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The Cell Phone Reliance Scale: Validity and Reliability

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ABSTRACT - Two studies were conducted to create a Cell Phone Reliance scale and examine its reliability and validity. In the first study, 195 participants responded to 30 potential items on a six point frequency scale along with other questions regarding their cell phone use. After discarding items with low corrected item total correlations, a full 26 item scale and an abbreviated 7 item scale were created. Both scales were found to have good internal consistency and correlated with numerous other variables regarding cell phone use, supporting its construct validity. In the second study (N = 149), the test-retest reliability of the two scales were examined. The results revealed that both scales had good temporal stability. The general discussion focuses on the limitations of this study as well as future uses of these scales.

Cell phones as tools have great utility. The prospect of having a personal communicative link at virtually any given moment is certainly a convenience in a multitude of ways. Indeed, with the ability to contact family, friends, employers, and emergency services, using a cell phone could literally be a life saver. However, like many behaviors, development of a reliance on cell phone use has the potential to bring detrimental consequences to the user and those around them. The severity of these consequences, as demonstrated through research, can be striking.

Since the development of cell phone technology by Motorola in the early 1980s, the use of this personal communicative device has rapidly increased. Recent studies have suggested that approximately 93% of college-aged students in the United States report owning a cell phone (Beaver, Knox, & Zusman, 2010). Additionally, data gathered by the Nielsen Company has revealed that the average American teen sends approximately 3,339 text messages per month, or more than six text messages every waking hour (NielsenWire, 2010).

Owning a cell phone has been linked with a number of positive psychological variables, including cell phones as a source of connection with family and friends, cell phones as aiding in the development of adolescent independence, and cell phones as indicators of social status (Blair & Fletcher, 2011). Additionally, children who owned cell phones indicated a higher social self-concept than children who did not own cell phones (Jackson et al., 2009). With such a high level of cell phone use in contemporary society and the number of positive psychological variables associated with cell phone

ownership, research investigating potential negative consequences of cell phone use may also be useful to help shed light on the other side of this technology.

From an academic perspective, the use of a cell phone poses a risk in its ability to distract. A study examining the detriments of cell phone use found a strong negative correlation between GPA and the number of texts sent and received, potentially because students directed their attention towards their text messages, rather than their studying (Harman & Sato, 2011). Another study found that students permitted to text during a lecture in class scored significantly lower on an exam than students who were not permitted to text during the same class (Ellis, Daniels, & Jauregui, 2010). Research by End, Worthman, Mathews, and Wetterau (2010) found that test performance related to information that had been disrupted by a ringing cell phone during the learning process was significantly worse compared to test performance related to information that had not been disrupted by a cell phone during the learning process. These studies thus suggest that divided attention during time best spent studying in a non-disruptive environment negatively impacts a student's academic performance.

Further evidence of the detriments of cell phone use comes in the form of divided attention and multitasking while walking and driving. Staurinos, Byington, and Schwebel (2011) found that cell phone use significantly distracted pedestrians crossing the street and that the content of the phone conversation did not play a significant role in the level of distraction. In the context of driving a motor vehicle, Strayer, Drews, and Johnston (2003) found that the reaction time of drivers in a driving simulation was significantly impaired while speaking on a cell phone, as the participants took longer to brake. This study contained three other experiments examining inattentional blindness caused by cell phone use while driving, showing that sensory information from the road is likely to be ignored or only processed at such superficial levels that they cannot be recalled after the experience. Indeed, research by Gherri and Eimer (2011) and Maples, DeRosier, Hoenes, Bendure, and Moore (2008) have revealed that the attentional processing of visual stimuli is impaired when concurrent spoken messages are encoded by a driver. The findings of these two studies are consistent with findings of Strayer and Drews (2007), which suggests that very little semantic processing of visual stimuli occurs outside of the focus of a driver's attention. This study also revealed that individuals are significantly less likely to create durable memory representations of visual objects if they engage in cell phone use while driving. Furthermore, research in this area has indicated that practice is unlikely to eliminate or even reduce the disruptive effects of concurrent cell phone use while driving (Cooper & Strayer, 2008). It is estimated that approximately 22% of motor vehicle accidents (per year) can be attributed to the disruption caused by the use of cell phones to the drivers (Farmer, Braitman, & Lund, 2010). The disruptive effect of cell phone use while driving has been documented in multiple other studies (e.g., Drews, Pasupathi, & Strayer, 2008; Seo & Torabi, 2004).

