

Structural equation models for prediction of subjective well-being: Modeling negative affect as a separate outcome

Öznel iyi oluşu yordamak için yapısal eşitlik modelleri: Negatif duygulanımı ayrı bir değişken olarak modelleme

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Abstract

Diener's recommendation that researchers assess well-being by combining scores on Satisfaction with Life (SWLS), positive affect (PA), and negative affect (NA) has been nearly universally adopted. Latent variables that represent subjective well-being (SWB) in structural equation models often include SWLS, PA and NA as multiple indicators. However, Diener and his colleagues have also pointed out that PA and NA have different predictors. In order to compare structural models in which NA is combined with other indicators of well-being with models in which NA is treated as a separate outcome, we collected data on SWB, neuroticism, extraversion, and global social support for college students ($N = 847$). Structural Equation Model 1, in which NA was one of several indicators of SWB, was compared with three other models that represented NA as a separate outcome. Better model fit was obtained when NA was represented as a separate outcome variable, rather than as one of several indicators of SWB. This type of model also yields more information about the different predictors for positive and negative components of well-being. In future research, data analysts may consider representing NA and other negative emotional outcomes as separate dependent variables, instead of treating them as (reverse scored) indicators of SWB.

Keywords: Subjective well-being, happiness, negative affect, social support, structural equation models

Özet

Diener'in, iyi oluşu, Yaşam Doyumu Ölçeği (YDO), pozitif duygulanım (PD), ve negatif duygulanım (ND)'dan edindikleri puanları birleştirerek değerlendirmeleri fikri araştırmacılar tarafından neredeyse evrensel olarak kabul görmüştür. Yapısal eşitlik modelinde Öznel İyi Oluşu (ÖİÖ) temsil eden diğer örtük değişkenler genellikle çoklu göstergeler olarak YDO, PD ve ND değişkenlerinden oluşur. Ancak, Diener ve arkadaşları PD ve ND'nin farklı yordayıcıları olduğuna da dikkat çekmişlerdir. ND'nin iyi-oluşun diğer göstergeleri ile birleştirildiği yapısal modeller ile ND'nin ayrı bir değişken olarak değerlendirildiği modelleri karşılaştırmak için, üniversite öğrencilerinden ÖİÖ, nevroziklik, dışa dönüklük ve global sosyal destek ile ilgili veri toplanmıştır ($N = 847$). ND'nin, ÖİÖ'nun bir çok göstergesinden biri olduğu Yapısal Eşitlik Modeli 1, ND'nin ayrı bir bulgu değişkenini temsil ettiği üç farklı model ile karşılaştırılmıştır. ND ayrı bir değişken olarak modele katıldığında, ÖİÖ'nun göstergelerinden birini temsil ettiği modele göre daha iyi bir sonuç elde edilmiştir. Böyle bir model ayrıca iyi oluşun negatif ve pozitif bileşenleri ile ilgili daha fazla bilgi sağlamaktadır. Gelecekte yapılacak olan araştırmalarda da, veri analistleri ND ve diğer negatif duygusal değişkenleri, ÖİÖ'nun (ters puanlanmış) göstergeleri olarak değerlendirmek yerine, ayrı birer bağımlı değişken olarak değerlendirmeyi düşünebilirler.

Anahtar Kelimeler: Öznel iyi oluş, mutluluk, olumsuz duygulanım, sosyal destek, yapısal eşitlik modeli

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Introduction

Diener's definition of SWB includes three components: High satisfaction with life, frequent positive affect, and infrequent negative affect (Diener, 1984, 1994; Diener, Suh, Lucas, & Smith, 1999). In practice, these components are usually measured using the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen & Griffin, 1985) and the positive and negative affect scales from the PANAS (Watson, Clark and Tellegen, 1988). An obvious way to translate Diener's recommendations into a measurement model for use in Structural Equation Modeling is to represent SWB as a latent variable with SWLS, PA, and NA as multiple indicator, as shown in Figure 1 (in the Results section).

Differences among components of subjective well-being (SWB), and associations between components of well-being, have been extensively studied over the last decade (e.g., Arthaud-Day, Rode, Mooney, & Near, 2005; Karademas, 2007); this research was in response to comments by Diener and his colleagues about the lack of research concerning differential influence of personal and situational variables on separate components of SWB (Diener, Suh, Lucas, & Smith, 1999).

Structural equation models with latent variables include assumptions about measurement (that is, which measured variables provide information about each latent variable of interest, such as SWB) and also hypotheses about causality (which predictor variables are hypothesized to influence outcomes such as SWB?). When a structural model focuses primarily on measurement, using SWLS, PA and NA as multiple indicators for a latent SWB variable yields good model fit. For example, Linley, Maltby, Wood, Osbourne, and Hurling (2009) obtained good fit for a model that examined Psychological Well-Being in relation to SWB, using SWLS, PA and NA as multiple indicators for SWB.

