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Development of the Mobile Phone Attachment Scale

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Abstract

Existing instruments that assess the individual's relationship with technology tend to focus on negative constructs and assume that a high use of technology reflects pathology. Since technology use can be beneficial, there is a need for a more balanced instrument.

An initial survey to assess the individual's relationship with their mobile phone was developed, checked for face validity and the resulting survey was administered online to students at local colleges.

146 adults (mean age=25.5 years) completed surveys. Principal Component Analysis with varimax rotation produced a final 27-item scale with factor loadings from .50 to .81, representing 4 components: "Usefulness", "Anxious Attachment", "Addiction" and "24/7" (continuous use).

This study produced an instrument to assess multiple aspects of the individuals' relationship to their mobile phone. Additional work is needed to validate this measure in other populations, with larger samples, and to assess its predictive ability in mHealth interventions delivered through mobile phones.

1. Introduction

Text messaging has shown promise as an effective delivery tool for behavioral health intervention [1–4] and may be particularly suited for interventions designed for young adults

and adolescents, since texting is a popular communication method, particularly among younger age groups [5]. In developing an intervention delivered through mobile devices, it is important to consider that the quality of an individual's relationship to his/her mobile phone may influence their receptivity to, and ultimately the efficacy of, mobile health (mHealth) programs and interventions [6]. There are several available instruments that measure problematic use of technology, such as excessive mobile phone use or internet addiction [7–9]. However, to date these measures have been derived from the addictions and psychopathology literature and are intended to measure problematic use of technology within a conceptual framework of use-as-pathology [10–12]. However, technologies such as mobile phones can serve many positive functions in the lives of individuals. For example, many applications (“apps”) now exist that help people track health behaviors (such as exercise, weight loss) and medical conditions including diabetes and asthma management [13–15]. For many, the mobile phone improves connectivity to social networks, family and friends [16–17]. However, we were unable to locate any instruments that assess positive qualities associated with mobile phone and technology use.

The goal of this study was to develop and test the psychometric properties of a new survey measure to assess mobile phone use patterns among college students.

2. Methods: Psychometric Testing of the Measure

2.1 Measure Development

A literature search was conducted using PubMed to identify factors that may be associated with mobile phone use. We identified constructs such as “social connectivity”, “dependence” and “mood”. We also included the constructs “work/organization,” and “importance” to assess positive functions of mobile phone use. Two individuals from our research team independently wrote a series of items for each construct in English at a 6th grade reading level. Then the entire research team reviewed the items to determine face validity. Any confusing or ambiguous items were edited and duplicates were deleted. The instructions and response format was also reviewed. The resulting instrument contained 38 items with 4 to 7 items per construct and used Likert scale response format. This initial draft of the Mobile Phone Attachment Scale was then pretested with eight adults to confirm item clarity and comprehension before administering it to the larger sample of adults.

2.2 Design

The instrument was administered to students at local colleges for initial examination of its psychometric properties. We tested for its internal validity and the relationship of individual subscales to other theoretically important variables to test for external validity. We included primarily community college students since they are more ethnically diverse, often married, have children and often concurrently employed [18–20], and so are more likely to be representative of the general population compared to a sample comprised primarily of residential college students.

2.3 Sample

To be eligible to participate in this study, individuals had to be an enrolled student at a local college in Southern New England, aged 18 years or older, and have a mobile phone. There were no exclusion criteria. Study staff visited local colleges and gave brief (< 10 minute) presentations during regular classes. The study was described as research concerning “mobile phone use.” Students interested in participating were asked to call or email the study staff. Individuals contacting study staff were then emailed a link to the study website which presented detailed information about the study and an informed consent document. On the informed consent page, students who clicked the button labeled “I consent, please proceed” were then linked to the online survey. After completion of the survey all participants had the option to provide their name and contact information to enter a drawing for \$50. This identifying information was stored separately from the survey data, thus keeping their responses anonymous. Online consent and the surveys took about 15 minutes to complete. The study was approved by the Institutional Review Board at Brown University.

2.4 Measures

Mobile Phone Attachment Scale (MPAS)—The MPAS consisted of 38 statements about mobile phone use. Participants were asked to report how true each statement was to them using a 5-point Likert scale from “1=not at all true” to “5=extremely true”.

Other measures—Participants reported demographic information including age, gender, race/ethnicity, education, employment status, and marital status. They responded to questions about their mobile phone use habits, and text message frequency. They were also asked to indicate whether they experienced any symptoms (SED) of emotional distress (e.g., feeling shaky, panic, rejection, worry) when away from their mobile phone or when the phone’s battery was empty, and answered a single item regarding how many minutes they would drive to retrieve their phone if they discovered they had left it at home. Anxiety symptoms were assessed using the 20-item State-Trait Anxiety Inventory (STAI) [21], and symptoms of depression were assessed using the 10-item CESD [22]. We also assessed impulsivity using the Barratt Impulsivity Scale (BIS-11) [23].