In addition to the detrimental effects of cell phone use in academic settings and while driving, research has also indicated that significant and constant exposure to cell phones is associated with a number of negative physiological consequences. Nedaa (2007) found that extended cell phone use is associated with burning sensations on the ear, ear numbness, pain in the side or back of the head, headaches, discomfort and pain in the eye, heartbeat disturbances, sleep disturbances, and breathing problems. Additionally, cell

phone use has also been linked to learning difficulties, difficulties concentrating, fatigue, stress, and agitation (Nedaa, 2007), as well as anxiety and insomnia (Jenaro, Flores, Gómez-Vela, González-Gil, & Caballo, 2007). Agarwal (2007) has also found a negative correlation between cell phone use and the quality of semen, suggesting a potential link between cell phones and infertility among males. Moreover, impairments in cognitive performance following exposure to pulsed electromagnetic fields such as those found in cell phones has led researchers to conclude that cell phone use should generally be restricted (Maier, Greter, & Maier, 2004).

Further support for the idea of regulating cell phone use comes from research suggesting that dependence upon cell phones may be indicative of other addictive or unhealthy behaviors. For example, a study examining students in Madrid (Spain) noted strong associations between cell phone use and poor grade performance, tobacco, marijuana and alcohol use, and depression (Sánchez-Martínez & Otero, 2009). Similarly, a study by Toda, Monden, Kubo, and Morimoto (2006) found strong associations between smoking behavior, unhealthy lifestyle, and cell phone use. While the use of a cell phone does not seem to have a direct negative impact in these studies, it does seem to act as an indicator of other harmful behaviors.

The dangers that these cell phones could pose to both the user and those around them, as well as findings which suggest that asking individuals to give up their cell phones for a period of time is related to great distress and anxiety (i.e., Stam & Stanton, 2004) leads to a need for a reliable and valid instrument to measure cell phone reliance. In the present research project, two studies were conducted to create such an instrument and examine its reliability and validity. The first study was designed to generate items for a full version as well as an abbreviated version of the scale and examine the internal consistency and validity of the scales. In the second study, test-retest reliability of the scales was examined.

Study 1

Method

Participants

A total of 195 undergraduate students at a small liberal arts university in a rural area in the United States of America (72 males, 122 females, 1 unspecified; mean age 19.61; range = 17-27, *SD*= 1.54) participated in the study in exchange for some credit for a Psychology course they were enrolled in.

Materials

Cell Phone Reliance Scale (CPRS). Thirty items regarding cell phone reliance were generated. Twelve of these items were translated from a Japanese mobile phone dependence questionnaire (MBDQ) created by Toda, Monden, Kubo and Morimoto (2004). The mobile phone dependency measure by Toda et al. (2004) consisted of 20 items. Some of their items were only relevant to speaking on the phone. These items were not included because our intention was to create a measure that considers both speaking and texting on the phone. Other items in Toda et al.'s (2004) cell phone dependency measure were specific to using a cell phone on a train. Since many of our respondents do not ride trains, these items were also omitted. With a use of a focus group procedure, the authors held meetings brainstorming other possible items that may reflect behavioral

tendencies or emotional experiences that are related to cell phone reliance. As a result, 18 original additional items were generated resulting in a total of 30 items for our initial item pool of the Cell Phone Reliance scale (CPRS). Eight of the 30 items were worded so that the scoring would be reversed. Participants responded on a six point frequency scale (Never or hardly ever - Always or almost always).

