Measurement invariance of the Phubbing Scale across 20 countries

Błachnio, Agata; Przepiórka, Aneta; Gorbaniuk, Oleg; Bendayan, Rebecca; McNeill, Monika; Angeluci, Alan; Abreu, Ana Maria; Ben-Ezra, Menachem; Benvenuti, Martina; Blanca, Maria J.; Brkljacic, Tihana; Babić, Nenad Čuš; Gorbaniuk, Julia; Holdoš, Juraj; Ivanova, Ana; Karadağ, Engin; Malik, Sadia; Mazzoni, Elvis; Milanovic, Anita; Musil, Bojan; Pantic, Igor; Rando, Belen; Seidman, Gwendolyn; D'Souza, Lancy; Vanden Abeele, Mariek M. P.; Wołończiej, Mariusz; Wu, Anise M.S.; Yu, Shu

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Abstract

Mobile phone addiction is a robust phenomenon observed throughout the world. The social aspect of mobile phone use is crucial; therefore phubbing is a part of mobile phone addiction. Phubbing is defined as ignoring an interlocutor by glancing at one's mobile phone during a face to face conversation. The main aim of this study was to investigate how the Phubbing Scale (containing 10 items) might vary across countries, and between genders. Data were collected in 20 countries: Belarus, Brazil, China, Croatia, Ecuador, India, Israel, Italy, Netherlands, Pakistan, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Turkey, UK, Ukraine, and USA. The mean age across the sample (N = 7,696, 63.0 % women, 37.0% men) was 25.31 years (SD = 9.40). The cross-cultural validity of the scale was investigated using multigroup confirmatory factor analyses (MGCFA) as well as the invariance analyses. Additionallly, data from each country was assessed individually via the confirmatory factor analyses (CFAs) for evaluating the factorial structure of the questionanire. We obtained two factors, based on only 8 of the items: 1) communications disturbances and 2) phone

obsession. Phubbing Scale containing 8 items obtained metric invariance across countires as well as scalar invariance across genders.

Key words: phubbing, mobile phone addiction, invariance, countires, gender

Introduction

In recent years, mobile phones connected to the Internet have become an integral part of people's lives. Mobile phone use has grown since their inception and is expected to increase steadily (Statista, 2019). Smartphone use on one hand brings us closer to others, but on the other hand it makes us feel alienated, which can be called the present-absent paradox (alone together) (David & Roberts, 2017). Recently, the research literature has focused on a new phenomenon, called phubbing (Karadağ et al., 2015; Roberts & David, 2016; Benvenuti et al., 2019). The word "phubbing" is made out of two other words: "phone" and "snubbing." Phubbing is defined as ignoring an interlocutor by glancing at one's mobile phone during a face to face conversation (Karadağ et al., 2015; Vanden Abeele, Hendrickson, Pollmann, & Ling, 2019). Research has revealed some gender differences in individuals' reasons for phubbing. For women, phubbing was related to a particular aspect of mobile phone use, namely its social element (SMS, and social media), whereas for men, it was associated with entertainment and informative aspects of mobile phone use (Internet and online gaming) (Karadağ et al., 2015). The studies indicated that phubbing is related to loneliness, low self-esteem, low life satisfaction as well as Facebook intrusion (Błachnio & Przepiorka, 2019, Blanca & Bendayan, 2018), anxiety and worry (Karadağ et al., 2015), poor quality and low satisfaction with romantic relationships (Roberts & David, 2016; Krasnova, Abramova, Notter, & Baumann, 2016) stress and depression (Davey et al., 2018)**,** and boredom (Al-Saggaf et al., 2019)**.** Phubbing is viewed as impolite and face-threatening behaviour (Vanden Abeele et al., 2016) that can have relational impact such as expectancy violations, ostracism, and attentional conflicts (Vanden Abeele, 2019).

