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Short Communication

A confirmatory factor analysis of the Mini-IPIP five-factor model personality scale

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ABSTRACT

The Mini-IPIP personality scale is a recently developed short measure of the five-factor model personality traits, derived from items in the International Personality Item Pool (Goldberg, 1999). The aim in this study was to examine the psychometric properties of the Mini-IPIP using factor analysis. 415 male and 1066 female participants completed the Mini-IPIP via the Internet. A five-factor confirmatory model of the measure showed only poor to moderate model fit, while alternative four and two factor confirmatory models of the data showed poor model fit. Despite this, a subsequent exploratory factor analysis of the measure indicated support for a five-factor structure and showed that nearly all items had minimal cross-loadings on non-target factors. The potential use of the Mini-IPIP in personality research is briefly discussed.

1. Introduction

The International Personality Item Pool (IPIP; Goldberg, 1999) makes freely available items for measuring constructs of interest in personality and individual differences research. These items measure a range of constructs and many sets of items have been developed as proxies of more widely known commercial and previously published personality inventories. In particular, the IPIP has been used to provide a number of measures of the five-factor model (FFM) personality traits, namely extraversion, neuroticism, agreeableness, conscientiousness and openness to experience. Our aim in this study is to test the factor structure of one such measure, the Mini-IPIP five-factor model personality scale (Donnellan, Oswald, Baird, & Lucas, 2006).

The Mini-IPIP personality scale was developed as a 20-item short form of the 50-item IPIP-FFM (Goldberg, 1999). The rationale was to provide a measure that could be used in time critical assessment situations, and that had superior psychometric properties to other short FFM measures (e.g., the Ten-Item Personality Inventory; Gosling, Rentfrow, & Swann, 2003). Donnellan et al. (2006) evaluated the Mini-IPIP across a series of studies, showing it had acceptable reliability and showed similar patterns of relationships with the longer IPIP-FFM when correlating the measure with facets of the FFM and other relevant personality measures. Generally, they demonstrated the Mini-IPIP may be a useful FFM measure when time is limited and a short assessment is required.

One potential problem with the Mini-IPIP, however, relates to its factor structure. While exploratory factor analyses (EFA) have generally been successful at extracting the five factors from self-report data, confirmatory factor analyses (CFA) have often failed to adequately model this structure (Church & Burke, 1994). It may be that having each item load on only one factor and constraining all other non-target loadings to zero is too restrictive for multi-trait personality measures, where these traits will be moderately intercorrelated. In this case, we might expect some items to have secondary loadings on non-target factors. Indeed, several studies have sought to use CFA to test the factor structure of the 50-item IPIP-FFM, and in each case item-level CFA analyses of the IPIP-FFM have shown poor overall model fit (Guenole & Chernyshenko, 2005; Lim & Ployhart, 2006). These studies subsequently used item parceling and showed good CFA model fit, but there are potential problems with item parceling in CFA and they limit what we can infer about item properties (Little, Cunningham, Shahar, & Widaman, 2002). Similarly, Donnellan et al. (2006) used CFA to test the Mini-IPIP as part of the scale development, and found poor to modest overall model fit, based on conventional cutoff values for the model fit indices. They further reported that the model modification indices indicated model fit would have been improved by freeing cross-loadings for several items.

In this study we further examine the psychometric properties of the Mini-IPIP personality scale using CFA. While a limited number of studies have examined the factor structure of the 50-item IPIP-FFM measure, to our knowledge no previous study has sought to examine the factor structure of the Mini-IPIP beyond the original

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series of studies developing the measure. Indeed, there is a general paucity of studies testing the factor structure of IPIP measures. Importantly, in each of the studies described by Donnellan et al. (2006), they derived the Mini-IPIP factors by examining the subset of relevant items after administering the full 50-item IPIP-FFM measure. In the current study, participants only completed the subset of Mini-IPIP items. In addition to testing the *a priori* five-factor structure of the Mini-IPIP, we also used CFA modeling to test a series of alternative plausible models of the measure. In this case, we tested models loosely based on Eysenck's model of personality and on the two super-ordinate factors extracted by Digman (1997). Examining the psychometric properties of measures derived from the IPIP in independent samples is an important process in the goal of producing valid and reliable self-report public domain personality measures. This will ultimately enhance and enrich collaboration between individual differences researchers (Goldberg et al., 2006).