Cell Phone use questionnaire. Numerous questions regarding cell phone use were generated in an effort to test the validity of the CPRS. In this questionnaire, we first asked participants to estimate the average number of times the participant checks for messages in one day. We also asked about the number of contacts they have stored on their phone. In addition, we also provided a series of number ranges so that participants can approximate their responses on other questions regarding cell phone use. These questions included the number of individuals the participant interacts with by calling or texting in one day, the number of phone calls made in one day, number of phone calls received in one day, the number of text messages sent in one day, and the number of text messages received in one day. The number ranges of the responses and the coding used for the statistical analyses are listed in Table 1.

Table 1
Coding of Ordinal Scale Items

Response coded as:	1	2	3	4	5	6
Question						
How many different people do you call or text on average per day?	0-3	4-6	6-8	8-10	> 10	
How many cell phone calls do you place on average per day (making a call that gets connected)?	0-1	2-5	6-10	11-15	16-25	> 25
How many cell phone calls do you receive on average per day (receiving a call that you actually answer)?	0-1	2-5	6-10	11-15	16-25	> 25
How many text messages on your cell phone do you send on average per day (individually sent messages)?	0-25	26-50	51-75	76-100	101-125	> 125
How many text messages do you receive on your cell phone on average per day (individually received messages)?	0-25	26-50	51-75	76-100	101-125	> 125

In addition to these general questions regarding cell phone use discussed above, we also asked a number of questions regarding how comfortable participants feel text messaging and speaking to someone on their cell phone, respectively, in six specific situations. These situations included driving a vehicle, in a university class, during a meal, interacting with someone face to face, in a formal meeting, and in a movie theater. For these questions, the participants were asked to respond on a six point scale (1 extremely uncomfortable - 6 extremely comfortable). Finally, participants were also asked to respond to two items about their cell phone use while driving a vehicle on a six point scale from (1 never or hardly ever - 6 always or almost always). The first item was "I keep my phone within reach while driving" and the second item was "I use my phone while driving".

Procedure

The participants arrived at a research laboratory in groups of approximately 10 - 35 individuals and were asked to sign a participant consent form and then to complete the CPRS. Upon completion of the CPRS, the participants were asked to complete the questionnaire regarding cell phone use described above. All participants were then debriefed and thanked for their participation.

Results & Discussion

An item analysis was conducted using the first set of data. As a result, 4 items with corrected item total correlations below 0.3 were omitted. Two of the four omitted items were items translated from Toda et al. (2004). The remaining pool for the full version of the scale consisted of 26 items (including 5 reversed items). The Cronbach alpha for the 26 items was .92. The corrected item-total correlations of the 26 items as well as the Cronbach alpha's of the scale if the item was deleted are presented in in Table 2.

Table 2
Corrected Item-Total Correlations and Cronbach Alphas if the Item was Omitted (CPRS)

Item	Corrected Item-Total Correlation	Cronbach Alpha if Item Deleted
1. It is important for me to replace my phone within 24 hours if it stops working	.509	.921
2. I use my phone when I am face to face with one other person	.459	.922
3. I feel fine even when I forget to bring my phone*	.560	.920
4. I avoid going to places with bad reception	.480	.921
5. Losing my wallet would be more traumatic than losing my phone*	.319	.924
6. I use my phone in the bathroom	.503	.921
7. I feel more attached to my phone than to most other things I own	.703	.918
8. I feel a sense of security when I hold my phone	.603	.920
9. It bothers me when I am asked put my phone away (or to turn my phone off)	.587	.920
10. I use my phone late at night when others are usually sleeping	.559	.920
11. Receiving voice/text messages makes me happy	.598	.920
12. I send more than 50 text messages to at least one person in a day	.616	.919
13. I find myself checking my phone for messages without making a conscious effort	.624	.919
14. I am tempted to check my phone for messages at meetings, at work, or in class	.679	.918
15. I do not text/phone people unless I have something important to say or ask*	.481	.921
16. It bothers me if I have not checked my phone/text messages for a few hours	.682	.918
17. Whenever something important happens, I immediately text people about it	.581	.920
18. I would feel lost if I did not have my phone	.731	.917
19. I use many texting acronyms (e.g., OMG, LOL, etc.)	.441	.923
20. It bothers me when people do not respond to my text messages in a timely manner	.543	.921
21. I frequently send text messages with over 50 words	.341	.924
22. Using my phone helps me relax when I am under stress	.636	.919
23. I send more than 30 text messages in one hour	.602	.920
24. I feel comfortable in situations where I cannot use my phone*	.308	.924
25. I do not check my phone for messages unless I am expecting something very important*	.399	.923
26. On average, I send: 1=less than 20; 2=21-100; 3=101-200; 4=201-300; 5=301-400; 6= over 400 text messages a day	.545	.921

