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Factorial Structure and Measurement Invariance of the PANAS in Spanish Older Adults

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Abstract. Developmental theories suggest age-related changes in the structure of affect. Paradoxically, the internal structure of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) has not been tested in Spanish older adults by means of confirmatory factor analysis (CFA) despite it is the most widely used measure of emotional well-being in later life. The aim of this study was to examine competing models of the internal structure of the Spanish version of the PANAS, its measurement invariance, reliability, and external validity. Participants were a representative sample of 585 community-dwelling people aged 60 and over, who also completed depression, loneliness and life satisfaction measures. Results showed that the orthogonal two-factor model with correlated errors (RMSEA = .057, 90% CI [.051, .063], SRMR = .084, CFI = .97, NNFI = .97) was the best fitting solution. Measurement invariance analyses confirmed that the two-independent factor structure can be used across young-old and very old people, as well as in both males and females. It showed good reliability (PA: α = .93, NA: α = .83), criterion, convergent and discriminant validity ($p < .01$). Our discussion highlights the role of age and culture in the experience and expression of emotions.

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Affect is essential to understanding the subjective well-being (SWB) and individuals' adaptation during the life cycle (Chen, Jing, Hayes, & Lee, 2012; Diener, Suh, Lucas, & Smith, 1999). The *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988) is probably the most widely used instrument to measure the affective component of SWB. However, the alleged independence of positive affect (PA) and negative affect (NA) is still controversial (Thompson, 2007; Tuccitto, Giacobbi, & Leite, 2010). Paradoxically, although some evidence suggests age-group differences in affective structure (e.g., Mroczek & Kolarz, 1998; Ready et al., 2011), the factorial structure of the PANAS has scarcely been examined in old and very old age. On the one hand, life-span theories of emotion such as socioemotional selectivity theory (SST; Carstensen, Isaacowitz, & Charles, 1999), dynamic integration theory (DIT; Labouvie-Vief & Medler, 2002), or the differential emotions theory (DET; Izard, 1977), suggest that emotions become more complex with age. Emotional complexity has been operationalized by a relatively greater independence in affect indicators (Ready, Akerstedt, & Mroczek, 2012) and the existence of a more diffuse affective structure in late life with more item cross-loadings in older adults than in younger adults (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Kercher, 1992; Mackinnon et al., 1999; Ready et al., 2011).

Recently, the original authors of the PANAS have studied the structure of affect considering the effects of age. As they stated "it is important to establish structural convergence in affect ratings for different age groups, because structural similarity allows for meaningful comparison across age groups and for investigation of change in affect across development" (Ready et al., 2011, p. 784). However, with the exception of Nolla, Queral, and Miró (2014), the few validation studies of the PANAS with older adults have examined the short version of the scale (e.g., Hilleras, Jorm, Herlitz, & Winblad, 1998; Kercher, 1992; Mackinnon et al., 1999). Furthermore, diverse methodological issues can relate to the divergence of results in the factorial studies of the PANAS (Tuccitto et al., 2010). The most important issues are related to both the method used to estimate the parameters, and to the fact of taking into account (or not) the content categories from Zevon and Tellegen's (1982) mood checklist.

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Positive and Negative Affect and Their Measurement with the PANAS

On a theoretical level, Watson and Tellegen (1985) described the structure of affects as a circumplex model where PA and NA represented the two main axes (orthogonal factors). At the empirical level, the PANAS was developed by selecting terms that were relatively pure markers of either PA or NA (Watson et al., 1988). For this purpose, the authors used descriptor word clusters (10 items in four categories for PA, and 10 items in five categories for NA) detailed in the factor analyses reported by Zevon and Tellegen (1982) allowing 13 correlated error terms. Although the PA and NA scales have shown adequate levels of internal consistency, some items had different problems. For example, the term "excited" has shown high cross-loadings in the PA and NA scales (Crawford & Henry, 2004; Joiner, Sandín, Chorot, Lostao, & Marquina, 1997; Mackinnon et al., 1999; Rodríguez & Church 2003; Thompson, 2007) suggesting both positive and negative connotations. The term "ashamed" has demonstrated low factor loadings for Crawford and Henry (2004), Hilleras et al. (1998), Rodríguez and Church (2003), and in the Spanish versions of Joiner et al. (1997) and Sandín et al. (1999). The term "guilty" has not been considered a general mood, but a term used to indicate culpability after an offense (Thompson, 2007). The detection of problematic items has entailed persistent recommendations for new validation studies (e.g., Villodas, Villodas, & Roesch, 2011).