However, treating NA as an indicator of SWB may not work well in the context of models that include hypotheses about causes of SWB. Some tests of causal models for SWB (such as Eryilmaz, 2012; McMahan & Renken, 2011; Molnar, Busseri, Perrier, & Sadava, 2009) have represented SWB as a latent outcome variable with SWLS, PA and NA (or similar measures) as indicators. There is an important reason why including NA as an indicator of SWB may not be the best approach when SWB is the outcome variable in a causal model. Diener and Emmons (1984) and others (Mroczek & Kolarz, 1998) have pointed out that PA and NA have different predictors. If this is the case, then including NA as an indicator of a latent SWB variable may not be optimal; this type of model structure cannot provide information about differences in prediction for positive and negative components of SWB. The present study examines simple 'causal' models for SWB that include some of the most commonly used predictors: Traits from the Five Factor model of personality and measures of quantity and quality of social relationships. The term 'causal' is shown parenthetically to remind us that, while the paths in structural equation models represent causal hypotheses, the results of the analyses cannot be interpreted as proof of causality.

Selected Predictors of SWB

Extraversion and Neuroticism (from the Five Factor model of personality) are consistently strong predictors of SWB (Costa & McCrae, 1980; David, Green, Martin & Suls, 1997; Diener, Oishi & Lucas, 2003; McCrae & Costa, 1991). Other variables frequently included in discussions of factors that may influence SWB are social network size and perceptions of social support (Diener & Seligman, 2002; Myers, 2002; Myers & Diener, 1995). Perceived social support is the amount of help a person believes to be available from other people, such as emotional support (nurturance or comfort), tangible support (money or other resources), and companionship. Social network size refers to the number of people from whom a person receives social support.

A small number of people ($n = 36$) reported that they did not have a living mother or a best friend. Mother and best friend are likely to be particularly important sources of social support; people who do not have these relationships are likely to have substantially different social support experiences than other participants in our study. To control for these variables (presence/ absence of best friend and mother), participants who did not have a living mother or best friend were removed from the analysis. The present study uses extraversion and neuroticism, along with global social support and network size, as predictors of SWB. Of course, other variables also predict SWB.

Differences in Predictors for PA and NA

Although overall subjective well-being has been defined to include frequent PA and infrequent NA, studies suggest that these are separable and that different factors may predict PA versus NA. Diener, Smith & Fujita (1995) reported that positive and negative emotions were correlated $-.44$ and that a two factor model for emotions accounted for significantly more variance than a one factor model. Diener and his colleagues stated: “In the past, many researchers have treated SWB as a monolithic entity, but it is now clear that there are separable components that exhibit unique patterns of relations with different variables” (Diener, Suh, Lucas, & Smith, 1999). For example, Karademas (2007) reported that self-efficacy and positive approaches to coping predict positive well-being, while neuroticism and stress predict negative well-being.

Mediated Causal Models

Several studies have examined whether the effects of extraversion on happiness and well-being may be accounted for or mediated by sociability or activity in social relationships (for example, Lucas, Le & Dyrenforth, 2008). Both Tkach and Lyubomirsky (2006), and Warner and Vroman (2011), examined whether the effects of extraversion and neuroticism on SWB were partially mediated by social relationships; both studies reported that effects of extraversion on SWB were partially mediated by measures of social activity or nurturing social relationships but that effects of neuroticism on SWB were not mediated by social activity or by other behavioral variables. When structural models include both traits and social behaviors as predictors of SWB, it is useful to examine paths that represent mediated relationships where these may exist.

Present Study

As noted earlier, most past Structural Equation Modeling (SEM) studies have used SWLS, PA, and NA as indicator variables for Overall SWB. The present study examines a different approach. Because Diener (2013) has argued that predictors of NA differ from the predictors of PA, we examine models in which NA is treated as a separate outcome variable and compare them to a model that uses NA as one of several indicators of a latent overall SWB variable. To avoid creating latent variables with fewer than 3 indicators, we added an additional variable as an SWB indicator, a measure of happiness (denoted Happy).

We distinguish Overall SWB from Positive SWB. Overall SWB (consistent with past research) is represented as a latent variable with SWLS, PA, Happy, and NA as indicators. In our new models Positive SWB has only SWLS, PA and Happy as indicators (that is, Positive SWB does not include NA as an indicator). Four models were evaluated for prediction of well-being from extraversion, neuroticism, global social support, and network size. Model 1 represents the past practice of including NA as one of the multiple indicators of Overall SWB (see Figure 1). Model 2 examines NA and

Positive SWB as separate outcomes. Model 3 is a minor modification of Model 2, in which paths with statistically non-significant coefficients were omitted. Finally, Model 4 includes indirect paths to represent the possibility that effects of traits on Positive SWB and NA may be partially mediated by social support and to evaluate whether treating NA as a separate outcome continues to work well in a slightly more complex model. See Figures 2, 3, and 4 for diagrams of these models.

