Personality and Individual Differences 105 (2017) 233–237

Contents lists available at ScienceDirect

Personality and Individual Differences

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

Factor structure and criterion validity of original and short versions of the Negative and Positive Affect Scale (NAPAS)

Mohsen Joshanloo *

Department of Psychology, Keimyung University, Daegu, South Korea

ARTICLE INFO

Article history:
Received 12 July 2016
Received in revised form 5 September 2016
Accepted 30 September 2016
Available online xxxx

Keywords:
NAPAS
Positive affect
Negative affect
ESEM
Short affect scale
MIDUS

ABSTRACT

This study investigated factor structure, reliability, and criterion validity of the original 12-item version as well as an abbreviated 10-item version of Mroczek and Kolarz' Negative and Positive Affect Scale (NAPAS). The sample (N = 2718) was drawn from the third wave of the National Study of Midlife in the United States (MIDUS III). Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modeling (ESEM) were used to analyze the data. The 12-item version of the scale demonstrated acceptable psychometric properties. Equally good model fit and reliability and identical criterion correlations were also found for the 10-item version of the scale. This suggests that scale shortening did not have any adverse psychometric effects. ESEM produced slightly better fit and considerably lower factor correlations, and thus was considered superior to CFA in the context of this study. Overall, these results indicate that both versions of the NAPAS show evidence of acceptable psychometric quality. Implications of the results and avenues for future research are discussed.

1. Introduction

Negative affect (NA) and positive affect (PA) have been implicated as core components in many mental disorders, as well as in psychological theories of human development, temperament, and personality (Allan, Lonigan, & Phillips, 2015). They also constitute the emotional component of subjective well-being (Lucas & Diener, 2015). NA and PA have been measured using various scales, including the 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Despite the pervasive use of the PANAS in psychological research (Diener, Kesebir, & Tov, 2009), the PANAS does not in fact measure general positive and negative affect. Instead, it measures positive and negative activation (Watson, Wiese, Vaidya, & Tellegen, 1999). Low-arousal positive and negative emotions (e.g., relaxed and sluggish) have been excluded from the scale, based on the notion that they only reflect the absence of activation, and thus their measurement is not essential (Watson et al., 1999). This exclusive focus on active emotions may, however, lead us to overlook the central role of low-arousal emotions for many people, religions, and cultures (for a review, see Tsai, 2007). For example, emotions such as peacefulness and relaxation are considered as crucial components of happiness in some non-Western cultures (Joshanloo, 2014). Researchers have also highlighted a number of psychometric issues associated with the use of the PANAS. For example, the factor structure of the scale is still being debated, it's factor structure can require a large number of item residual covariances to reach acceptable fit, and the items can function dramatically differently across various studies and cultural contexts (e.g., Allan et al., 2015; Gaudreau, Sanchez, & Blondin, 2006; Leue & Beauducel, 2011; Merz et al., 2013; Terraciano, McCrae, & Costa, 2003). Given these caveats, there is a growing demand for affect scales yielding clearer factor structures with better chances of cross-cultural replicability.

Mroczek and Kolarz' (1998) Negative and Positive Affect Scale (NAPAS[1]) measures general affect with six items per subscale. The items capture a combination of high-arousal (e.g., "nervous") and low-arousal (e.g., "calm and peaceful") affective states. NA and PA yielded alphas of 0.87 and 0.91, respectively, in a sample of 2727 American adults (Mroczek & Kolarz, 1998). Confirmatory factor analysis (CFA) has shown that with two item residual covariances, the factor structure of the scale achieves acceptable fit indices (Joshanloo & Bakhshi, in press).

Highly correlated residual covariances reflect substantial overlap in the contents of item pairs (Joshanloo, 2016b; Terraciano et al., 2003). One common strategy to deal with highly correlated residuals is to permit a covariance between the item pairs, if the two items are within the same subscale, and if the covariance is theoretically justifiable. Another strategy is to omit one of the items in each item pair, which can result in an abbreviated scale. This can be considered a favorable outcome given the premium currently placed on short scales, particularly for inclusion

* Department of Psychology, Keimyung University, 1095 Dalgubeol Boulevard, Dalseo-Gu, Daegu 42601, South Korea
E-mail address: mjoshanloo@hotmail.com.