Note. * = reversed item

We then created an abbreviated version of the scale by choosing the items that were related to cell phone use in general (rather than only texting) that had the highest corrected item-total correlations. As a result, the abbreviated version of the Cell Phone Reliance Scale (CPRS-A) consisted of 7 items. All of the 7 items revealed corrected item-total correlations above 0.6. The Cronbach alpha for the 7 item scale was .87. Although it was not as high as the CPRS, this figure suggests that the CPRS-A also has adequate internal consistency. The corrected item-total correlations of the 7 items as well as the Cronbach alpha's of the scale if the item was deleted are presented in in Table 3. To examine the validity of the CPRS and the CPRS-A, we also conducted correlation analyses between these measures and other variables regarding cell phone use. The means and standard deviations of the total score of the two measures as well as the correlations between these measures and the questions regarding cell phone use are listed in Table 4.

The responses to the questions requiring participants to choose a number range (indicated in Table 1) are considered to be ordinal variables. Since Weinberg and Abramowitz (2008) suggest that a Spearman correlation analysis should be used when we examine correlations between an ordinal variable and a continuous variable, we conducted a Spearman's correlation analysis between those variables and the CPRS and CPRS-A. For all other correlations, we used the Pearson correlation coefficients. These correlations revealed that both the CPRS and CPRS-A correlated positively with the average number of times the participant checks for messages in one day, and the number of contacts they have stored on their phone. In addition, both measures were also positively correlated with the number of individuals the participant interacts with by calling or texting in one day, the number of phone calls made in one day, number of phone calls received in one day, the number of text messages sent in one day, and the number of text messages received in one day. Furthermore, the two scales were also positively correlated with how comfortable participants felt text messaging, while driving a vehicle, in a university class, during a meal, interacting with someone face to face, in a formal meeting, and in a movie theater. Both measures were also positively correlated with how comfortable participants felt talking to someone on the phone while driving a vehicle and during a meal. Finally, the two versions of the scale were also positively correlated with how often they keep their phone within reach while driving and how frequently they use their phone while driving.

In order to explore if the CPRS can be divided up into numerous subscales measuring various facets of cell phone reliance, we conducted an exploratory factor analysis. An examination of the scree plot revealed that the eigenvalues leveled off after the first two factors. The eigenvalues were above one for the first six factors. Therefore we conducted five separate principal component analyses restricting the solution to two to six factors, respectively. As a result, we found that none of the five analyses revealed any meaningful solution in the way the items were grouped together. This suggests that the CPRS would best be used as a single measure without any subscales. Furthermore, since the CPRS-A consists of items in the CPRS, it was assumed that the CPRS-A would also be used as a single measure without any subscales. Future research, however, is needed to support this assumption.

In order to explore other characteristics of the two versions of the scale we examined for sex differences. A *t*-test on sex differences revealed that women scored significantly higher than men on both the CPRS, $t(192) = 3.273$, $p<.001$, and the CPRS-A, $t(192) = 3.214$, $p<.005$. The means and standard deviations for men and women are listed in Table 5.

Table 3
Corrected Item-Total Correlations and Cronbach Alphas if the Item was Omitted (CPRS-A)

Item	Corrected Item-Total Correlation	Cronbach Alpha if Item Deleted
1. I feel more attached to my phone than to most other things I own	.689	.844
2. I feel a sense of security when I hold my phone	.609	.856
3. I find myself checking my phone for messages without making a conscious effort	.608	.855
4. I am tempted to check my phone for messages at meetings, at work, or in class	.657	.848
5. It bothers me if I have not checked my phone/text messages for a few hours	.671	.847
6. I would feel lost if I did not have my phone	.710	.841
7. Using my phone helps me relax when I am under stress	.565	.860