The most controversial topic related to the PANAS continues to be the assumption of PA and NA independence, and whether that structure remains stable in different cultures and population groups (e.g., Merz et al., 2013). Since the exploratory factor analysis (EFA) carried out by Watson et al. (1988) its orthogonal structure has been replicated using factorial techniques in several studies (e.g., Mackinnon et al., 1999; Rodríguez & Church, 2003; Tuccitto et al., 2010), even with old and very old samples (e.g., Hilleras et al., 1998; Kercher, 1992). For example, Mackinnon et al. (1999) found that the structural characteristics of the PA and NA short-form scales were remarkably independent of differences in age and gender. Interestingly, the correlation between PA and NA did not increase as a function of age. Similarly, findings from Tuccitto et al. (2010), testing nested models in sport athletes, supported the orthogonality of the PA and NA subscales.

Validation studies in Spanish samples also gave support to orthogonality. Authors such as Joiner et al. (1997) concluded that PA and NA were relatively orthogonal, after conducting EFA and CFA in a sample of women aged 45 to 65. Although they did not compare an orthogonal model to an oblique model, they found an adequate overall goodness of fit for the orthogonal model and that a one-factor model did not show a good fit to the data. Later, Sandín et al. (1999) found in university students that PA and NA were quasi-independent latent variables, and a reasonably good fit for a respecified orthogonal model. Recently (Nolla et al., 2014) supported findings from Joiner et al. (1997) and Sandín et al. (1999) using EFA techniques in a convenience sample of older adults ranging from 65 to 91 years. They also found the same factorial structure across gender.

However, there is also some evidence against orthogonality. Findings from Terraciano, McCrae, and Costa (2003) showed no differences between the oblique model and the orthogonal two factor model, but when examining the *trait* vs. *state* version, the oblique model fitted the data significantly better for the trait version than the orthogonal model. Several goodness-of-fit indices showed that the orthogonal model from Joiner et al. (1997) resulted in a poor fit.

Studies testing competing confirmatory factor analytic models showed that PA and NA were significantly correlated, and the best fit for the oblique models (Crawford & Henry, 2004). These findings were partially supported later by Thompson (2007), although the PA and NA scales showed a similar correlation, the goodness-of-fit indices indicated that the PANAS fell marginally short of a well-fitting oblique model. Poor results were attributed to item cross-loadings above .25 and low factor loadings of some items. Similarly, Merz and Roesch (2011) confirmed the best fit for a model with two correlated factors and correlated error terms derived from Zevon and Tellegen (1982). More recently, in a CFA study using nested models, Merz et al. (2013) found that a three factor model, allowing correlated error terms, provided the best fit to the data. However, according to Merz et al. (2013), the two-factor models were also supported, with an oblique solution (r = –.28, $p \leq .05$) that fitted significantly better than the orthogonal solution.

Emotions, Aging and Culture

The relationship between age and affect is more complex in older adults rather than in those than at other life stages (Ready et al., 2012; Röcke, Li, & Smith, 2009). For decades, research has shown inconsistent findings concerning whether old and very-old adults differ in their levels of affective well-being (Charles et al., 2010; Pinquart, 2001; Vogel, Schilling, Wahl, Beekman, & Penninx, 2012).

In addition to age, both the experience and expression of emotions are influenced by cultural factors (Carstensen et al., 1999). One of the biggest questions about the structure of affect is whether the structure found in individualistic cultures can be replicated in collectivistic cultures (Rodríguez & Church 2003). Theoretical approaches such as Adams, Anderson, and Adonu's (2004) about the cultural component of emotions, and studies of Diener and Suh (1999), and Mesquita (2001), showed intercultural differences in the experience of emotions that make it necessary to continue examining their internal structure. For example, Shimmack, Oishi, and Diener (2002) examined whether gender moderated the cultural effect on the relationship between pleasant and unpleasant emotions. They observed gender differences in the experience of emotions: while in Western cultures the women´s correlation between PA and NA was more negative than the men´s correlation, in Asian cultures, the correlations were identical for women and men. To date, the results about the relationship between the PA and the NA in individualistic and collectivistic cultures have been inconsistent and further studies are needed.