The predictions were as follows: Model 1 should not fit well, because it does not take into account the possibility that NA has different predictors than Positive SWB. All three subsequent models represent Positive SWB and NA as separate outcomes. Model 2 (with NA as a separate outcome) should fit better than Model 1, because Model 2 allows predictor variables to have different relationships with Positive SWB and NA. Model 3, including only statistically significant paths from Model 2, should fit about the same as Model 2; the inclusion of fewer paths in Model 3 highlights the different predictors for Positive SWB and NA and Model 3 is more parsimonious. Finally, we predicted that adding mediated paths (in Model 4) should continue to yield adequate model fit with NA and Positive SWB represented as separate outcomes.

Method

Participants

A total of 911 students completed an on line survey. After deleting those who completed the survey multiple times, persons under the age of 18, those who had incomplete data on variables included in subsequent analysis, the 33 people who said that they did not have a best friend, and 3 persons who reported mother deceased, the sample size was 847. (Those who did not report a best friend or mother were dropped because these variables could have a strong influence on well-being; however, there were too few persons without best friends or mothers to include presence/absence of these as predictor variables.) Thus, all persons in the remaining sample reported that they had a mother and best friend. The sample was homogeneous (71% female, 97% between age 18 and 21, 93% white, 65% freshmen, and 96% heterosexual).

Measures

Big Five Inventory (BFI; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008). This measure uses 44 items to assess personality traits in the five factor model. Each has a 5-point scale (1 = *disagree strongly*, 5 = *agree strongly*). Items form subscales for each of the five factors: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. The measure has shown internal consistency across a number of samples with alphas ranging from .75 to .90 and averaging above .80 (John & Srivastava, 1999). The current study used the extraversion (Cronbach's $\alpha = .67$) and neuroticism (Cronbach's $\alpha = .84$) scales.

Interpersonal Support Evaluation List (ISEL-12; Cohen, Mermelstein, Kamarck, & Hoberman, 1985). This measures global perceived social support. This measure is a short version of the original measure created by Cohen et al. (1985) and has been validated by Cohen (see <http://www.psy.cmu.edu/~scohen/scales.html> for further information). The short version shows adequate internal consistency (Cronbach's $\alpha = .74$), and similar results were found within the current sample (Cronbach's $\alpha = .85$). Previous versions have used longer versions to obtain three subscales (i.e., Appraisal, Tangible, Belonging); in the present study, the ISEL-12 provided one global score of perceived social support. Scores were calculated by summing scores across items, each rated on a 1 (*definitely false*) to 4 (*definitely true*) scale; possible scores ranged from 12 to 48.

Network Size. In a series of open ended questions, participants were asked to list up to five people (other than mother and best friend) who were substantial sources of support. Some respondents listed more than one person per text box response (e.g., if the person listed 'grandparents', this could refer to up to four persons, but the exact number is not clear. We coded plural responses as 2 sources of support.) If the respondent also reported an exclusive dating partner, this was added to the number of supportive persons. Network size therefore corresponds to the number of supportive people other than mother and best friend. The range of scores on the Network Size measure was 0 to 10. No reliability coefficient (such as Cronbach's α) could be obtained for this measure.

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). This scale is a 5-item measure designed to assess global life satisfaction, a cognitive component of subjective well-being. The scale has shown good internal consistency (Cronbach's $\alpha > .85$) in several samples and showed similar consistency in the current sample (Cronbach's $\alpha = .87$) (Diener et al., 1985; Pavot, Diener, Colvin, & Sandvik, 1991). A 7-point Likert-type scale (1 = *strongly disagree*, 7 = *strongly agree*) is used with the five items. The average of the items was multiplied by the total number of items; thus, the range of possible scores was from 5 to 35, and higher scores represent greater satisfaction with life.

Subjective Happiness Scale (Lyubomirsky & Lepper, 1999). This is a 4-item measure of global subjective happiness, another component of subjective well-being. This was included in order to have one additional indicator variable for SWB. The measure has good internal consistency (Cronbach's $\alpha > .80$, Lyubomirsky & Lepper, 1999); in our sample Cronbach's $\alpha = .84$. Each item was rated on a 7-point scale; one item was reverse worded. Total score was the average of ratings across the four items; the range of possible scores was 1 to 7 with higher scores indicating greater happiness.

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). This measure uses 20 affective adjectives to assess positive and negative affect (e.g., emotions, moods). Each item was rated on a 5-point scale (1 = *very slightly or not at all*, 5 = *extremely*). The PANAS has shown good internal consistency across several samples (Cronbach's $\alpha > .80$) using a variety of time instructions (Watson et al., 1988). The current study used the time frame *in the past week* (Cronbach's $\alpha = .86, .84$, respectively for the PA and NA scales). Ratings were summed across items; possible scores ranged from 10 to 50 for each scale.

Procedure

At universities in the United States, all research involving human participants must be approved by an Institutional Review Board (IRB). The IRB evaluates proposed research to ensure that informed consent is obtained, that there are minimal risks to participants, and that confidentiality of responses is maintained. This research was IRB approved. Participants responded whether they were willing to do the survey after reading an informed consent form, then completed an anonymous one hour on-line survey that included demographics and measures described above. They were provided with written debriefing information and thanks for participation. Participants received one hour of credit (worth points toward a psychology course grade) as compensation. Additional measures included in the survey (ratings of relationship quality and conflict for mother, best friend, and dating partner if present) will be reported elsewhere.