[1] Mroczek and Kolarz use a separate title for each subscale: the Negative Affect Scale and the Positive Affect Scale. In the present study, the title "the Negative and Positive Affect Scale" (NAPAS) is used to refer to the whole scale for convenience, and also to distinguish the scale from other affect scales.

http://dx.doi.org/10.1016/j.paid.2016.09.060
0191-8869/

in long surveys that demand considerable participant time (Heene, Bollmann, & Bühner, 2014). However, shortening may degrade the reliability of the scale (Schweizer, 2011), or cause substantial decrements in model fit and criterion validity (Heene et al., 2014; Rammstedt & Beierlein, 2014). Therefore, it is important to critically examine the impact of shortening on the statistical properties of the scale. When omitting overlapping items proves to be substantially detrimental to psychometric quality of the scale, the strategy of correlated item residuals should be preferred.

1.1. The present study

Using a large and recent American sample, the present study sought to investigate the factor structure and criterion validity of the NAPAS, and to explore the possibility of developing a short version of the scale. The original model of the scale and two modified models were compared in the present study. The modified models included a model with correlated item residuals, and a model excluding items with overlapping content. The models were compared based on their fit, internal consistency, and criterion validity. Four variables were chosen as criterion variables: neuroticism, extraversion, self-esteem, and life satisfaction. Neuroticism has been found to be positively correlated with NA and negatively correlated with PA (Lucas & Diener, 2015). Extraversion, self-esteem, and life satisfaction have been found to be negatively related to NA and positively related to PA (Lucas & Diener, 2015; Schimmack & Diener, 2003). It was expected that these relationships would be replicated in the present study with both the original and short versions of the NAPAS.

1.2. Analytical strategy

Joshanloo and colleagues' (Joshanloo, in press; Joshanloo, Bobowik, & Basabe, 2016) research on various scales of mental well-being indicates that usually the factor structure of well-being scales cannot be adequately represented within a simple structure CFA approach. Recent research in other fields (such as personality psychology) also raises doubt about the adequacy of traditional CFA in capturing the factor structure of many psychological scales (Marsh, Morin, Parker, & Kaur, 2014; Morin, Marsh, & Nagengast, 2013). The main reason for CFA's failure is thought to be its overly restrictive assumption that each item should load on a single latent factor, and its loadings on other factors should be fixed at zero. In practice, items with non-zero correlations with more than one latent factor are far from rare (Asparouhov, Muthén, & Morin, 2015). Yet, a majority of factor loadings are constrained to zero in CFA, which tends to result in inaccurate estimates, including overestimated factor correlations (Marsh et al., 2014).

The new technique of Exploratory Structural Equation Modeling (ESEM) has been suggested as a substitute for CFA (Asparouhov & Muthen, 2009). In ESEM, all items are permitted to load on all factors. When there are significant cross-loadings (which is almost always the case), ESEM tends to produce better fit and less inflated factor correlations. Marsh et al. (2014) recommend that researchers routinely conduct and report the results of both CFA and ESEM. If ESEM reveals significant non-target loadings, and yields better fit and less inflated factor correlations, the results of ESEM should be considered superior to those of CFA. Otherwise, CFA is preferable on the basis of parsimony. Previous research with well-being scales suggests that ESEM nearly always outperforms CFA in capturing the factor structure of well-being scales (e.g., Joshanloo, 2016a; Joshanloo, Jose, & Kielpikowski, in press). Moreover, ESEM analyses have revealed significant cross-loadings in the Persian version of the NAPAS (Joshanloo, 2016b). Therefore, a mere reliance on CFA when studying the factor structure of affective constructs may lead to incomplete and inaccurate conclusions. Accordingly, in the present study, both ESEM and CFA were used and their results were compared.