Present Study

Surprisingly, there are no studies about the psychometric properties of PANAS in people aged 60 and over in Spanish older adults using CFA techniques, although this instrument is widely used to measure subjective well-being in this population (e.g., Márquez-González, Izal, Montorio, & Losada, 2008). So, Spain is a collectivistic country that represents a new ground to study the validity of the PANAS. The invariance of the measure has not been explored either, although some authors have drawn attention to the lack of validation studies of well-being scales with this kind of sample (e.g., Godoy-Izquierdo, Moreno, Pérez, Serrano, & García, 2013; Nolla et al., 2014).

Thus, the aims of this study were to examine: (a) competing models of the internal structure of the PANAS proposed by Crawford and Henry (2004), Tuccitto et al. (2010) and Sandín et al. (1999); (b) the measurement invariance across age and gender; (c) the reliability of the PA and NA; and (d) its criterion validity and convergent/discriminant validity. In contrast to previous studies we did not examine a unidimensional model.

Considering Ready et al.'s (2011) findings with older adults and the research about emotions in different cultures, we expected a better fit for orthogonal models and a less clear factorial structure than in studies of individualistic cultures. Regarding the invariance of the PANAS, we were interested in testing whether participants from different age groups (young-old: 60–74 vs. old-old: 75+) and genders (males-females) employed the same conceptual framework to respond to the scale (configural invariance), whether the item loadings of the PA and NA latent factors were invariant (metric invariance), and whether the latent factors have the same relationship in all groups (covariance factor invariance). Similarly to Thompson (2007), and considering the main tenets of developmental theories about emotion regulation in old age, we tested criterion validity examining the influence of age and gender on PANAS scores. We predicted that PA would be correlated positively with age and inversely with NA (Charles, Reynolds, & Gatz, 2001), and that women would score higher on NA and lower on PA than men (Crawford & Henry, 2004; Lim, Yu, Kim, & Kim, 2010). Concerning the relationship with convergent/discriminant validity, we predicted that PA would be positively related to satisfaction with life, and negatively to depression and loneliness, and that NA would be positively related to depression and loneliness, and negatively to satisfaction with life (Chen et al., 2012; Merz & Roesch, 2011; Ready, Weinberger, & Jones, 2007; Terracciano et al., 2003).

Method

Participants and Procedure

Participants were Spanish community-dwelling older adults living in Salamanca that were recruited through a stratified sampling with equal allocation according to age and sex based on the municipal census. The response rate was 66.77%. The results reported here refer to 585 participants (M = 74.11, SD = 7.92, range = 60–98). Women represented 53.5% of the sample. The most frequent marital status was married (56.9%). Most of the sample (86.2%) had children (M = 2.61), was living with his/her partner (56.4%), and had primary or secondary education (73.5%). Nearly 40% of the sample was earning less than 451€ per month. Data were gathered by face-to-face interviews in their private homes. Participants were not paid. The interviews lasted approximately an hour. After obtaining the informed consent, the anonymity and confidentiality of participants and of the data were assured. The study was approved by the Ethics Committee of the Universidad de Salamanca.

To perform the invariance analysis we split the sample in two groups according to their age and gender: the "young-old" (60–74 years, n = 292, 53.4% female and 46.6% male) vs. the "old-old" (75 years and over, n = 293, 53.6% female and 46.4% male), and male (n = 272, aged 60 to 98, M = 74.32, SD = 7.08) vs. female (n = 313, aged 60 to 98, M = 73.94, SD = 7.79).

Instruments

The Positive and Negative Affect Schedule (PANAS)

(PANAS: Watson et al., 1988; Spanish version by Sandín et al., 1999). As in the original PANAS, the Spanish

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PANAS is a 20-item inventory with 10 items for PA and 10 for NA. We instructed participants to rate the extent to which they experienced each emotion "during the past week." Items were rated on a 5-point Likert-type scale, from 1 (not at all or very slightly) to 5 (very much) (for PA: M = 33.02, SD = 8.24, and for NA: M = 19.50, SD = 6.29).