Results

Preliminary Data Screening

Scores on Extraversion, Neuroticism, SWLS, and PA were fairly normally distributed. Scores on ISEL, NA, and network size were skewed (with a mode near the high end of the range for the ISEL and near the low end of the range for NA and network size). There were no extreme outliers. Scatter plots for pairs of variables did not suggest problems with assumptions of linearity. Descriptive statistics for all variables appear in Table 1; values are generally similar to those reported in past research where these measures have been used. Correlations among predictors are summarized in Table 2; none of these were high enough to suggest serious collinearity problems. Correlations among the well-being measures appear in Table 3; as expected, these were positively correlated with each other, except for NA, which had negative correlations with other well-being measures. Finally, correlations between predictor and outcome variables are presented in Table 4.

Table 1. *Descriptive statistics for all variables*

	<i>M</i>	<i>SD</i>	Min	Max
Extraversion	27.77	4.54	13	38
Neuroticism	23.43	6.02	8	40
ISEL	40.77	5.86	17	48
Network size	1.87	2.10	0	10
SWLS	26.02	5.67	5	35
PA	35.08	6.32	14	50
NA	21.81	6.65	10	50
Happiness	5.22	1.00	1.5	7

N = 847

Extraversion and Neuroticism are scales from the John version of the Big Five personality trait assessment; ISEL is Cohen's Interpersonal Support Evaluation List (12 item version); Network size is number of persons who were reported as significant sources of support, not including mother and best friend (all persons in final sample had mother and best friend); SWLS is Diener's Satisfaction with Life Scale; PA and NA are the positive and negative scales of the Watson et al. PANAS affect rating scale; Happiness is the Lyubomirsky and Lepper scale.

Table 2. *Pearson correlations among predictor variables*

	Neuroticism	ISEL	Network Size
Extraversion	-.232***	.324***	.080*
Neuroticism		-.218***	.051
ISEL			.196***

For all correlations, $N = 847$; significance tests are two-tailed.

Extraversion and Neuroticism are scales from the John version of the Big Five personality trait assessment; ISEL is Cohen's Interpersonal Support Evaluation List (12 item version); Network size is number of persons who were reported as significant sources of support, not including mother and best friend (all persons in final sample had mother and best friend).

*** $p < .001$ ** $p < .01$ * $p < .05$

Table 3. *Pearson correlations among well-being outcome measures*

	PA	NA	Happiness
SWLS	.445***	-.323***	.578***
PA		-.167***	.461***
NA			-.312***

*** $p < .001$ For all correlations, $N = 847$; significance tests are two-tailed.

SWLS is Diener's Satisfaction with Life Scale; PA and NA are the positive and negative scales of the Watson et al. PANAS affect rating scale; Happiness is the Lyubomirsky and Lepper scale.

Table 4. *Pearson correlations between predictors and outcomes*

	SWLS	PA	NA	Happiness
Extraversion	.302***	.355***	-.125***	.436***
Neuroticism	-.341***	-.359***	.519***	-.477***
ISEL	.349***	.261***	-.218***	.367***
Network Size	.091**	.077*	-.029	.072*

*** $p < .001$ ** $p < .01$ * $p < .05$ For all correlations, $N = 847$; significance tests are two-tailed.

Extraversion and Neuroticism are scales from the John version of the Big Five personality trait assessment; ISEL is Cohen’s Interpersonal Support Evaluation List (12 item version); Network size is number of persons who were reported as significant sources of support, not including mother and best friend (all persons in final sample had mother and best friend); SWLS is Diener’s Satisfaction with Life Scale; PA and NA are the positive and negative scales of the Watson et al. PANAS affect rating scale; Happiness is the Lyubomirsky and Lepper scale.

To rule out the possibility that there might be interactions between variables, preliminary regression analyses were performed that included interactions between extraversion and neuroticism, and the ISEL and network size variables. None of these interactions were statistically significant.

Model 1: Past Approach to Modeling in which NA is represented as an indicator of SWB

Most researchers who have used a latent variable with multiple indicators to represent well-being in structural models have created one latent variable for well-being and used SWLS, PA and NA as indicator variables; in this study, the Lyubomirsky & Lepper (1999) Happiness scale was added as an additional indicator variable for positive well-being. Figure 1 represents the first model that was tested. Neuroticism, Extraversion, ISEL, and network size were represented as correlated predictors of the latent variable SWB. AMOS 20 was used to conduct all of the following structural equation model analyses, with Maximum Likelihood as the method of estimation.

