphones provide.

King et al. (2010) and King et al. (2014) suggest that nomophobia be regarded as a situational phobia. Based on the description of specific situational phobias (Choy, Fyer, & Lipsitz, 2007), we also propose that nomophobia can be considered a situational phobia evoked by the unavailability of a smartphone or the thought of not having it, not being able to use it and losing it. Choy et al. (2007) explain that "specific phobia is characterized by an excessive, irrational fear of a specific object or situation, which is avoided at all cost or endured with great distress" (p. 267). Situational phobias are experienced when a specific situation evokes an intense, irrational fear that leads to an intense reaction that can be both physical and emotional. Thus, people with nomophobia, or nomophobes, would have an irrational fear of being out of smartphone contact or not being able to use their smartphones, and would strive to eliminate the chances of not being able to use their smartphone. Had they been unable to use their smartphones, they would have intense feelings of anxiety and distress. Moreover, it has been suggested nomophobia should be included in DSM-5 (Bragazzi & Del Puente). Considering the DSM-5 Criteria for Specific Phobia (American Psychiatric Association, 2013), it is plausible that nomophobia may be listed as a situational phobia under specific phobia identified in DSM-5.

The use of mixed methods research, specifically exploratory sequential design, made it possible to explore qualitatively the dimensions of nomophobia through the experiences of individuals from the population. By utilizing both qualitative and quantitative approaches, this study provided greater insight into nomophobia as a theoretical construct than could be obtained using either qualitative methods or quantitative methods. In that manner, this study contributes to the nomophobia research literature by revealing the dimensions of nomophobia, and by devising and validating the NMP-Q, which was proven to yield valid and reliable scores.

With its novel approach to investigating nomophobia as a theoretical construct, this study provides a better understanding of the dimensions of nomophobia. However, there are certain limitations that should be addressed. Firstly, although the population of the present study is undergraduate students in the U.S., selecting the entire sample from a large Midwestern university may be a limitation to the generalizability of the study's results because the convenience sample used in the present study was not representative of all undergraduate students in the U.S. Therefore, this limitation should be considered when interpreting the results of this study. Further research should seek to replicate the results of the present study using more representative samples. Secondly, as with any other self-reported questionnaire, the self-reported structure of the NMP-Q may be a limitation because of social desirability bias.

In an attempt to address the scarcity of research into nomophobia, this study explored the dimensions of nomophobia, devised the NMP-Q as self-reported measure to assess the severity of nomophobia, and provided empirical support for the validity and reliability of the NMP-Q. Future research should seek to further

investigate the psychometric properties of the NMP-Q and to explore the psychological mechanisms underlying nomophobia. Especially, studies examining the psychological factors comorbid with nomophobia are imperative. Moreover, further investigation into the prevalence of nomophobia among different demographic groups in diverse contexts are needed. For instance, a previous study revealed that females were more susceptible to nomophobia when compared to males (SecurEnvoy, 2012). Conversely, in another study, males were shown to be more likely to demonstrate nomophobic behaviors than males (Mail Online, 2008). Given these inconsistent results, further investigation is needed to disentangle whether males and females differ in their proclivity to nomophobia. In addition, future research should aim to determine which factors predict nomophobia, which can be useful for identifying the risk groups and developing prevention strategies to help those groups cope with nomophobia. Overall, we envisage that further investigation into the phenomenon of nomophobia is viable, and that the NMP-Q, as a self-reported measure of nomophobia, can be useful for future research.

Acknowledgements

We would like to offer our sincere appreciation to the students who participated in this study, and to those who helped us during the data collection process. We also would like to thank Dr. Mack Shelley and Dr. Stephen Gilbert for their suggestions and feedback during the development of NMP-Q.

References

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.), Arlington, VA: American Psychiatric Publishing.

Bragazzi, N. L., & Del Puente, G. (2014). A proposal for including nomophobia in the new DSM-V. *Psychology Research and Behavior Management, 7*, 155–160.

Chiu, S. I. (2014). The relationship between life stress and smartphone addiction on Taiwanese university student: A mediation model of learning self-efficacy and social self-efficacy. *Computers in Human Behavior, 34*, 49–57.