Table 4
Means, Standard Deviations and Correlations with CPRS and CPRS-A

Variable	*M*	*SD*	Correlation with CPRS	Correlation with CPRS-A
CPRS	89.16	22.43	--	.94**
CPRS-A	24.59	8.02	.94**	--
Age	19.61	1.54	-.19**	-.17*
# of contacts call/text	136.64	125.66	.29**	.26**
Checking message/day	32.09	36.98	.38**	.31**
Number of people/day	2.16^	.96	.41**^{s}	.35**^{s}
Number calls made	1.97^	.79	.26**^{s}	.22**^{s}
/received	1.89^	.84	.25**^{s}	.22**^{s}
Text sent	3.31^	1.70	.59**^{s}	.44**^{s}
/received	3.37^	1.70	.57**^{s}	.41**^{s}
Comfort texting/Driving	2.90	1.54	.16**	.14*
Comfort texting/Class	3.45	1.53	.37**	.36**
Comfort texting/Meal	4.11	1.50	.29**	.24**
Comfort texting/Face to Face	3.00	1.32	.27**	.20**
Comfort texting/Meeting	1.70	1.01	.18*	.15*
Comfort texting/Movie theater	2.99	1.61	.18*	.16*
Comfort calling/Driving	2.90	1.54	.20**	.18*
Comfort calling/Class	1.18	0.65	.03	.02
Comfort calling/Meal	2.09	1.27	.15*	.14*
Comfort calling/Face to Face	1.47	0.92	.04	.02
Comfort calling/Meeting	1.10	0.46	.01	.04
Comfort calling/Movie theater	1.21	0.70	.03	.03
Phone within reach while driving	4.52	1.70	.30**	.35**
Use phone while driving	3.10	1.49	.29**	.27**

Note. $n = 195$ *p <0.05 (two-tailed) **p <0.01 (two-tailed) ^ variable is coded into number ranges (see Table 1) ^{s} = Spearman's rho

Table 5
Means and Standard Deviations by Sex from Study 1

	M	*SD*	*n*
CPRS			
Women	92.77	22.54	122
Men	82.45	20.36	72
CPRS-A			
Women	25.84	8.07	122
Men	22.23	7.23	72

Study 2

Although cell phone reliance is not a personality trait, we assumed that it is a characteristic with a reasonable amount of temporal stability. Although it is conceivable that the people's reliance on cell phones may be replaced with reliance on other modes of communication, it would be reasonable to assume that cell phone reliance levels would be relatively consistent within a three week time span. Therefore, Study 2 was designed to examine the test-retest reliability of the CPRS and the CPRS-A.

Method

A total of 149 undergraduate students at a small liberal arts university in a rural area in the United States of America (66 males, 83 females) completed the CPRS twice (three weeks apart). The mean age of the participants for this set of data was 19.47 (range = 17-44, *SD*= 2.71). All participants received some credit for a Psychology course they were enrolled in.

Table 6
Means and Standard Deviations by Sex and Combined from Study 2

	M	*SD*	*n*
CPRS (time 1)			
Men	85.98	22.77	66
Women	94.02	20.36	83
Total	90.46	21.76	149
CPRS (time 2)			
Men	84.45	20.72	66
Women	92.18	21.26	83
Total	88.76	21.30	149
CPRS-A (time 1)			
Men	23.56	8.04	66
Women	27.59	7.83	83
Total	25.81	8.15	149
CPRS-A (time 2)			
Men	22.92	7.54	66
Women	26.14	8.35	83
Total	24.72	8.13	149

Results & Discussion

A test-retest reliability analysis was conducted with the two sets of data collected three weeks apart. The correlation between the scores of the 26 item CPRS scale was .93, suggesting that the CPRS has good temporal stability. The correlation between the scores of the 7 item CPRS-A scale was .89. Although it was not as high as the CPRS, this figure suggests that the CPRS-A also has adequate temporal stability.