2. Method

2.1. Participants

The data were drawn from the third wave of the National Study of Midlife in the United States (MIDUS III; Ryff et al., 2016). Data collection took place in 2013–2014. The overall MIDUS III sample consists of 3294 respondents. Females constitute 54.9% of the sample. The mean age is 63.64 ($SD = 11.35$). Of the sample, 88.7% chose "white" as their main racial origin, 3.7% self-identified as "black and/or African American", and the rest of the sample chose other categories. Due to missing data on all of the affect items, 576 participants were excluded, leaving a final sample of 2718 to be used in the present analyses.

2.2. Measures

2.2.1. Affect

On a scale from 1 = *all* to 5 = *none of the time*, respondents indicated how much they felt 12 affective states during the past 30 days (Mroczek & Kolarz, 1998). The items are shown in Table 2.

2.2.2. Neuroticism

Respondents indicated how well four self-descriptive adjectives (i.e., Moody, Worrying, Nervous, Calm) described them, on a scale from 1 = *a lot* to 4 = *not at all* (Lachman & Weaver, 1997) ($\alpha = 0.714$).

2.2.3. Extraversion

Respondents rated how well five adjectives (i.e., Outgoing, Friendly, Lively, Active, Talkative) described them, on a scale from 1 = *a lot* to 4 = *not at all* (Lachman & Weaver, 1997) ($\alpha = 0.756$).

2.2.4. Self-esteem

Respondents indicated their agreement with seven statements (e.g., "I certainly feel useless at times"), on a scale from 1 = *strongly agree* to 7 = *strongly disagree* (Rosenberg, 1965) ($\alpha = 0.757$).

2.2.5. Life satisfaction

Five items were used to measure life satisfaction (Prenda & Lachman, 2001), using a scale from 0 = *the worst possible* to 10 = *the best possible*. The items captured satisfaction with overall life, work, health, relationship with spouse/partner, and relationship with children ($\alpha = 0.632$).

When necessary the items were reverse-coded. More information about the sample, procedure, and variables can be found on the MIDUS official website (http://midus.wisc.edu).

2.3. Statistical analysis

Model fit was assessed in Mplus 7.4, with maximum likelihood and an oblique geomin rotation ($\varepsilon = 0.5$). A minimum cutoff of 0.95 for Comparative Fit Index (CFI), a maximum cutoff of 0.08 for Root Mean Square Error of Approximation (RMSEA), and a maximum cutoff of 0.08 for Standardized Root Mean Square Residual (SRMR) were considered as indicative of acceptable fit (Browne & Cudeck, 1993; Hu & Bentler, 1999; Weston & Gore, 2006). Models with smaller values of AIC (Akaike information criterion) and BIC (Bayesian information criterion) are preferred to those with higher AIC and BIC values. In the one-factor models, all of the items were specified to load on a single affect factor.

3. Results

3.1. Factor structure and factor loadings

The fit indices for the models are presented in Table 1. Because the fit of the one-factor models were very bad, these models are not discussed

Table 1
Model fit.