Chóliz, M. (2012). Mobile-phone addiction in adolescence: The Test of Mobile Phone Dependence (TMD). *Progress in Health Sciences, 2*(1), 33–44.

Choy, Y., Fyer, A. J., & Lipsitz, J. D. (2007). Treatment of specific phobia in adults. *Clinical psychology review, 27*(3), 266–286.

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis*. Psychology Press.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five traditions*. Sage.

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

DeVellis, R. F. (2003). *Scale development: Theory and applications* (Vol. 26). Thousand Oaks, CA: Sage.

Field, A. (2009). *Discovering statistics using SPSS*. Beverly Hills, CA: Sage.

George, D., & Mallery, P. (2011). *SPSS for windows step by step: A simple guide and reference 18.0 update*. Pearson.

International Telecommunications Union (2014). *The world in 2014: ICT facts and figures*. <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures 2014-e.pdf> Retrieved 21.11.14.

Kang, S., & Jung, J. (2014). Mobile communication for human needs: A comparison of smartphone use between the US and Korea. *Computers in Human Behavior, 35*, 376–387.

King, A. L. S., Valença, A. M., & Nardi, A. E. (2010). Nomophobia: The mobile phone in panic disorder with agoraphobia: Reducing phobias or worsening of dependence? *Cognitive and Behavioral Neurology, 23*(1), 52–54.

King, A. L. S., Valença, A. M., Silva, A. C. O., Baczynski, T., Carvalho, M. R., & Nardi, A. E. (2013). Nomophobia: Dependency on virtual environments or social phobia? *Computers in Human Behavior, 29*(1), 140–144.

King, A. L. S., Valença, A. M., Silva, A. C., Sancassiani, F., Machado, S., & Nardi, A. E. (2014). "Nomophobia": Impact of cell phone use interfering with symptoms and emotions of individuals with panic disorder compared with a control group. *Clinical Practice and Epidemiology in Mental Health, 10*, 28–35.

Lee, S. Y. (2014). Examining the factors that influence early adopters' smartphone adoption: The case of college students. *Telematics and Informatics, 31*(2), 308–318.

Lee, S., Tam, C. L., & Chie, Q. T. (2013). Mobile phone usage preferences: The contributing factors of personality, social anxiety and loneliness. *Social Indicators Research, 118*(3), 1205–1228.

Mail Online (2008). *Nomophobia is the fear of being out of mobile phone contact – And it's the plague of our 24/7 age*. <http://www.dailymail.co.uk/news/article-550610/Nomophobia-fear-mobile-phone-contact–plague-24-7-age.html> Retrieved 15.05.14.

Matusik, S. F., & Mickel, A. E. (2011). Embracing or embattled by converged mobile devices? Users' experiences with a contemporary connectivity technology. *Human Relations, 64*(8), 1001–1030.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.

Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2012). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing, 16*(1), 105–114.

Park, N., Kim, Y. C., Shon, H. Y., & Shim, H. (2013). Factors influencing smartphone use and dependency in South Korea. *Computers in Human Behavior, 29*(4), 1763–1770.

Pew Research Center (2014). *Mobile technology fact sheet*. <http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/> Retrieved 21.05.14.

Salehan, M., & Negahban, A. (2013). Social networking on smartphones: When mobile phones become addictive. *Computers in Human Behavior, 29*(6), 2632–2639.

SecurEnvoy (2012). *66% of the population suffer from nomophobia the fear of being without their phone*. <http://www.securenvoy.com/blog/2012/02/16/66-of-the-population-suffer-from-nomophobia-the-fear-of-being-without-their-phone/> Retrieved 12.05.14.

Sokolowski, R. (2000). *Introduction to phenomenology*. Cambridge University Press.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Boston: Pearson.

Thurstone, L. L. (1947). *Multiple-factor analysis*. Chicago, IL: University of Chicago Press.

Walsh, S. P., White, K. M., & Young, R. M. (2010). Needing to connect: The effect of self and others on young people's involvement with their mobile phones. *Australian Journal of Psychology, 62*(4), 194–203.