3. Analyses

Descriptive analyses were used for all demographic variables to describe the sample. A preliminary descriptive analysis was conducted for each item of the Mobile Phone Attachment Survey. An exploratory dimensional analysis of the initial 38-item measure was conducted using Principal Component Analysis (PCA) with varimax rotation [24]. Listwise deletion of items was used to form the correlation matrix of item responses used in the PCA analysis. Cronbach’s Coefficient Alpha statistic was calculated to determine internal consistency for the total measure and subscales. We examined external validity and initial construct validity with Pearson r correlations to examine associations between the derived subscales and scores on anxiety, depressive symptoms and impulsivity.

Analysis of variance was used to examine subscale scores by participant characteristics (i.e. age). Post hoc statistical differences were examined using the Tukey HSD test procedure.

The Welch robust test was used where homogeneity of variance was violated, followed by the Games-Howell post hoc test procedure. Analyses were conducted using IBM SPSS Statistics for Windows, Release 20.0.0 (©IBM Corp., 2011, Armonk, NY, www.ibm.com).

4. Results

4.1 Sample and Survey Results

A total of 260 students contacted the study staff and were emailed the link to the study website. A total of 149 students consented and completed the online survey. However, three respondents reported being <18 years old and their data were excluded from the study. Final analysis included responses from 146 participants.

The majority of the participants were women (75%), White (78%), and the mean age was 25.5 years ($SD = 9.4$, range = 18–64). Participant characteristics are presented in Table 1.

All participants had a cell phone, 98% reported using text messages with 86% texting multiple times daily. Slightly more than half (56%) also had a landline phone, indicating that mobile phone was a primary medium of communication for this sample. Other uses of mobile phone reported were: take pictures (94%), email (84%), GPS (84%), calendar (78%), play games (64%), and 39% reported other uses such as banking, using apps, social media, listening to music, reading books, accessing the Internet, and watching movies. Among participants the most common apps used were for navigation (84%), social networking (78%), and to play games (61%). About a quarter of the participants used health related apps including exercise tracking (25%), weight control (24%), and managing a health condition (16%). More than half of the participant reported experiencing one or more symptoms of emotional distress (SED) when they do not have their phone with them (Table 2). On average participants reported they would drive 10.71 minutes ($SD=9.7$, range 0–60) to retrieve a phone left at home. The most common symptom reported when they did not have their phone was insecurity/worry (43%) followed by panic (20%). The most common feelings reported when their phone's battery was dead were anxiety (28%) and agitation (27%). Experience of any SED was significantly correlated with minutes spent to retrieve a phone ($r=.350$, $p<0.001$).

4.2. Exploratory Dimensional Analysis

A four component solution was judged the best solution based on the convergence of the results of a parallel analysis procedure [24] conducted within SPSS [25] and by a visual examination of the scree plot [26]. Next, an iterative process was used to remove items with very low component item loadings ($<.40$ on all components), and complex items with high item loadings ($>.40$) on more than one component, with a final goal of retaining items with loadings in a medium to high range ($>.50$). The final four-component solution included 27 items and accounted for 58% of the variance. The individual item loadings ranged from .509 to .819. The final items for the complete Mobile Phone Attachment Scale (MPAS) are presented in Table 3. The four components are: "Usefulness", "Anxious Attachment", "Addiction", and "24/7" (continuous use 24 hours/day).

Internal Consistency—All four subscales demonstrated good internal consistency reliability (Cronbach's alpha): Usefulness = .90; Anxious Attachment = .87; Addiction = .84; and "24/7" = .77.

Subscale Relationships and Discrimination—Mean item subscale scores were computed and all subscales were then correlated with each other. All four subscales were positively correlated with each other with correlations ranging from .53 to .63.

External Validity Analyses—Three subscales; Anxious Attachment, Addiction and "24/7", were positively correlated with anxiety scores ($p=.003$, $p=.044$ and $p=.040$ respectively), and impulsivity scores ($p=.003$, $p<.001$. and $p=.003$, respectively). All four subscales were positively correlated with depression scores (CESD) with correlations between Usefulness ($r=.267$) and "24/7" ($r=.278$) being weaker than the correlations between depressive symptoms and both Addiction ($r=.382$) and Anxious Attachment ($r=.400$). The number of minutes an individual would drive to retrieve their phone was also significantly correlated with all four subscales (all values $p<.01$: Table 4).