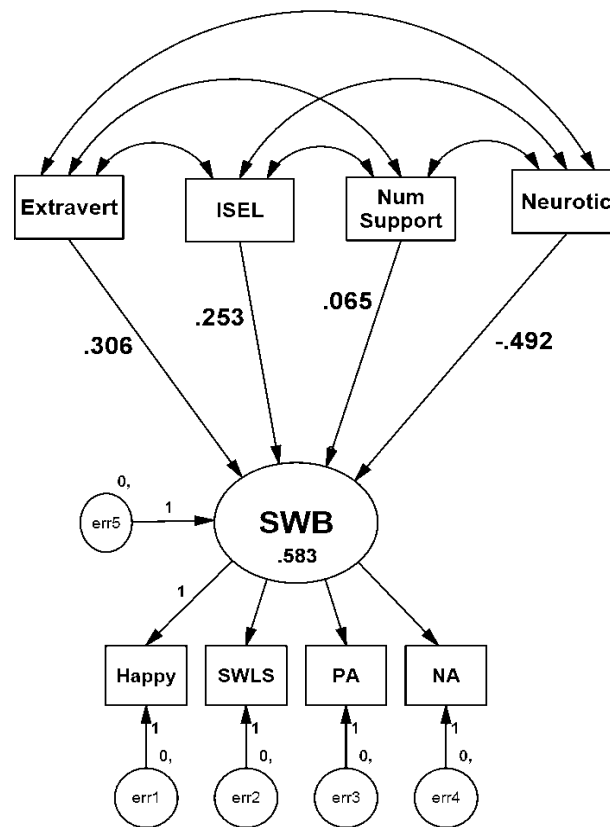


Figure 1. Model 1 SWLS, Happiness, PA, and NA are indicators for the latent variable SWB, with ISEL, E, N and network size as correlated predictors of SWB. Standardized path coefficients are shown. Numbers within ovals or rectangles represent squared multiple correlations for outcomes

Extraversion and Neuroticism are scales from the John version of the Big Five personality trait assessment; ISEL is Cohen's Interpersonal Support Evaluation List (12 item version); Network size is number of persons who were reported as significant sources of support, not including mother and best friend (all persons in final sample had mother and best friend); SWLS is Diener's Satisfaction with Life Scale; PA and NA are the positive and negative scales of the Watson et al. PANAS affect rating scale; Happiness is the Lyubomirsky and Lepper scale.

As predicted, Model 1 did not provide adequate fit; $\chi^2(14) = 191.8, p < .001$; obtained CFI = .886 (CFI > .90 considered desirable) and obtained RMSEA = .123 (RMSEA < .10 or even lower is considered desirable). See Kline (2011) for discussion of criteria for model fit. The Akaike Information Criterion (AIC) can be used to make comparisons among non-nested models; a lower AIC value indicates better fit/ less loss of information; for model 1, AIC = 251.756. All path coefficients were statistically significant, $p < .001$. All coefficients reported here are standardized path coefficients. The largest Modification Index (MI = 79.263) was for the association between Neuroticism and err4 (the error term associated with NA). This indicates that NA was not adequately explained by this model and in particular, the strength of the relationship between Neuroticism and NA was not captured by this model. Adding a path to represent a nonzero correlation or covariance between Neuroticism and err4 would not make sense. It makes more sense to interpret this large Modification Index as an indication that Model 1, with a single path from predictors to all SWB indicators, does not provide adequate paths to predict NA. Perhaps a model that includes different predictive paths for NA than for the positive components of SWB will provide a better fit; that was the approach taken in development of Model 2.

Model 2: Modified Approach with NA as Separate Outcome

To improve model fit, the following modification was made. Instead of treating NA as an indicator variable for the latent variable SWB, NA was represented as a separate outcome variable in Model 2. The latent outcome variable was renamed Positive SWB because the remaining indicator variables (happiness, SWLS and PA) were all positive components of SWB. Figure 2 shows the standardized path coefficients for Model 2. All predictor variables had causal paths for both outcome variables, positive SWB and NA. Fit indexes were adequate for this model; $\chi^2 = 63.3(11), p < .001$, CFI = .966, RMSEA = .075, AIC = 129.291. The overall R^2 for prediction of SWB was .535 and the R^2 for prediction of NA was .283. All paths were statistically significant in this model ($p < .001$) except for the paths from extraversion and number of supportive people to NA. Note that Positive SWB was predicted by both extraversion and neuroticism while NA was predicted only by neuroticism (and not by extraversion).