Phubbing can be related to mobile phone addiction and other behavioural addictions (Karadağ et al., 2015; Chotpitayasunondh & Douglas, 2016). Mobile addiction is defined as a social disorder and phobia connected with strong dependency on communication through

virtual environments (Han, Kim, & Kim, 2017). The use of phones in many aspects of life has led to the emergence of the concept of problematic mobile phone use. Problematic mobile phone can also be defined as a behavioural addiction (Takao et al., 2009) (Hao et al., 2019) (Haug et al., 2015). It is a social disorder and phobia related to a strong dependency on communication through virtual environments (Han et al., 2017). It is also related to lack of impulse control that doesn't include intoxication (Hao et al., 2019). Lin et al. (2015) created twelve diagnostic criteria for smartphone addiction (e.g. preoccupation with smartphone use, tolerance, lack of time control in using, physical and psychological effects because of relying on a smartphone, worsening social relationships because of a smartphone use). Problematic mobile phone use in the literature is also called a nomophobia (Han et al., 2017), or smartphone addiction (Haug et al., 2015).

Aim of the study

The goal of this study was to provide evidence for measurmant invariance across countires and for gender of the Phubbing Scale in samples from different countries (Karadağ et al., 2015; Vanden Abeele, 2019). We hypothesised that meaning and structure of all the scale items were similar in all countries where data was gathered. That would indicate the validity of scale, which in turn would allow for future performance of multilevel modelling analyses. Our main emphasis was was **measurement invariance**, because it points towards comparability factor when considering different countries. Moreover, it is also an indicator of the similarity of a construct meaning. Three aspects of measurment invariance were tested: (1) configural invariance, which implies stability and replicability of the construct (as measured by a scale) in the context of cultures; (2) metric invariance, which compares the construct between compared groups in terms of correlates and predictors; (3) scalar invariance, which allows possibility of comparing latent means across countries (Davidov et al., 2014).

Statistical analyses

Multigroup confirmatory factor analyses (MGCFA) as well as invariance analyses were applied to assess the cross-cultural validity of the scale. Those calculations were performed on data collected in 20 countries. Moreover, data from each country was assessed individually via the confirmatory factor analyses (CFAs), which allowed to evaluate the factorial structure of the questionanire. Most frequently used criteria to evaluate the goodness of fit model include comparative fit index (CFI) greater than .90, and root mean square error of approximation (RMSEA), standardized root-mean-square residual (SRMR) lower than .08 (optimally they should be lower than .05). This usually indicates that the model is well-fitted (e.g. Brown, 2015; Hu & Bentler, 1998; Schermelleh-Engel, Moosbrugger, & Müller, 2003; Konarski, 2010). On the other hand however, if the sample sizes and the *df* are small, the RMSEA may stipulate that the model is not well fitted (Kenny et al., 2015). In light of the above, as well as following the suggestions by MacCallum, Browne, & Sugawara (1996), who stipulate a mediocre fit with RMSEA between .08 and .10, we decided to apply a more liberal criterion RMSEA < .10. Because of non-normal distribution, we used the MLM (mean-adjusted maximum likelihood) estimator with robust standard errors to estimate CFA parametrs in each country and MLR (robust maximum likelihood) estimator in 2-level confirmatory factor analysis (Muthén & Muthén, 2015).

Furthermore, we measured the invariance of the 10-item questionnaire across all the countries. Most frequently, MGCFA recognises the three types of measurement invariance (configural, metric and scalar). These types of measurement invariance require equal papameters across samples. Configural invariance implies equal numbers of factor indicators and latent variables to be imposed in all countries. Metric invariance (also referred to as

"weak invariance") requirement assumes equality all the country factor loadings. Scalar invariance (also referred to as "strong invariance") takes place, if all factor loadings and all the intercepts are equal across all the countries (Milfont & Fischer, 2010).

Mplus was used to calculate a 2-level confirmatory analysis (Muthén & Muthén, 2015). To compute MGCFA we applied an R environment and the R packages lavaan (Rosseel, 2012) and semTools (Hirschfeld & Von Brachel, 2014). Some researchers believe that the number of groups drives relative fit indices (ΔCFI and ΔRMSEA). Rutkowski & Svetina (2014) suggest that in case of data from over 20 countries being analysed certain changes should be adopted as evidence of the lack of invariance. First of all, the comparative fit index (ΔCFI) should be equal to or greater than .02. Secondly, the root mean square error of approximation (ΔRMSEA) is required to be greater than or equal to .03.