2. Method

2.1. Participants and procedure

1481 participants completed the Mini-IPIP via the Internet as part of a larger study collecting data on a number of self-report personality scales. Participants were comprised of 415 males (mean age = 24.67 years; *SD* = 9.71) and 1066 females (mean age = 24.34 years; *SD* = 7.74). Participants were recruited via an email sent to students at universities in England and Wales. After providing demographic details, participants completed each of the questionnaires online. Completion of the questionnaires took approximately 10–15 min. Only data from participants who completed all items in the Mini-IPIP were included in the sample. A small number of participants ($N = 11$) were removed from the data prior to analysis, as they had responded with the same response option to all items (e.g., a response of '1'), or had completed the measure in an implausibly fast time (e.g., <45 s).

2.2. Measure

The Mini-IPIP is a 20-item scale, with four items measuring each of the five-factor model traits. Each item is a phrase describing a behaviour (e.g., '*Am the life of the party*'), and participants were instructed to indicate how accurate this phrase is for them, using a 5-point Likert-type scale. Scores for individual items from each scale were summed to produce a total score for each of the five scales.

2.3. Data analysis

All CFA analyses were conducted with the MPlus 5.2 software program (Muthen & Muthen, 2009). The CFA models were tested using maximum likelihood estimation of the sample covariance matrix. Model fit was ascertained using a mean-adjusted minimum fit function χ^2. As χ^2 values are potentially inflated by large sample sizes, fit was also examined using widely used practical indices of model fit. These included the root mean square error of approximation (RMSEA), the comparative fit index (CFI) and the standardized root mean square residual (SRMR).

While the *a priori* five-factor model of the data would be expected to show the best model fit, we also tested two more parsimonious, yet theoretically plausible CFA models. We first tested a variation of Eysenck's model of personality, in which the extraversion and neuroticism FFM items load on the equivalent factor in the Eysenck model, and the agreeableness and conscientiousness FFM items load on a factor that could be labeled psychoticism. The items assessing openness/intellect in the Mini-IPIP do not map neatly to any one of the Eysenckian dimensions, and so these items were left to form a separate factor. We also tested a model that contained two factors, loosely based on the super-ordinate factors extracted by Digman (1997). In this case, the neuroticism, agreeableness and conscientiousness items loaded on a factor that could be labeled 'alpha', and the extraversion and intellect items loaded on a factor that could be labeled 'beta'. When comparing the overall fit of these models, we used the Aikake Information Criterion (AIC), as well as the global fit indices highlighted above.

3. Results

3.1. Descriptive statistics

Table 1 presents basic descriptive statistics for the items and total scores of the Mini-IPIP. According to Curran, West, and Finch (1996), for univariate normality, skewness and kurtosis values of 0–2, and 0–7, respectively, can be taken as demonstrating sufficient normality. On the basis of the values shown in Table 1, the data appear to show sufficient normality. The mean scores for each scale in this sample were broadly consistent with those reported by Donnellan et al. (2006). Cronbach's alpha for each scale was acceptable, particularly given the relatively small number of items in each scale. The reliability estimates were also similar to those reported by Donnellan et al. (2006). The inter-correlations between the five scales in the Mini-IPIP are shown in Table 2. The magnitude of scale inter-correlations ranged from zero to moderate in size. The two largest significant correlations were those between extraversion and agreeableness, and extraversion and neuroticism.

3.2. Testing the Mini-IPIP factor structure

Table 3 shows the CFA model fit indices for each of the three CFA models. The *a priori* five-factor model of the Mini-IPIP showed mixed global fit; the RMSEA and SRMR indicated acceptable model fit, while the CFI indicated poor model fit. The factor loading of each item on its respective factor was moderate to high, and the latent factor correlations were similar to the inter-correlations found using observed scores. The model modification indices indicated model fit would improve by freeing paths between the conscientiousness item '*Make a mess of things*' and the neuroticism factor, and between the agreeableness item '*Am not really interested in others*' and the extraversion factor. Despite this, the smaller AIC figure shown in Table 3 for the five-factor CFA model indicates that this model is preferable to the two more parsimonious models tested. Both the four and two factor CFA models of the Mini-IPIP showed poor overall model fit.