Participant Sub-group Analyses—Significant differences were noted on scores of subscales when examined by participant age group. Participants older than 30 years of age ($n=37$) had significantly lower scores on all four subscales compared to participants 30 years old or less (Table 5). No differences were observed in the scores by gender.

Participants who experienced one of more emotional symptoms (SED) when not having phone with them had higher scores on all four MPAS subscales compared to those who did not experience any emotional symptoms ($p<.05$). Age was negatively correlated with SED ($r=-0.17$, $p=0.037$) such that older participants were less likely to report symptoms of emotional distress when they did not have their phone with them (Table 6).

5. Discussion

There is a great interest in providing health care and behavioral health interventions through mobile technologies (mHealth), including the mobile phone [13–15]. To understand the effects these interventions have on behaviors, it is also important to understand the relationship the individual has with their mobile phone.

However, mHealth involves not only health behavior, but also behaviors related to interacting with mobile technology and interacting with other people through mobile devices. Given the immediate and reciprocal nature of both health behavior and the behavior of interacting with a mobile device, thought leaders suggest that our current behavioral health theories may be inadequate, particularly as mHealth interventions become more interactive and adaptive [27]. There are calls to expand our understanding of how interacting with a mobile device impacts health behavior, and there is a great need for research that will contribute to new theory regarding the interaction between mobile technology use, mHealth interventions, and behavior change [28–29].

This study produced a survey instrument with good internal consistency and strong separation of three distinct subscales. The Mobile Phone Attachment Scale provides a

measure of an individual's relationship to his/her mobile phone with positive (Useful), negative (Anxious Attachment, Addiction) and neutral ("24/7") valences. Results showed that the positive subscale of the MPAS ("usefulness") was not correlated with impulsivity (BIS) or anxiety (STAIT). This differentiates the MPAS from other instruments in that both impulsivity and anxiety have been shown to be associated with mobile phone use in studies of mobile phone addiction or dependence [30–32]. However, within the MPAS, usefulness was significantly correlated with all three other subscales, suggesting that valuing the mobile phone, even for its positive benefits, can lead to some anxiety about not having it available. However, our results do not suggest that this level of anxiety is dysfunctional. Indeed, some level of anxiety can be beneficial by enhancing attentiveness to important things (like making sure to bring your phone with you or ensuring the battery is charged).

We sought to avoid creating a scale that represents increased use of mobile technology as being related to pathology. However, depressive symptoms as measured by the CESD were positively correlated with all four MPAS subscales. It may be that individuals experiencing these symptoms may rely more heavily on their mobile phones to assist them with health issues, connect to other people and cope with negative mood. It is worth noting that the Usefulness and "24/7" subscales were more weakly associated with CESD scores. Additional work with other populations will be needed to either confirm or refute these associations. In particular, research comparing depressed and non-depressed individuals may provide insight into items that better discriminate positive and negative aspects of technology use and help to refine a future version of these components.

Age group appeared to distinguish between those with greater and lesser attachment to their cell phones; older participants scored lower on all three subscales than those under age 30. Similarly, emotional distress associated with mobile phone being unavailable was also negatively correlated with age. Older adults have lived in a world without this technology, whereas younger adults have virtually always had mobile phones as a regular part of their lives. They may therefore rely more on them and have a closer relationship with technology and devices than older adults. There were however, no differences between men and women on these constructs.

While the results of this scale development study are promising, there are some limitations of this investigation that should be noted. The participants in this study were students at local colleges, the sample had a relatively high proportion of women and was primarily white; thus responses in this sample may differ from results obtained with a different sample (e.g., older, general adult population, minorities). Therefore, replication is needed in other populations to ensure that the factor loadings are valid across diverse samples. In addition, this study was conducted in a heavily populated urban area of the northeast United States. It is possible that factor loadings and response patterns might differ from samples recruited in other areas. Future work with this scale is needed to obtain responses from a larger, more diverse sample of participants. Additional work is needed to compare the Mobile Phone Attachment Scale to other measures of technology addiction, which would support discriminative validity.

The Mobile Phone Attachment Scale developed in this study may prove to be a useful indicator of the quality of the individual's relationship with their mobile phone, and may comprise an important element in understanding the efficacy of mHealth interventions and programs. The scale may be a useful addition to studies of mobile and other technology-delivered therapies, acting as a covariate to broaden our understanding of how individuals respond to these therapies when delivered through mobile and other technological devices. Such work may ultimately contribute to the advancement of theory regarding mHealth and the intersection of mHealth and traditional behavioral theory.