METHOD

Participants and procedure

A sample of 7,696 (63.0% women and 37.0% men) mobile phone users took part in the study. Data were collected in 20 countries: Belarus, Brazil, China, Croatia, Ecuador, India, Israel, Italy, Netherlands, Pakistan, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Turkey, UK, Ukraine, and USA. The mean age of all the participants was 25.31 years (*SD* = 9.40).

The individuals invited to participate in the study were mobile users. The study was conducted in local languages, and back-translation procedures were used. Snowball sampling method was applied in order to recruit a large group of respondents varied in terms of socio-demographic characteristics. After the electronic version of the questionnaire was prepared, the link to the research site was sent out via the Internet. The participants volunteered to take

part in the study and received no monetary reward for doing so. They were informed about the anonymity of the study.

Measures

The Phubbing Scale was used in the study (Karadağ et al., 2015). It consists of 10 items (e.g., "My eyes start wandering on my phone when I'm together with others", "People complain about me dealing with my mobile phone"; see Table 1). Participants responded to the items using a 5-point scale (from 1 = strongly disagree to 5 = strongly agree). The original version of the scale contains two factors: (1) Communication disturbance, which is defined as disturbance in a face-to-face communication by dealing with one's mobile phone, as well as (2) Phone obsession, which is defined as constantly needing and desiring own mobile phone (Karadağ et al., 2015). Psychometrical values of the original Phubbing Scale was $\alpha = .87$, for communication disturbance scale $\alpha = .87$ and $\alpha = .85$ for phone obsession scale (Karadağ et al., 2015).

RESULTS

First, goodness-of-fit was tested for the two-factor of Phubbing Scale structure based on two-level CFA to control any between-group variability across the countries in testing for the validity of factorial structure. We used MLR estimator because of non-normal distribution of items. The two-factor model was poorly fitted to data within-level, as indicited by poor CFI: MLR χ^2 (79) = 1552.91 ($p < .001$), CFI = .859, TLI = .839, RMSEA = .049, SRMR = .067[1]. Intraclass Correlations and within-level standardized factor loadings are presented in Table 1.

[1] CFA without considering the levels also indicates a poor fit: MLR χ^2 (34) = 2410.63, CFI = 0.883, TLI = 0.845, RMSEA = 0.095 CI90 [0.092; 0.099], SRMR = .066.

The alternative two-factor model (without poorly loading item 5 and item 10) was well fitted to data within-level: MLR χ^2 (47) = 612.33 ($p < .001$), CFI = .933, TLI = .920, RMSEA = .040, SRMR = .039.

Table 1

Items of Phubbing Scale and within-level standardized factor loadings in pooled international samples of 20 countries

Item	10-item model	8-item Model	ICC
Factor 1 Communication disturbances			
1. My eyes start wandering on my phone when I'm together with others	.712	.715	.159
2. I am always busy with my mobile phone when I'm with my friends	.804	.817	.137
3. People complain about me dealing with my mobile phone	.664	.655	.070
4. I'm busy with my mobile phone when I'm with friends	.773	.773	.102
10. The time allocated to social, personal or professional activities decreases because of my mobile phone.	.426	-	.059
Factor 2 Phone Obsession			
5. I don't think that I annoy my partner when I'm busy with my mobile phone	.265	-	.051
6. My phone is always within my reach	.583	.591	.106
7. When I wake up in the morning, I first check the messages on my phone.	.624	.632	.108
8. I feel incomplete without my mobile phone.	.727	.740	.092

9. My mobile phone use increases day by day.	.588	.574	.104

N = 7,696; ICC – Intraclass Correlations.

Further, descriptive statistics: mean, SD, and Cronbach's alpha, were computed. We also calculated CFAs for the 8-item model in every individual country. Moreover, the pooled-within structure was explored for the 20 countries. Table 2 illustrates that a two-factor model in Phubbing Scale indicates good fit according to CFI and SRMR. This refers to all the 20 countries. Furthermore, as Cortina (1993) points out, with the Cronbach's alpha larger than .65 and a scale smaller than 5 items, a good internal consistency was observed in all the countries. SRMR, RMSEA and CFI supported how well the model fits with the data from all countries except Pakistan (CFI = .886) and Serbia (RMSEA = 0.134).