Model	χ^2	*df*	CFI	SRMR	AIC	BIC	RMSEA	90% CI for RMSEA	
								LL	UL
Original (12 items)									
One-factor									
ESEM/CFA	4707.014	54	0.758	0.099	61,884.122	61,982.414	0.178	0.174	0.182
Two-factor									
ESEM	1658.386	43	0.916	0.039	58,857.494	58,985.820	0.118	0.113	0.122
CFA	1851.622	53	0.906	0.047	59,030.730	59,131.753	0.112	0.107	0.116
Original with residual covariances (12 items)									
One-factor									
ESEM/CFA	3337.979	52	0.829	0.087	60,519.087	60,622.840	0.152	0.148	0.157
Two-factor									
ESEM	611.885	41	0.970	0.023	57,814.993	57,948.779	0.072	0.067	0.077
CFA	846.870	51	0.959	0.037	58,029.978	58,136.461	0.076	0.071	0.080
Shortened (10 items)[a]									
One-factor									
ESEM/CFA	2996.499	35	0.796	0.093	52,564.486	52,646.396	0.176	0.171	0.182
Two-factor									
ESEM	404.666	26	0.974	0.021	49,990.654	50,097.137	0.073	0.067	0.080
CFA	617.617	34	0.960	0.037	50,187.604	50,272.245	0.079	0.074	0.085
With residual covariances and covariates									
Two-factor ESEM	1256.248	81	0.951	0.031	91,396.196	91,590.388	0.073	0.069	0.076
Shortened with covariates[a]									
Two-factor ESEM	1127.773	58	0.944	0.032	83,951.116	84,117.957	0.082	0.078	0.086

Note. LL = lower limit; UL = upper limit. The BIC value is sample-size adjusted.
All χ^2 values are significant at $^{***}p < 0.001$.
[a] Item 2 of NA and Item 1 of PA were omitted in these models.

further in the present study. As can be seen in Table 1, the two-factor CFA and ESEM models fitted the data noticeably better than did the one-factor model. The factor loadings of these models are presented in Table 2. Relying on the commonly used cutoff of 0.30 for size of loading to be considered salient in defining constructs (e.g., Fabrigar, Wegener, MacCallum, & Strahan, 1999; Rosellini & Brown, 2011), it was found that all of the items had salient loadings on their target factors both in CFA and ESEM. The ESEM results also revealed that many items had significant non-target loadings.

The fit of the two-factor CFA and ESEM models did not meet the desired standards, suggesting the need for model modification. In keeping with previous research with the MIDUS II sample and an Iranian sample (Joshanloo & Bakhshi, in press), the modification indices indicated that specifying item residual covariances between items 2 ("nervous") and 3 ("restless or fidgety") of the negative affect scale, and between items 1 ("cheerful") and 2 ("in good spirits") of the positive affect scale would considerably improve the fit of the models. Two modified models were specified. In one of them, the two correlated residuals were permitted, maintaining the 12 items of the scale. In the other model, two items were omitted. Considering that factor loadings of the items in each item pair (Table 2), as well as their item-scale correlations were almost identical, four separate ESEM models were tested in which all possible combinations of the items (NA2 & PA1, NA2 & PA2, NA3 & PA1, and NA3 & PA2) were removed from the model. The fit of the four models were very close, but the model with slightly better fit was the one in which item 2 of NA ("nervous") and Item 1 of PA ("cheerful") were omitted. Hence, the second modified model had 10 items and no residual covariance.

The fit indices of the modified CFA and ESEM models are reported in Table 1. The modified ESEM models fitted the data better than did the modified CFA models, as indicated by larger CFI and smaller AIC, BIC, RMSEA, and SRMR values. Moreover, there were a large number of significant secondary factor loadings as shown in Table 2. Accordingly, it can be concluded that ESEM provides a slightly better representation of the data. Hence, CFA results will not be further discussed in the present study, and ESEM will be used in the consecutive analyses. Inspecting the fit indices of the two modified ESEM model shows that permitting residual covariances and scale shortening were both successful in improving the fit of the model to meet the standards commonly used in psychological research.

Table 2
Standardized factor loadings of the 12-item scale (two-factor models).