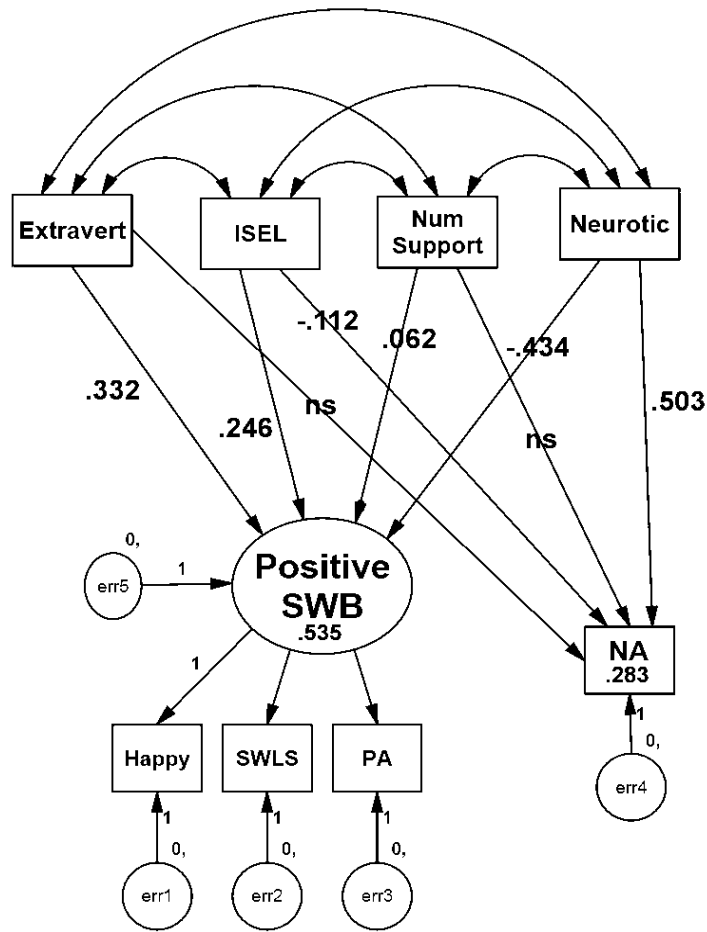


Figure 2. Model 2: NA treated as a separate outcome. Correlated predictors are extraversion, global social support/ISEL, network size, and neuroticism; outcomes are positive SWB (with indicator variables happiness, SWLS, and PA); and NA as a separate outcome variable. All possible causal paths included.

Model 3: Paths That Were Not Statistically Significant in Model 2 Omitted

Model 3 was the same as model 2, except that the non-significant paths in model 2 were removed (i.e., extraversion and network size to NA). Model fit remained good, with $\chi^2(13) = 65.493, p < .001, CFI = .966, RMSEA = .069, AIC = 127.494$. Neuroticism was predictive of both Positive SWB and NA. However, variables that represent positive traits and behaviors (extraversion, social support and number of supportive people) were weakly related to NA, or not statistically significant as predictors.

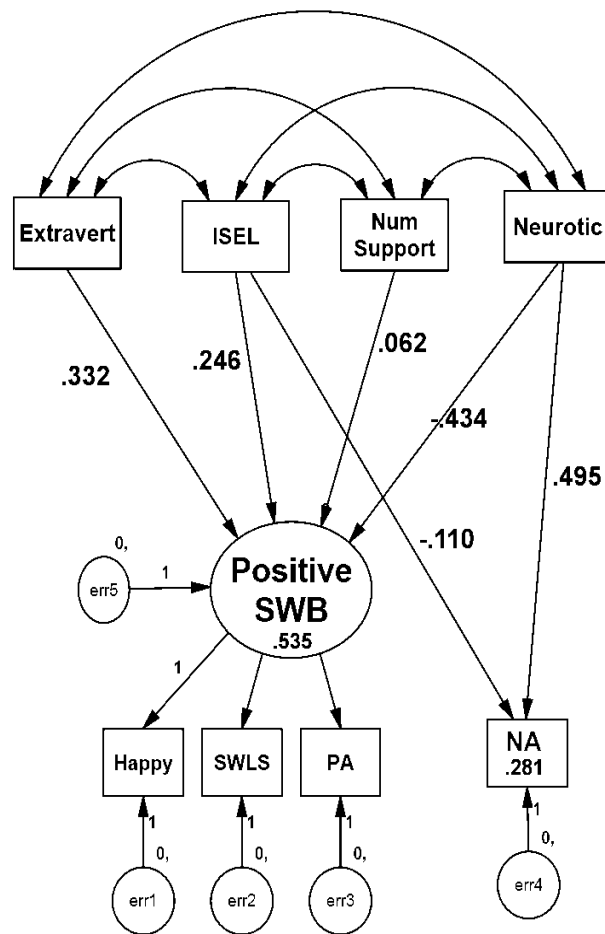


Figure 3. Model 3: Same as Model 2, but with non-significant causal paths omitted. In this model, ISEL, network size, and extraversion are predictors of positive SWB (with indicator variables happiness, SWLS and PA). Neuroticism predicts both positive SWB (with a negative path coefficient) and NA.

Model 4: Social Support as Potential Mediator of Effects of Personality on SWB and NA

Instead of representing traits and social support simply as correlated predictors, this model included indirect/mediated paths to represent the possibility that effects of extraversion and neuroticism on positive SWB and NA might be partially mediated by social support. Number of supportive people / social network sized was dropped from this model because it had weak effects in earlier analyses.