Satisfaction with Life Scale (SWLS)

(SWLS: Diener et al., 1985, Spanish version provided by Diener, 2009). We used this scale to measure the cognitive component of happiness. The scale is designed to enable individuals to evaluate their lives (an overall evaluation of one's life) according to their own subjective criteria. The scale consisted of five items (e.g., "In most ways, my life is close to my ideal"), which were rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The sum of the items forms the total score of life satisfaction. The reliability was satisfactory (α = .85).

De Jong Gierveld Loneliness Scale (DJGLS)

(DJGLS: De Jong Gierveld & Kamphuis, 1985; Spanish version by Buz & Pérez-Arechaederra, 2014). The scale is composed of six items phrased negatively and five items phrased positively. The positive items express feelings of social embeddedness (e.g., "There are plenty of people I can lean on when I have problems"). The negative items express feelings of desolation (e.g., "I often feel rejected"). These items had three response categories (3 = *Yes*, 2 = *More or less*, 1 = *No*) that must be dichotomized (De Jong Gierveld & Van Tilburg, 2011). If the response *More or less* or *Yes* is given to a negatively worded item a scale point is assigned to the emotional loneliness score. The same rule is applied if the response *More or less* or *No* is given to a positively worded item. The final score ranges from 0 = *no loneliness* to 11 = *extreme loneliness*. The scale has been used in several surveys and has proved to be a rather robust, reliable and valid instrument. The measure was found to be reliable in this sample (α = .79).

Geriatric Depression Scale Short-Form (GDS-8)

(GDS-8: Buz, 1996). We measured the presence of depressive symptoms with the 8-item version of the Geriatric Depression Scale (Yesavage et al., 1982). The items may be answered *yes* or *no*. The total score ranges from 0 to 8 points, with higher scores indicating more depressive symptoms. The reliability for the scale was satisfactory (α = .93).

Data Analyses

Hierarchical confirmatory factor analysis

According to the recommendation of Jöreskog and Sörbom (1996) to estimate the parameters in our CFA models, we analyzed the polychoric correlation matrix using the diagonally weighted least squares (DWLS) estimation, and we computed standard errors from the asymptotic covariance matrix. We conducted a series of CFA's on five different models representing the full version of the PANAS to determine the competing model that best fit our data. These competing models (see Table 1), were tested without modifications.

To examine how each CFA model provided validity evidence we used several goodness-of-fit statistics. Because the data were nonnormally distributed (Mardia´s coefficient = 43.01, $p \leq .001$) we used the Satorra-Bentler scaled χ^2 (S-Bχ^2). Additionally, we used (a) the root mean square error of approximation (RMSEA < .06 for acceptable fit, and between .08 to .10 for marginal fit); (b) the standardized root mean square residual (SRMR close to .08 for acceptable fit); (c) the comparative fit index (CFI > .90 for good fit); (d) the non-normed fit index (NNFI > .90 for good fit).

To test the orthogonality of PA and NA and the effects of correlated error terms in competing nested models we used the χ^2-difference model comparison test (i.e., ΔS-Bχ^2 [Δdf, p]) adjusted for nonnormality under DWLS estimation. Rejection of the null hypothesis in the χ^2-difference model comparison tests implies that the less constrained model provides a statistically significant decrease in χ^2 and therefore fit the data better than its nested model. Complementarily,

Table 1. *Tested factor models and their description*

Models	Description
Model 2a	Two (PA, NA) orthogonal factors (Watson et al., 1988).
Model 2b	Two (PA, NA) correlated factors (Terracciano et al., 2003).
Model 2c	The same as model 2a, but correlated errors were permitted according to Zevon and Tellegen´s (1982) mood content categories (Tuccito et al., 2010).
Model 2d	The same as model 2b, but correlated errors were permitted according to Zevon and Tellegen´s (1982) mood content categories (Crawford & Henry, 2004; Merz & Roesch, 2011).
Model 2e	The same as model 2c, but correlated errors were permitted according to Sandín´s et al. (1999) model.

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because the χ^2 difference test is sensitive to sample size and departures from normality (Cheung & Rensvold, 2002) we used ΔCFI and ΔRMSEA (Chen, 2007). Models were considered acceptable when both indices met cut-off values of ΔCFI < .01 and ΔRMSEA < .015. When the best fitting model was identified, we examined its model parameter estimates to determine the adequacy of an item as an indicator of PA or NA.