As noted above, CFA models of five-factor personality measures have often shown poor overall model fit, particularly for large five-factor measures with complex facet structures. Indeed, CFA models of personality measures often show only modest to poor model fit, particularly measures with large numbers of observed indicators and/or latent factors (Marsh et al., 2009). The constraining of cross-loadings to zero may be unrealistic for personality measures with complex structures.[1] In the case of the Mini-IPIP, we have observed only modest to poor CFA model fit. We thus decided to test an EFA model, using maximum likelihood estimation, to examine the extent of item cross-loading. Global fit indices for this model are shown in Table 3. It can be seen that the five-factor EFA had acceptable to good model fit based on the fit indices, and had a

[1] Rammstedt, Goldberg, and Borg (in press) have also highlighted the deleterious effect of acquiescent response bias on the factor structure of Big Five models, in particular for lower educated samples. They show that using ipsatized data improves the factor structure. Given our sample are university educated we did not anticipate this to be an issue with our data.

Table 1
Descriptive statistics for the Mini-IPIP-FFM personality scale.

Item	Mean	*SD*	Skewness	Kurtosis	α
1. Am the life of the party	2.93	1.07	−0.22	−0.80	
6. Do not talk a lot	2.38	1.24	0.49	−0.88	
11. Talk to a lot of different people at parties	3.16	1.29	−0.18	−1.16	
16. Keep in the background	2.72	1.18	0.16	−0.98	
2. Sympathize with others' feelings	4.27	0.89	−1.70	3.31	
7. Am not interested in other people's problems	1.90	1.10	1.20	0.59	
12. Feel others' emotions	3.90	0.98	−0.98	0.66	
17. Am not really interested in others	1.70	0.94	1.43	1.64	
3. Get chores done right away	2.93	1.25	−0.03	−1.12	
8. Often forget to put things back in their proper place	2.78	1.37	0.16	−1.27	
13. Like order	3.62	1.14	−0.65	−0.38	
18. Make a mess of things	2.55	1.16	0.28	−0.91	
4. Have frequent mood swings	2.93	1.35	−0.02	−1.26	
9. Am relaxed most of the time	3.38	1.16	−0.43	−0.73	
14. Get upset easily	2.99	1.29	−0.04	−1.19	
19. Seldom feel blue	2.73	1.25	0.29	−0.98	
5. Have a vivid imagination	4.00	1.10	−1.12	0.55	
10. Am not interested in abstract ideas	2.18	1.89	0.60	−0.41	
15. Have difficulty understanding abstract ideas	2.20	1.03	0.55	−0.46	
20. Do not have a good imagination	1.81	1.06	1.34	1.04	
Total scores					
Extraversion	12.99	3.83	−.25	−.67	.81
Agreeableness	16.57	2.85	−1.13	1.51	.70
Conscientiousness	13.22	3.53	−.20	−.52	.68
Neuroticism	11.81	3.72	.02	−.57	.72
Intellect	15.81	3.11	−.72	.27	.70

Table 2
Correlations among the five factors of the Mini-IPIP.

	1	2	3	4	5
1. Extraversion	–				
2. Agreeableness	0.22*	–			
3. Conscientiousness	−0.03	0.05	–		
4. Neuroticism	−0.26*	−0.01	−0.12*	–	
5. Intellect	0.16*	0.12*	−0.12*	−0.04	–

* $p < .0001$.

Table 3
Fit statistics for the Mini-IPIP models.

	Fit statistics					
	χ^2	*df*	CFI	RMSEA	SRMR	AIC
CFA models						
Five-factor	1323.12	160	0.82	0.07	0.06	85952.80
Four-factor	2131.17	164	0.70	0.09	0.09	86835.48
Two-factor	4009.54	169	0.42	0.12	0.13	88921.02
EFA models						
Five-factor	804.26	100	0.91	0.07	0.03	85394.22
Four-factor	1625.16	116	0.80	0.09	0.06	86183.12
Two-factor	3699.51	151	0.52	0.13	0.10	88187.47

Note: CFI, comparative fit index; RMSEA, root mean square error of approximation; SMSR, standardized root mean square residual; AIC, Aikake Information Criterion.

lower AIC value when compared to the CFA models. We also tested four and two factor EFA models, but as seen in Table 3, they showed poor model fit. The first five eigenvalues were 3.46, 2.47, 2.15, 1.79, and 1.47; only the next eigenvalue was also above 1 (1.09). Table 4 shows the standardized factor loadings and factor correlations for the five-factor EFA. It shows that all 20 items load most strongly on their *a priori* factor, and that there are generally negligible cross-loadings across other factors. The factor correlations are similar to those shown for the observed scores and the latent factors in the five-factor CFA model.