	ESEM		CFA
	Negative	Positive	
Negative			
1. So sad nothing could cheer you up	**0.677*****	−0.150***	**0.758*****
2. Nervous[a]	**0.518*****	−0.131***	**0.598*****
3. Restless or fidgety	**0.489*****	−0.124***	**0.566*****
4. Hopeless	**0.823*****	−0.033**	**0.815*****
5. That everything was an effort	**0.638*****	−0.175***	**0.743*****
6. Worthless	**0.771*****	−0.026	**0.764*****
Positive			
1. Cheerful[a]	−0.080***	**0.797*****	**0.827*****
2. In good spirits	−0.138***	**0.789*****	**0.857*****
3. Extremely happy	−0.017	**0.763*****	**0.755*****
4. Calm and peaceful	−0.197***	**0.659*****	**0.769*****
5. Satisfied	−0.204***	**0.691*****	**0.805*****
6. Full of life	−0.105***	**0.742*****	**0.791*****

Note. Loadings that are larger than 0.30 are shown in boldface.
[a] These items were removed from the shortened scale.
** $p < 0.01$.
*** $p < 0.001$.

3.2. Criterion validity

To obtain correlations between the four criterion variables (i.e., neuroticism, extraversion, self-esteem, and life satisfaction) and the affect factors, the criterion variables were added as covariates to the two modified ESEM models. All of the criterion variables were modeled as observed variables, and were specified to covary with each other and with the affect factors. As shown in Table 1, the fit indices of the two models were acceptable. Covariance estimates are reported in Table 3. The estimates for the two modified models were nearly identical, showing that irrespective of the modification strategy, the relationships between positive and negative affect and the criterion variables remain virtually unchanged. As expected, PA was negatively associated with neuroticism, and positively associated with extraversion, self-esteem, and life satisfaction. As expected, these relationships were found to be

Table 3
Relationship with covariates.

Covariates	Unstandardized	Standardized
With residual covariances (12 items)		
Negative		
Neuroticism	0.285	0.458
Extraversion	−0.100	−0.172
Self-esteem	−4.364	−0.590
Life satisfaction	−0.665	−0.509
Positive		
Neuroticism	−0.268	−0.429
Extraversion	0.238	0.409
Self-esteem	3.677	0.497
Life satisfaction	0.681	0.521
Shortened (10 items)		
Negative		
Neuroticism	0.282	0.451
Extraversion	−0.098	−0.170
Self-esteem	−4.343	−0.587
Life satisfaction	−0.659	−0.504
Positive		
Neuroticism	−0.265	−0.425
Extraversion	0.242	0.416
Self-esteem	3.641	0.492
Life satisfaction	0.681	0.521

Note. All the coefficients are significant at $p < 0.001$

in the opposite direction for NA. Overall, these results confirm the criterion validity of the NAPAS, and indicate no noticeable adverse effect of shortening on criterion-related validity.

3.3. Factor correlations

Correlations between the positive and negative affect factors are reported in Table 4. The correlations were remarkably smaller in ESEM than in CFA. This provides another justification for choosing ESEM over CFA as the superior method in the present study. Above all, the correlations in the modified models were nearly identical to each other and to those of the original model.

3.4. Internal consistencies

Internal consistencies of the 10- and 12-item scales are reported in Table 4. All the alphas were acceptable, and the alphas of the 10-item scale were not noticeably different from the alphas of the 12-item scale.

4. Discussion

Using the new method of ESEM, the present study sought to examine the factor structure of the NAPAS, and to examine the psychometric quality of a slightly shortened version of the scale, in a recently collected American sample. The results supported the two-factor structure of the modified 12-item scale, its reliability, and criterion validity. The analyses with the 10-item scale also suggest no signs of unreliability and content-deficiency as a result of shortening. Model fit and subscale reliabilities remained almost unchanged under scale shortening. Identical conclusions concerning correlations with criterion variables can be derived irrespective of the version used. Shortening also did not noticeably change the latent correlations between NA and PA. Overall, these results support adequate psychometric properties of both the modified 12-item and the 10-item versions of the scale. The 10-item scale seems to be a slightly more economical scale, while retaining the content breadth of the 12-item scale.