Measurement invariance (MI)

We conducted a multigroup confirmatory factor analysis (MGCFA) to test measurement invariance and structural invariance of the best fitting model across age and gender. In accordance with Vandenberg and Lance (2000), we carried out a series of hierarchically ordered steps. Once adequate model fit was established for each group separately (e.g., 60–74 vs. 75+), we began with the establishment of a baseline model (the reference model) followed by testing for increasingly more stringent levels of constrained equivalence (the comparison model). For configural invariance, no equality constraints were imposed either on item parameters or on factor variances or latent means across the two groups. The next step was to impose equality constraints on the factor loadings across the groups to test metric invariance. Investigating metric invariance we can determine whether the same unit of measurement is being used for the items across the groups. The final step was to assess whether the covariance between the latent variables was equivalent across the groups. When factor covariance invariance is met, it suggests that all latent factors have the same relationship in all groups. The same procedure was repeated for gender.

To determinate whether model´s invariance constraints were likely to hold or not we also used the χ^2-difference model comparison test (i.e., ΔS-Bχ^2 [Δdf, p]) (Satorra & Bentler, 2001) as well as ΔCFI and ΔRMSEA. A difference in CFI of .01 or less was adopted as evidence that the imposition of additional constraints did not appreciably reduce the fit of the model, thus supporting the invariance hypothesis (Cheung & Rensvold, 2002).

Criterion validity and convergent/discriminant validity of the PANAS was examined through linear and non-linear relations with sociodemographic variables and other related constructs such as depression, satisfaction with life and loneliness.

All statistical analyses were conducted with SPSS 19, FACTOR 8.1 (Lorenzo-Seva & Ferrando, 2006) and LISREL 8.80 (Jöreskog & Sörborm, 1996).

Results

Hierarchical Confirmatory Factor Analysis

Similarly to previous authors (e.g., Terraciano et al., 2003), several NA scores, especially “guilty” and “ashamed”, were positively skewed and/or excessively kurtotic.

Table 2 presents the goodness-of-fit statistics of the tested models. Results showed that the models allowing correlations between error terms apparently had a better fit than the models not allowing them. According to the cut-off values for RMSEA, SRMR, CFI and NNFI, the original model of Watson et al. (1988) presented a marginal fit, and Sandín et al.´s (1999) model, which permitted some correlations between error terms, only had an acceptable fit.

To determine the independence of the latent factors, we examined whether the orthogonal models (*model 2a, model 2c* and *model 2e*) had a better fit than those which allowed the factors to correlate (*model 2b* and *model 2d*) (see Table 4). The χ^2-difference model comparison test revealed that the oblique models were slightly better than their respective nested models.

As expected, the latent factors PA and NA were quasi-independent (Φ = –.03). Later, we tested the effect of allowing error terms to correlate. Inferential statistics showed that a significant fit improvement only appeared when the two compared models included error term correlations. The statistical significance improvement is outstanding for the fit of *model 2c* and *model 2d* when compared to their nested model (*model 2e*).

Table 2. *Goodness of fit indices and confidence intervals of tested models*

Two Factor Model	S-Bχ^2	*df*	RMSEA 90% CI	SRMR	CFI	NNFI
Model 2a Orthogonal factors	812.27	170	.080 [.075, .086]	.092	.94	.94
Model 2b Oblique factors	805.85	169	.080 [.075, .086]	.090	.94	.94
Model 2c Orthogonal factors, CEs	453.87	157	.057 [.051, .063]	.084	.97	.97
Model 2d Oblique factors, CEs	445.78	156	.056 [.050, .063]	.081	.97	.97
Model 2e Orthogonal factors, CEs	657.93	166	.071 [.065, .077]	.087	.95	.95

Note: p < .001 for the S-Bχ^2 statistic in all cases.

CEs = correlated errors; S-Bχ^2 = Satorra-Bentler scaled χ^2; *df* = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; CFI = comparative fit index; NNFI = non-normed fit index.