Table 2

Fit indices for the single sample CFAs, mean values, standard deviations, and Cronbach's alphas in Phubbing and Phone Obsession scales for 20 countries

		MLM					Cronbach's alpha		*M*(*SD*)	
Country	*N*	$\chi^2(df = 19)$	CFI	TLI	RMSEA	SRMR	Phubbing	Phone Obs	Phubbing	Phone Obs
Belarus	400	57.497	0.969	0.954	0.071 [0.053;0.090]	0.045	0.892	0.805	1.59(0.71)	2.54(1.06)
Brazil	311	60.581	0.942	0.915	0.084 [0.061;0.107]	0.064	0.800	0.742	2.03(0.76)	3.61(0.92)
China	441	59.759	0.943	0.916	0.070 [0.052;0.088]	0.059	0.751	0.720	2.19(0.63)	3.66(0.86)
Croatia	688	126.809	0.924	0.888	0.091 [0.077;0.105]	0.055	0.805	0.738	1.92(0.68)	3.30(0.83)
Ecuador	415	53.275	0.965	0.948	0.069 [0.048;0.092]	0.048	0.793	0.730	2.01(0.68)	3.32(0.90)
India	126	35.246	0.924	0.888	0.082 [0.042;0.120]	0.071	0.712	0.760	2.15(0.82)	2.60(1.00)
Israel	390	63.427	0.959	0.939	0.077 [0.059;0.097]	0.051	0.858	0.749	2.59(0.93)	3.29(0.96)
Italy	639	69.088	0.957	0.936	0.064 [0.049;0.080]	0.046	0.761	0.709	1.96(0.58)	3.27(0.81)
Netherlands	322	30.765	0.986	0.979	0.044 [0.009;0.071]	0.035	0.843	0.705	2.18(0.67)	3.23(0.76)

Pakistan	410	94.035	0.886	0.832	0.098	[0.080;0.118]	0.080	0.721	0.706	2.35(0.78)	3.21(0.90)
Poland	409	44.165	0.974	0.962	0.057	[0.037;0.077]	0.049	0.842	0.736	1.62(0.59)	2.81(0.90)
Portugal	400	26.151	0.991	0.988	0.031	[0.000;0.056]	0.031	0.804	0.707	2.21(0.67)	3.04(0.89)
Serbia	365	144.089	0.937	0.907	0.134	[0.116;0.154]	0.082	0.952	0.793	2.26(1.13)	3.28(0.89)
Slovakia	182	33.305	0.947	0.922	0.064	[0.028;0.097]	0.054	0.768	0.684	1.89(0.65)	3.09(0.86)
Slovenia	434	54.868	0.953	0.930	0.066	[0.048;0.085]	0.054	0.809	0.663	1.95(0.66)	3.11(0.76)
Spain	511	70.339	0.951	0.928	0.073	[0.056;0.090]	0.044	0.802	0.727	2.17(0.72)	2.96(0.81)
Turkey	517	92.175	0.941	0.913	0.086	[0.071;0.103]	0.052	0.837	0.730	2.66(0.85)	3.56(0.88)
UK	126	17.815	0.998	0.998	0.015	[0.000;0.070]	0.043	0.795	0.762	1.83(0.67)	2.61(0.90)
Ukraine	402	28.154	0.991	0.987	0.035	[0.000;0.059]	0.033	0.840	0.761	1.76(0.58)	2.91(0.95)
USA	208	43.493	0.943	0.917	0.079	[0.050;0.108]	0.060	0.806	0.679	2.37(0.71)	3.35(0.79)

Note. CFI = Comparative Fit Index, RMSEA = root-mean-square error of approximation, SRMR = standardized root-mean-square residual.