4. Discussion

The aim of this study was to examine the factor structure of the Mini-IPIP (Donnellan et al., 2006). This scale has been recently developed from a longer five-factor measure that utilizes items from the IPIP. The IPIP represents an important attempt to provide researchers with a public domain resource for use in individual differences research. As such, it is important that the psychometric properties of measures derived from the IPIP are thoroughly assessed and evaluated.

We found that a five-factor CFA model of the Mini-IPIP had only poor to moderate model fit, although it did show superior model fit to plausible four and two factor CFA models. The model modification indices for the five-factor model indicated there may have been cross-loadings for some of the items. We subsequently tested EFA models to examine the extent of item cross-loading. A five-factor EFA model exhibited better fit than the five-factor CFA model, and showed acceptable model fit. An examination of the EFA factor loadings generally indicated there was negligible cross-loading of items across the factors. All items had strong factor loadings on their primary factor. Only one item exhibited a potentially problematic cross-loading; the conscientiousness item '*Make a mess of things*' had a moderate negative loading on the neuroticism factor. The inter-correlations between the five factors were generally small to moderate, indicating no substantial overlap in the content domain represented by each factor.

Overall, this study helps demonstrate the suitability of the Mini-IPIP personality scale as a short-form measure of the FFM. This measure may be particularly useful in assessment situations where time or other circumstances only allow a limited number of measures to be used. The results from this study highlight that the measure has acceptable reliability and a clearly interpretable factor structure. In this respect, the findings from the current study support the original data provided by Donnellan et al. (2006). Importantly, in the current study participants only completed the 20 items of the Mini-IPIP, whereas in the Donnellan et al. (2006) study the subset of items were extracted *post hoc* from a larger set of administered items. The results from this study will

Table 4
Standardized parameters for the five-factor EFA.

Item number	Standardized loadings				
	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Intellect
1	**0.68**	−0.03	−0.03	−0.01	0.03
6	**0.74**	0.04	0.04	0.09	−0.05
11	**0.60**	0.09	−0.03	−0.07	0.04
16	**0.83**	−0.05	0.00	−0.02	0.02
2	−0.04	**0.68**	0.00	0.03	0.01
7	0.03	**0.51**	0.00	−0.06	0.00
12	0.00	**0.69**	0.02	0.08	0.07
17	0.22	**0.52**	−0.01	−0.12	−0.03
3	−0.01	0.14	**0.60**	0.01	−0.01
8	−0.03	−0.05	**0.68**	−0.05	0.00
13	−0.03	0.03	**0.57**	0.16	−0.01
18	0.07	−0.01	**0.51**	−0.34	0.01
4	0.04	−0.03	−0.03	**0.72**	0.06
9	−0.07	−0.03	0.04	**0.57**	0.01
14	−0.01	0.14	−0.02	**0.68**	−0.10
19	−0.02	−0.06	0.00	**0.50**	0.03
5	0.05	0.02	−0.01	0.17	**0.72**
10	−0.07	0.05	−0.08	−0.06	**0.45**
15	−0.01	0.01	−0.03	−0.17	**0.44**
20	0.00	−0.02	0.07	0.00	**0.79**
	Latent variable correlations				
	1	2	3	4	5
1. Extraversion	–				
2. Agreeableness	0.19*	–			
3. Conscientiousness	−0.08	0.04	–		
4. Neuroticism	−0.32*	0.02	−0.08	–	
5. Intellect	0.21*	0.12*	−0.17*	−0.06	–

Note: items corresponding to each factor *a priori* are bold highlighted. Please see Table 1 for item content.
* $p < .0001$.

hopefully contribute to further development of the Mini-IPIP. It will be important for future studies to examine the properties of the scale in more representative samples; the current sample was comprised of relatively highly educated, and predominantly female, students. Clearly, assessing the factor structure of a measure such as this is an initial step, and it is hoped subsequent studies can examine relationships between the Mini-IPIP and other behavioural and self-report measures of interest. In this way, we can develop a true 'collaboratory' for individual differences researchers (Goldberg et al., 2006).

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