Table 3. *Difference tests comparing nested models of the PANAS*

Models	ΔS-Bχ^2 (Δdf, p)	ΔCIF	ΔRMSEA
Model 2a vs. Model 2b	9.18 (1, p = .002)	.000	.000
Model 2c vs. Model 2d	18.40 (1, p < .001)	.000	.001
Model 2a vs. Model 2c	409.39 (13, p < .001)	.030	.021
Model 2b vs. Model 2d	413.92 (13, p < .001)	.030	.022
Model 2e vs. Model 2c	236.42 (9, p < .001	.010	.008
Model 2e vs. Model 2d	253.41 (11, p < .001)	.010	.015

Note: ΔS-Bχ^2 = χ^2-difference model comparison test. If the p value is significant it means that the extended model is better than the nested one. ΔCIF = comparative fit index difference test; ΔRMSEA = root mean square error of approximation difference test.

Considering the theoretical ground of the PANAS schedule, the correlation between PA and NA latent variables, and the cut-off values in RMSEA, SRMR, CFI and NNFI, we identified *model 2c* as the best fitting model.

The next step was to examine factor loadings and error correlations to determine whether the *model 2c* could be interpretable at a theoretical level. Although we observed adequate factor loadings for PA ($\lambda_{interested}$ = .64, λ_{alert} = .87; $\lambda_{attentive}$ = .67; $\lambda_{excited}$ = .74; $\lambda_{enthusiastic}$ = .73; $\lambda_{inspired}$ = .64; $\lambda_{determined}$ = .77; λ_{strong} = .84; λ_{active} = .87), the term "proud" showed a very low loading (λ = .10). Also, six out of eight error correlations were not statistically significant. With respect to NA, the factor loadings were more homogeneous ($\lambda_{distressed}$ = .70; λ_{upset} = .60; λ_{guilty} = .51; $\lambda_{ashamed}$ = .33; $\lambda_{hostile}$ = .59; $\lambda_{irritable}$ = .61; $\lambda_{nervous}$ = .71; $\lambda_{jittery}$ = .55; λ_{scared} = .55; λ_{afraid} = .51), but also lower than those for PA. Nevertheless, all error correlations (except one) were significant. Taken together, results revealed that, especially for PA, the error terms reproduced partially Zevon and Tellegen´s (1982) mood content categories. Moreover, the modification indices (MIs) did not show significant sources of misfit for the model. Nevertheless, the MIs suggested a cross-loading for "proud" upon PA as well as NA. We will discuss this finding later.

Measurement Invariance

Once adequate fit was established for each group separately (60–74 vs. 75+; males vs. females) measurement invariance and structural invariance were tested in *model 2c* throughout the imposition of increasingly stringent cross-group equivalence rules. The results showed that the configural model fitted the data reasonably well across age (RMSEA = .067, CFI = .956), and gender (RMSEA = .064, CFI = .961) (see Table 4). The metric invariance model showed that the factor loadings were invariant across age and gender. In both cases, the changes in fit indices were smaller than the

Table 4. *Goodness of fit indices for MI model comparisons across age and sex*

	S-Bχ^2/df	RMSEA 90% CI	SRMR	CFI	NNFI	ΔS-Bχ^2 (Δdf, p)	ΔCFI	ΔRMSEA
Age								
Old	2.09	.061 [.052, .071]	.093	.971	.963			
Very old	1.90	.056 [.046, .065]	.094	.972	.971			
Configural invariance	2.33	.067 [.061, .073]	.098	.956	.956			
Metric invariance	2.34	.068 [.062, .073]	.102	.957	.955	4.31 (18, n.s)	.001	.001
Factor covariance invariance	2.36	.068 [.062, .074]	.103	.956	.955	59.36 (26, < .001)	.000	.001
Sex								
Male	1.85	.056 [.046, .066]	.097	.973	.962			
Female	2.16	.061 [.052, .070]	.087	.972	.964			
Configural invariance	2.22	.064 [.058, .071]	.087	.961	.957			
Metric invariance	2.19	.064 [.058, .070]	.088	.960	.958	4.78 (18, n.s)	–.001	.000
Factor covariance invariance	2.21	.064 [.058, .070]	.091	.959	.958	68.90 (26, < .001)	–.002	.000

Note: S-Bχ^2/df = Chi-square to degrees-of-freedom ratio (values should be less than 3). RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; CFI = comparative fit index; NNFI = non-normed fit index. ΔS-Bχ^2 = χ^2-difference model comparison test; ΔCIF = comparative fit index difference test; ΔRMSEA = root mean square error of approximation difference test.

cut-off values. Similarly, the factor covariance invariance test showed the equality of factor covariance across age and gender.