The modification indices of the original scale indicated that specifying a covariance between the residuals of items 2 ("nervous") and 3 ("restless and fidgety") for NA could largely improve the fit of the model. Similar results have been obtained in a large sample form Iran (Joshanloo & Bakhshi, in press). These two items are related to anxiety, whereas the other negative affect items are either related to depression and low self-esteem (e.g., hopeless, sad, worthless) or loss of energy ("that everything was an effort"). Consistent with the findings in Iran (Joshanloo & Bakhshi, in press), the modification indices also indicated that specifying a covariance between the residual terms of Items 1 ("cheerful") and Item 2 ("in good spirits") for PA could largely improve model fit. These two items both refer to moderately active affective states. The other items of the scale refer to more passive (i.e., "calm and peaceful" and "satisfied") or highly active states of mind (i.e., "extremely happy" and "full of life"). Given the content similarities in these item pairs, it seems that specifying item residual covariances and omitting one of the items in each pair for the sake of scale shortening are both justifiable.

ESEM revealed that many of the items of the scale had significant secondary loadings on the non-target factor (Table 2). The secondary loadings are constrained to zero in CFA analysis, which results in worse fit. Moreover, ESEM yielded lower correlations between the positive and negative affect factors than CFA, which is because "in CFA, where virtually all cross-loadings are fixed to zero, there is more burden on the factor correlations to reproduce the correlations among indicators loading on different factors because there are no cross-loadings to assist in these model-implied estimates" (Brown, 2015, p. 178). Altogether, it seems that ESEM outperforms simple structure CFA in capturing the factor structure of affect. Hence, researchers are encouraged to apply ESEM along with CFA to obtain more accurate estimates in research on affect. In particular, ESEM can bring more precision to the research on the dimensionality of affect as measured by various scales (Russell & Carroll, 1999). It should also be noted that despite the existence of significant non-target loadings in the present ESEM analyses, PA and NA are chiefly defined by their target loadings, and the contribution of the non-target loadings is limited. This is reflected in the remarkably stronger target loadings compared to the non-target loadings (Table 2).

Overall, the present results suggest that both the 12- and 10-item versions of the scale can be used with confidence in American samples. Although in the present study, the functioning of the PANAS and the NAPAS were not directly compared, given the inconsistent results of previous studies on the factor structure the PANAS (e.g., Allan et al., 2015; Gaudreau et al., 2006; Merz et al., 2013), it seems that both

Table 4
Latent factor correlations and internal consistencies.

	Correlation between NA and PA	Internal consistency	
Original 12 item scale			
CFA	−0.647	Negative (6 items)	0.845
ESEM	−0.430	Positive (6 items)	0.910
12 items with residual covariances			
CFA	−0.648	Negative (6 items)	0.845
ESEM	−0.436	Positive (6 items)	0.910
10 item scale			
CFA	−0.644	Negative (5 items)	0.829
ESEM	−0.426	Positive (5 items)	0.895

Note. NA = negative affect; PA = positive affect.
All the correlations are significant at $p < 0.001$.

versions of the NAPAS provide clearer factor structures than does the PANAS at least in the USA. The NAPAS has of course the extra advantage of relative brevity, which is desired in may research contexts. Lengthy questionnaires may cause boredom and fatigue in participants, impairing the motivation to complete the whole questionnaire (Rammstedt & Beierlein, 2014).

The study had some limitations. For example, younger adults are underrepresented in the sample used in this study, given the average age of 63.64. This may have affected the results, considering that research has documented some age differences in emotional experience (Gross et al., 1997). Thus, additional research with younger samples is required. The NAPAS has shown acceptable psychometric properties in Iran (Joshanloo & Bakhshi, in press), and has yielded acceptable internal consistencies across samples from 15 nations with eight different languages (Joshanloo et al., 2015). Despite these promising results, not much is known about the scale's cross-cultural validity. Future research will need to examine the factor structure of the scale in other cultural contexts. In addition, the NAPAS has been used with a fixed time frame of the instructions (i.e., "during the past 30 days"), whereas for some affect scales, various time frames (e.g., "right now," "today," and "in the past week") have been used. Hence, it remains an important avenue for future research to investigate possible consequences of changing the time frame of the NAPAS.

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