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Table 1

Characteristics of study participants (N=146)

	N (%)
Gender	
Male (including 1 transgender)	37 (25.3)
Female (including 1 transgender)	109 (74.7)
College status	
Community college	135 (92.5)
4 year/residential college	9 (6.2)
Graduated last year	2 (1.4)
Student status	
Full time	88 (60.3)
Part time	56 (38.4)
Race/Ethnicity	
White	114 (78.1)
Black	6 (4.1)
Asian	3 (2.1)
Native American	5 (3.4)
Multi-racial	18 (12.3)
Hispanic	26 (17.8)
How often do you use text messaging?	125 (85.6)
Several times each day	9 (6.2)
At least once a day	7 (4.8)
Several times a week	2 (1.4)
About once a week	
Working towards a degree?	
Yes	144 (98.6)
No	2 (1.4)
Marital Status	
Single	112 (76.7)
Married	26 (17.8)
Divorced	8 (5.5)
Job status	
Full time	40 (27.4)
Part time	73 (50.0)
Not employed	33 (22.6)

Table 2

Symptoms of Emotional Distress (SED)

	N (%)
Have you experienced any of these symptoms or emotions due to not having your phone with you?	
Insecurity/worry	63 (43.2)
Panic	29 (19.9)
Loneliness	21 (14.4)
Fast heart beat	16 (11.0)
Depression/sadness	12 (8.2)
Rejection	6 (4.1)
Feeling shaky	5 (3.4)
Sweating	5 (3.4)
Rapid breathing	2 (1.4)
None of the above	67 (45.9)
	N (%)
When your phone's battery is empty, do you ever feel....	
Anxious	41 (28.1)
Agitated	39 (26.7)
Distressed	21 (14.4)
Afraid	12 (8.2)
Disoriented	10 (6.8)
Other - negative emotions	15 (10.3)
Other – positive emotions (i.e. relieved, I don't care)	2 (1.4)
None of the above	58 (39.7)

Table 3**MPAS Final 27-items****Usefulness**

My phone helps me keep track of my healthy habits.
 My phone helps me make positive health decisions.
 My phone helps me to be more organized.
 My phone is my personal assistant.
 I can get more work done when I have my phone with me.
 I am never bored if I have my phone with me.
 My phone makes me feel connected to people.
 My phone is the main source of getting any information I need.

Anxious Attachment

I feel anxious if I don't have my phone with me.
 I feel anxious if I have not received a call or message for some time.
 I feel isolated without my phone.
 I feel dependent on my phone.
 I feel annoyed/angry when people do not respond to my texts immediately.
 I would rather lose my wallet or purse than my phone.
 I check my phone (for text, email, voicemail, etc.) even when it hasn't rung or sounded an alert.

Addiction

I find myself occupied on my phone even when I'm with other people.
 I find myself occupied with my phone when I should be doing other things.
 I find myself engaged on the mobile phone for longer periods of time than I intended.
 My phone wakes me up at night (dings or notifications from texts, calls or other messages).
 I wake up to check my phone for messages at night.
 I would get more work done if I spent less time on my phone.

"24/7"

I keep my phone on 24 hours a day.
 I don't leave home without my phone.
 I set my phone on vibrate or silent mode rather than turning it off.
 I read or send text messages when I am at work or in class.
 I use my phone all day.

Table 4

Subscale:		1	2	3	4
CESD	r	.267 ^b	.400 ^b	.382 ^b	.278 ^b
	p	.001	.000	.000	.001
Impulsivity	r	.096	.245 ^b	.307 ^b	.246 ^b
	p	.258	.003	.000	.003
Anxiety	r	.118	.243 ^b	.168 ^a	.170 ^a
	p	.157	.003	.044	.040
Minutes traveled	r	.257 ^b	.334 ^b	.327 ^b	.216 ^b
	p	.002	.000	.000	.009
Mean		2.79	2.38	2.43	3.84
SD		1.03	.99	1.02	.92

^a
=p <.05;^b
=p <.01

Scales: 1) Usefulness; 2) Anxious Attachment; 3) Addiction; 4) "24/7"

Table 5

Subscale differences by age

	Above 30	30 years or less	p value
Useful	2.28 (1.07)	2.97 (0.97)	.000
Anxious Attachment	1.98 (1.03)	2.52 (0.95)	.004
Addiction	1.93 (0.97)	2.60 (0.99)	.000
“24/7”	3.34 (1.05)	4.02 (0.80)	.001 *

* Welch robust test was used because of homogeneity of variance violations

Table 6

Subscale differences: Symptoms due to not having the phone with them

	Yes	No	p value
Useful	2.97 (0.94)	2.58 (1.09)	.023
Anxious Attachment	2.78 (1.03)	1.92 (0.70)	.000 *
Addiction	2.64 (1.06)	2.18 (0.91)	.006
“24/7”	4.05 (0.76)	3.59 (1.02)	.003 *

* Welch robust test was used because of homogeneity of variance violations