Lastly, we conducted a three-step measurement invariance test across countries and across genders. Table 3 contains the global fit coefficients for configural, metric, and scalar measurement invariances. The results indicate that both configural and metric invariances were observed across all the 20 explored countries according to Rutkowski and Svetina's (2014) liberal cut-off criteria (ΔRMSEA $\leq$.03 and ΔCFI $\leq$.02). On the other hand, changes in both, the comparative fit index and the root mean square error of approximation do not confirm scalar (strong) invariance (ΔRMSEA > .03 and ΔCFI > .02). Therefore results support the conclusion about the weak invariance of the tested scale across countries. Next, the results of MGCFA indicated configural, metric and scalar (full) invariances across genders (Table 3). Moreover, we established residual invariance, which indicates the similarity across genders of the total of specific variance and error variance.

Table 3

Measurement invariance of Phubbing and Phone Obsession scales across cultures (20 countries) and genders

	χ^2	*df*	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	ΔSRMR
Measurement invariance across 20 cultures								
Configural invariance (equal form)	1400.45	380	0.953	0.081	0.047			
Metric (weak) invariance (equal factor loadings)	1829.96	494	0.939	0.082	0.067	0.014	0.001	0.020
Scalar (strong) invariance (equal indicator intercepts)	6061.93	608	0.735	0.153	0.118	0.204	0.071	0.051
Measurement invariance across genders								
Configural invariance (equal form)	1121.65	38	0.943	0.063	0.049			
Metric (weak) invariance (equal factor loadings)	1129.36	44	0.943	0.059	0.049	0.000	0.004	0.000
Scalar (strong) invariance (equal indicator intercepts)	1304.45	52	0.934	0.058	0.049	0.009	0.001	0.000
Residual invariance (equal measurement residuals)	1371.29	63	0.931	0.054	0.048	0.003	0.004	0.001

Note. CFI = Comparative Fit Index, RMSEA = root-mean-square error of approximation, SRMR = standardized root-mean-square residual.

Discussion

The main aim of this study was to investigate the measurement invariance of the Phubbing Scale consisting of 10 items (Karadağ et al., 2015). We checked invariance across 20 countries and genders. We also developed a version of the scale that is valid for use in different countries and investigating the measurement invariance of the method in samples from different countries. We obtained an 8-item scale consisting of two factors: communication disturbances and phone obsession. The tested method included two aspects of mobile phone use. The first is associated with disturbing the communication, namely using a mobile phone during a face to face contact (Karadağ et al., 2015). The second is related to mobile phone dependence and the compulsion to have a phone in sight (Karadağ et al., 2015).

Our results support the metric invariance of the 8-item Phubbing Scale across all the 20 countries. This indicates that we cannot compare means, but we can compare correlations between phubbing and other variables across the countries (Milfont & Fischer, 2010). However, it should be noted that scalar invariance is difficult to achieve, as researchers often mention (Laguna et al., 2017; Zemojtel-Piotrowska et al., 2018; Gallardo-Pujol et al., 2019). We however established full scalar (strong) invariance across genders. This indicates that the Phubbing Scale scores can be meaningfully compared across genders and predictors; the outcomes of phubbing can be added to the model and the resulting effects can be compared across genders (Milfont & Fischer, 2010; Van de Vijver et al., 1997).

Specific limitations have to be acknowledged in this study. Foremost among them is a limited sample; most of our data were collected from students, which means different ages depending on the country (e.g. Ukraine - younger and Israel - older). Moreover, caution should be applied when generalizing the student sample to the whole population.

Despite these limitations, we can indicate a numer of salient findings. To our knowledge, our analyses are the first in the literature to show the invariance of Phubbing Scale. The results indicate that Phubbing Scale demonstrates good psychometrical properties within the 20 countries (Belarus, Brazil, China, Croatia, Ecuador, India, Israel, Italy, Netherlands, Pakistan, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Turkey, UK, Ukraine, and USA). The results also indicate that Phubbing Scale can also be used in cross-cultural studies for between-group comparisons of within-group relations of phubbing and other variables. This is especially relevant, given the essential nature of replication studies and their role in developing research-based knowledge. Recent publications have indicated that there is a great need to promote systematic approach and replication efforts (Koole & Lakens, 2012; Open Science Collaboration, 2015).

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Compliance with Ethical Standards: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflicts of Interest: The authors declare that they have no conflict of interest.

Informed Consent: Informed consent was obtained from all individual adult participants included in the study.

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