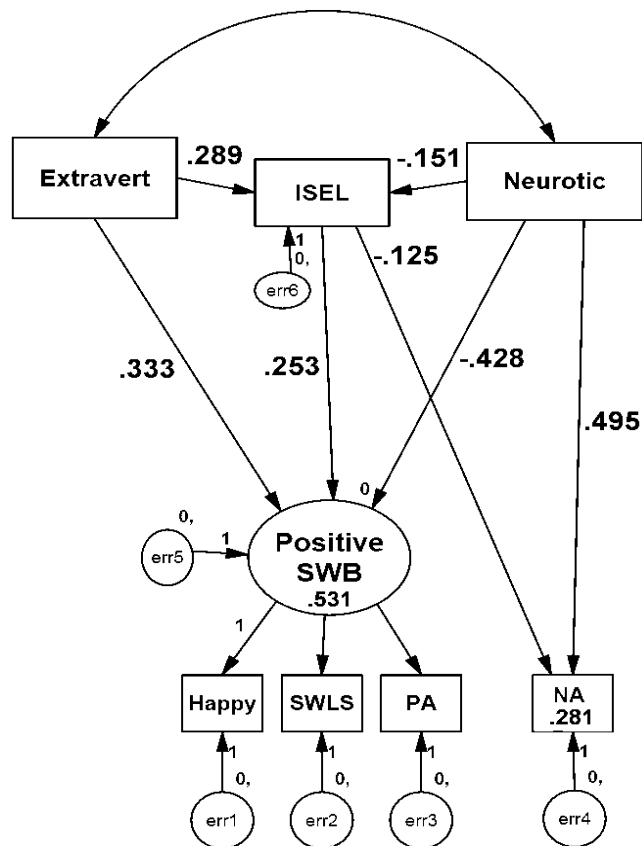


Figure 4. Model 4: Prediction of Positive SWB and NA from Extraversion and Neuroticism with ISEL as a partial mediator of effects on positive SWB

The fit for Model 4 was good. Fit statistics were $\chi^2(10) = 63.579$, $p < .001$; CFI = .965; RMSEA = .080; and AIC = 113.579. The overall R^2 for prediction of SWB from Extraversion, Neuroticism and ISEL was .531, and the R^2 for prediction of NA was .281. To evaluate the indirect path from Extraversion to SWB, mediated by social support, we consider the product of the path coefficients from Extraversion to ISEL (denoted a) and from ISEL to SWB (denoted b). (In discussions of tests of mediation, these paths are typically denoted a and b and the product, ab , represents the strength of the indirect or mediated relationship; Warner, 2013). Bootstrapping was performed ($N = 2000$ bootstrap samples) and a bias-corrected, accelerated 95% CI was set up; the sample value of ab in standardized units was .075, LL = .052, UL = .100; this value of ab had an obtained p value of .001, and thus can be judged statistically significant. However, the effect via this indirect path (.075) was small compared the direct path from extraversion to SWB (with a standardized path coefficient of .333) In other words, a statistically significant but relatively small part of the effect of extraversion on SWB may be mediated by social support (indexed by the ISEL).

Similar analyses were performed to evaluate whether part of the effect of neuroticism on SWB was mediated by social support (ISEL). The standardized estimate for the ab path that represented the path from neuroticism to ISEL and from ISEL to SWB was -.039, with a CI that ranged from -.059 to -

.023; this was statistically significant, $p = .001$. For Neuroticism, as for Extraversion, there was statistically significant but very weak mediation by ISEL. The direct effect of Extraversion on SWB ($\beta = -.428$) was much stronger.

In the context of a model that controlled for both neuroticism and extraversion, the direct effect of ISEL on SWB was moderate, standardized coefficient = .228, $p < .001$. Social support measured by the ISEL predicted about 5% of the variance in SWB in the context of this model. (The zero order correlation of ISEL with SWLS was .349, therefore when personality traits were not statistically controlled, social support predicted about 12% of the variance in life satisfaction.)

Comparison of Model Fit

Some models were not nested in other models, therefore the χ^2 test could not be used to test statistical significance of changes in fit across models. Model fit can be compared across non-nested models using the AIC (a larger value of AIC indicates worse fit). The AIC values for the four models were as follows: Model 1, 251.76; Model 2, 129.29; Model 3, 127.49; and Model 4, 113.58. Model 1, the only model in which NA was used as an indicator for Overall SWB and not as a separate dependent variable, had worse fit than Models 2, 3, and 4, all of which used NA as an outcome variable separate from Positive SWB. Models 2, 3 and 4 were similar to each other in fit.

Discussion

Results suggest that it is preferable to treat NA as a separate outcome variable in structural models that test causal hypotheses for SWB, rather than using NA as one of several indicators for a latent SWB variable, as often done in some past research. Doing this may yield better model fit and also more specific information about the different ways predictors are related to positive and negative outcomes. Model 1, the only model that incorporated NA as an indicator variable for SWB, had the worst fit among all the models examined, with the largest AIC value. Models that represented NA as a separate outcome from the positive components of SWB (happiness, SWLS, and PA) performed much better. Examination of results from models 2 and 3 suggest that while positive SWB is predictable from both extraversion and neuroticism, NA is predictable only from neuroticism (and not from extraversion). Model 4 results indicate that this interpretation still makes sense even when social support variable (ISEL) is represented as a mediating variable. Model 4 results also suggest that (as in prior reports by Tkach & Lyubomirsky, 2006; and Warner & Vroman, 2011), social relationship variables were only weak mediators of the effects of extraversion and neuroticism on SWB.