Consistent with the results of Study 1, *t*-tests on sex differences on the CPRS revealed that women scored significantly higher than men both in time 1, $t(147) = 2.243$, $p<.05$, and in time 2, $t(147) = 2.228$, $p<.05$. Furthermore, *t*-tests on sex differences on the CPRS-A also revealed that women scored significantly higher than men both in time 1, $t(147) = 3.074$, $p<.005$, and in time 2, $t(147) = 2.470$, $p<.05$. The means and standard deviations for the total sample, for men and women, at both time 1 and time 2 are listed in Table 6.

General Discussion

The findings of Study 1 suggest that both the CPRS and CPRS-A have good internal consistency. The results of Study 1 also provide some preliminary support to the validity of both scales. Both measures correlate positively with general frequency variables of phone use as well as phone use while driving a motor vehicle. These correlations were unsurprising given that previous research has found similar results regarding frequency of cell phone use and using one's phone while driving (Farmer et al., 2010).

Both the CPRS and the CPRS-A were also positively correlated with comfort text messaging in situations that some people may find inappropriate (e.g., while driving a vehicle, in a university class, during a meal, interacting with someone face to face, in a formal meeting, and in a movie theater). These results are consistent with past work indicating that frequency of cell phone use is linked to how comfortable a person is texting in a university class (Harman & Sato, 2011).

In addition, the CPRS and the CPRS-A were both positively correlated with how comfortable participants felt talking to someone on the phone while driving a vehicle and during a meal. Surprisingly, there was no significant correlation between these two measures and how comfortable participants felt while talking to someone on the phone in a university class, while interacting with someone face to face, in a formal meeting, or in a movie theater. This may have been due to the fact that many of our participants do not use their phone to speak to others very often. As can be seen in Tables 1 and 4, the average number of phone calls our participants make or receive in a day is less than two. Because speaking to someone on the phone happens quite infrequently, cell phone reliance may have less to do with how comfortable a person feels speaking to someone on the phone than using it for other purposes.

In Study 1, we also examined whether the CPRS can be divided into various subscales measuring various facets of cell phone reliance. Since the findings of the exploratory factor analysis on the CPRS in Study 1 did not yield any meaningful solution, and the CPRS-A consists of items in the CPRS, it is assumed that both the CPRS and the CPRS-A would best be used as a single measure without any subscales.

The findings of Study 2 suggest that both the CPRS and the CPRS-A have good test-retest reliability over a three week period. Although cell phone reliance is not a

personality trait, it seems very reasonable to assume that it is a characteristic with some temporal stability, especially over a period of three weeks.

As is evident from examining the reliability values and the correlations with other variables associated with cell phone use, the CPRS has slightly higher internal consistency, temporal stability, and validity than the CPRS-A. Therefore, whenever possible, we encourage future researchers to use the CPRS to obtain the most reliable and valid results. However, if practical constraints on the research requires the use of a shorter measure, using the CPRS-A at the cost of slightly lower reliability and validity (even though the present findings suggest that it is still an adequate measure) may be sufficient as a measure of cell phone reliance.

The results of both Study 1 and Study 2 reveal that, on average, women tend to score higher than men on cell phone reliance. This finding may not be surprising given that, among teenagers, girls have been reported to use their text messaging function on their cell phones much more frequently than boys (NielsenWire, 2010). Additionally, a significant negative correlation was observed between CPRS scores and age. This finding seems consistent with past work demonstrating the same relationships between the number of text messages sent and received per month and age. Individuals in the 13-17 year age groups were reported to send and receive the most text messages per month and individuals in the 18-24 year age group were reported to send and receive the second highest number of text messages per month (NielsenWire, 2010).

Although the results of the current research project have been very promising, these studies are not without limitations. For example, the participants in the two studies were all undergraduate university students in the United States. In the future, examining the reliability and validity of this scale with other populations is necessary. In addition, it would be extremely interesting to investigate how the scores of these scales correlate with variables such as driving accident frequency, emotional well-being, health status, healthy behaviors, cell phone brand loyalty, as well as academic and cognitive performance. It is our hope that many researchers will benefit from using the CPRS and CPRS-A as a tool to examine the impact our cell phones have on many other facets of our lives.

Author Note

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