Criterion Validity, and Convergent/Discriminant Validity

Next, we examined criterion validity. We conducted three hierarchical regression analyses to test the effects of age on the PA scale. In the first step we entered age, and in the second and third step, their quadratic and cubic functions, respectively. The procedure was repeated for the NA scale. Similarly to Crawford and Henry (2004), our findings revealed that the relationship between age and both PA and NA was better described as a linear correlation. Thus, partially supporting our predictions, the correlation between age and PA was non-significant, $r = -.02$, but between age and NA was low but significant, $r = .10$, $p = .05$, probably due to the effect of the sample size. Additionally, univariate analyses showed no significant differences across gender on the PA scale, $F(1, 583) = 1.95$, $p = .12$, $\eta^2 = .003$, but females scored slightly higher than males on the NA scale, $F(1, 583) = 13.95$, $p \leq .05$, $\eta^2 = .023$.

The correlations conducted to test convergent validity revealed, as predicted, that PA was positively related to life satisfaction, $r = .42$, and negatively to depression, $r = -.46$, and loneliness, $r = -.31$. Similarly, as predicted, NA was related positively to depression, $r = .41$, and loneliness, $r = .24$, and negatively to life satisfaction, $r = -.21$.

Moreover, we evaluated the independent contributions of PA to life satisfaction and of NA to depression and loneliness by means of three hierarchical regression analyses. For life satisfaction, we introduced in the first step NA scores, and in the second PA scores. The same procedure was repeated for depression and loneliness, but entering PA in the first step and NA in the second. Our findings revealed that both PA and NA contribute independently to life satisfaction, depression and loneliness ($p < .001$ in all cases). As expected, PA explained a significant amount of variance of satisfaction with life, $\Delta R^2 = .17$, $p < .001$, and NA added a significant amount of explained variance to loneliness, $\Delta R^2 = .05$, $p < .001$, but especially to depression, $\Delta R^2 = .16$, $p < .001$.

Reliability of the Measures

The reliability estimates for PA and NA subscales were calculated using the alpha coefficient based in a non-linear approximation. We selected it instead of Cronbach´s alpha because of the ordinal nature of the variables, the asymmetry of the distributions, and the high variability in the intercorrelation of the items. For PA, reliability was .93 and for NA was .83.

Discussion

The objective of this work was to examine the internal structure of the Spanish version of the PANAS applied to individuals over 60 years old. Although this instrument is being widely used for research and clinical purposes, we have inconsistent evidences regarding its internal structure. The validation studies of the 20-item PANAS scale in older adults are very scarce. To fill this gap, we compared in a sample of community-dwelling older adults five different models to determine the independence of PA and NA, the presence of Zevon and Tellegen´s (1982) mood content categories, the measurement invariance, the reliability, as well as the criteria, convergent and discriminant validity of the scale.

Our CFA results confirmed that the orthogonal model allowing 13 correlated error terms according to mood content categories from Zevon and Tellegen´s (1982) (*model 2c*), best fit the data of Spanish older adults. These results were consistent with previous studies (e.g., Carstensen et al., 2000; Ready et al., 2012; Ready et al., 2007; Tuccito et al., 2010) that hypothesized an independent relationship between PA and NA in older people reflecting the complexity of affect in late life.

Regarding the presence of the emotion category system of Zevon and Tellegen (1982), we did not obtain the expected results. Even though including error term correlations produced a significant improvement in the tested models, that structure was only partially present. The reason is that while almost all correlations between errors were significant in NA, almost none of them were significant in PA. This suggests that, although theoretically justified, the effects of allowing error term correlations seem to be more related to a methodological issue than to the fact that older Spaniards share the emotional category structure proposed by Zevon and Tellegen (1982).