The results are consistent with the argument that 'bad is stronger than good', as suggested by Baumeister, Bratslavsky, Finkenauer, & Vohs (2001). Extraversion had positive effects only as a predictor of the positive components of SWB; Extraversion was not significantly related to lower NA, at least within the context of these data. On the other hand, neuroticism predicted both higher NA, and lower scores on positive SWB components. These results are also partially consistent with findings of Rusting and Larsen (1996). In their mood induction study, extraversion was associated with positive but not negative affect (consistent with the results reported here). By contrast, Rusting et al. reported that neuroticism was associated with negative but not positive affect. In the present study neuroticism predicted both well-being and NA. The difference in outcomes may well be due to the fact that they studied induced mood, while we measured naturally occurring PA and NA.

This study has several limitations. Although the sample was large it was also homogeneous with respect to age, ethnicity and education. Results might not generalize to other age or ethnic populations. The sample was selected such that all retained participants reported having a mother and best friend;

thus, people who truly had no social support at all were not included in our sample (the network size variable in this study was number of people who were important sources of support in addition to mother and best friend). Because of this, the effect of network size may be underestimated here. Also, the time frame for which affect was reported on the PANAS was *in the past week*. None of the other variables in this study were evaluated for such a limited time frame. It is conceivable that predictive associations among variables might have been stronger, and perhaps even qualitatively different, if the PANAS had been given with instructions to report affect in general without any limited time frame in the instructions.

It is important to note that structural equation modeling tests whether hypothesized causal models are consistent with observed data. Good model fit, however, does not prove that a particular model is theoretically sound, nor does this type of analysis provide a basis for causal inference. These are called ‘causal’ models because many paths represent causal hypotheses. The final model presented here fit the observed data well; this does not establish causality. It also does not rule out the possibility that alternate models may exist that fit the data just as well or better. The intent in this paper was not to prove that extraversion, neuroticism and social support causally influence subjective well-being, but rather, to point out that when models are tested, model fit is better when NA is treated as a separate outcome variable. Results suggest, but do not prove, that different causal variables may influence NA and other, positive aspects of SWB.

The final model (model 4) predicted a large proportion of the variance in positive SWB ($R^2 = .531$) and a much smaller proportion of variance in NA ($R^2 = .281$). The relatively weak prediction of NA is probably due to several factors. First, other than neuroticism, no ‘negative’ predictors (such as perceived stress) were included. Second, negative affect did not have multiple indicators; it would be possible to develop a multiple indicator assessment of NA. Finally, the limited time frame for assessment of NA may have reduced the correlations of this variable with the other variables in this study.

Overall, results were consistent with our predictions. SEM models that included NA as a separate outcome variable fit better than an SEM model that included NA as one of several indicators of overall subjective well-being. Adequate model fit is not the only issue, however. From a theoretical perspective, the idea that positive and negative affect may have different causes or predictors is not new; Diener (2013) recently renewed this argument. Our data provide an example of this. In Model 3 we found that Positive SWB was significantly related to all four predictor variables, whereas NA was significantly predictable only from Neuroticism and perceived social support (and not from Extraversion and network size). This kind of information is lost when researchers combine NA with other indicators of (positive) well-being.

Directions for Future Research

Future research could include a larger set of measures of both positive and negative components of well-being. In addition, it would be useful to assess PA and NA using multiple time frames, because correlations among well-being components may change as a function of the time periods used in positive and negative mood assessments; this in turn would probably change the magnitudes of paths for both the measurement and structural/ regression components of the SEM model. Additional well-being measures, for example, those based on Ryff and Singer’s (1996) model, would extend research to other types of well-being that are more eudaimonic in nature. Diener’s definition of well-being, and the measures used in the present study, assess hedonic well-being.

Future research should also include additional predictors of well-being. Research could also examine more diverse samples of participants. Data from participants with different backgrounds (age,

education, culture and so forth) might yield different results. In addition, different estimation methods for SEM model parameters could also be examined.

Obviously the argument that negative and positive well-being outcomes should be examined separately would be much stronger if models that separate NA from positive components of well-being fit better and yield different predictive models for NA and positive well-being across many situations such as: Different and/or additional measures, multiple time frames for assessment of mood, more diverse samples, and a variety of estimation methods and analyses. Further empirical work could clarify the degree to which results reported here may be generalizable. Re-analysis of data from past studies in which similar variables were measured, but NA was not examined separately, could provide substantial new information about Diener's ideas that positive and negative well-being are related to different predictors.

To summarize: Results suggest that it would be useful and informative to examine NA separately from indicators of positive components of well-being in future research. This approach could yield better model fit and also more information about different pathways that may lead to positive and negative aspects of well-being.

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