The CFA for PA and NA at the item level indicated that the majority of the items present adequate factor loadings, and only two items ("ashamed" and "proud") did not show adequate loadings. Likewise previous authors (e.g., Joiner et al., 1997; Thompson, 2007; Villodas et al., 2011), the term "proud" was not explained well enough by PA, which questions if this item is a good indicator of PA in older adults (e.g., Thompson, 2007) and in those with a medium-low education level (e.g., Joiner et al., 1997). Similarly, Merz et al. (2013) found low factor loadings and a minor threat for measurement invariance across age for the same item. In Spanish, the positive or negative meaning of *proud* depends on the communicative context and, it is possible that its social acceptance is different in collectivistic and individualistic cultures. As in younger populations (Thompson, 2007; Tuccito et al., 2010) and in collectivistic cultures (Moriondo, Palma,

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Medrano, & Murillo, 2012; Rodríguez & Church, 2003) the term "ashamed" has some difficulties as a good indicator of NA in older adults (Kercher, 1992; Mackinnon et al., 1999). Similarly, Nolla et al. (2014) found the lowest factor loadings for the terms "ashamed" and "guilty" in Spanish older adults.

From the life span perspective, our factor loadings can be reflecting improvements in age-related emotion regulation. For example, "shame" would be an emotion that the organism tries to maintain at a low level to avoid negative consequences for the person. In this line, Watson, Wiese, Vaidya, and Tellegen (1999) pointed out that it is normal that NA levels were low because in everyday life old people are less exposed than other age groups to situations that produce NA. They would only increase significantly when some activating situation appears so, when the situation is solved they go back to the baseline level. Moreover, older people are more likely to reappraise a stressful event in a positive way than younger persons because they use antecedent-focused strategies more frequently than response-focused strategies to regulate their emotions (Charles & Carstensen, 2007).

Results obtained from the test of measurement invariance confirmed that the two-independent factor structure (with correlated errors) can be used across young-old and very old people, as well as, across males and females. Configural, metric and factor covariance invariance demonstrated that for older adults of different ages, and for males and females (a) the PANAS measures the same construct; (b) the 20 items of the scale measures PA and NA in the same way, (c) and that the latent factors correlate similarly. This is an important issue because "the failure of a psychological measure to be equal across groups may indicate that the language used in the items or the values or aspirations in the items do not validly apply to different groups" (Atienza, Balaguer, & García-Merita, 2003, p. 1259). Future research should compare factor structure across different health conditions (objective and subjective), living conditions (living with a partner vs. living alone) and also explore the clinical usefulness of the PANAS in old age.

Our findings about the criterion validity of the PANAS seem to agree with cross-sectional and longitudinal results (e.g., Carstensen et al., 2000; Charles et al., 2010; Kunzman, 2008; Windsor & Anstey, 2010) that suggest the stability of affects in the elderly. However, contrary to the proposals of Pinquart (2001), and Vogel et al. (2012) the present findings do not support a non-linear hypothesis about the relationship between age and affect.

Results related to the convergent and discriminant validity of PANAS permit us to recommend this instrument as a measure of subjective well-being. The relationships of the other component of well-being, life satisfaction, were positive for PA and negative for NA. In addition, as suggested by Crawford and Henry (2004), the PANAS could be also used as a complementary measure to diagnose depression. Supporting the tripartite model (e.g., Clark & Watson, 1991) high levels of depression correlated positively with NA and negatively with PA.

This work has some limitations and we consider that our results must be considered with some caution. Even though we found an orthogonal model with a satisfactory adjustment, and several theories related with the interpretation of these results, we consider that the Spanish version of the PANAS should be improved reviewing some items to better capture the structure of emotions in older adults. Several strategies can be employed to pursue this objective. For example, research advances in the expression of emotions show that the Spanish terms used to describe basic and universal emotions are organized consistently following a salience order (Delgado, 2009). Some of these emotions, such as "happiness" are not present in the PANAS instrument. Another promising line of research could be to examine the tenability of the three factor models (PA: NA; Afraid, Upset) studied by Gaudreau, Sanchez, and Blondin (2006) in young samples, or the more recent bifactor models argued by Ebesutani et al., 2011).

Given the advantages of shortening measurement scales for older adults, similarly to Merz et al. (2013), new research should examine the psychometric properties of the existing short forms of the PANAS or develop new versions using the most recent methodological trends. In this regard, we encourage future research to deeply study the functioning of this scale with studies from the Item Response Theory (IRT) (e.g., Pires, Filgueiras, Ribas, & Santana, 2013) since IRT modeling provides a comprehensive and accurate evaluation of item characteristics based on "item-free" and "person-free" estimations.

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