Journal of Research in Personality 45 (2011) 2–9

Contents lists available at ScienceDirect

Journal of Research in Personality

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

Modeling trait and state variation using multilevel factor analysis with PANAS daily diary data

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ARTICLE INFO

Article history:
Available online 11 November 2010

Keywords:
Positive Affect
Negative Affect
Trait variability
State variability
Daily diary
Multilevel factor analysis

ABSTRACT

This study used daily diary data to model trait and state *Positive Affect* (PA) and *Negative Affect* (NA) using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Data were collected from 364 college students over five days. Intraclass correlation coefficients suggested approximately equal amounts of variability at the trait and state levels. Multilevel factor analysis revealed that the model specifying two correlated factors (PA, NA) and correlated uniqueness terms among redundant items provided the best fit. Trait and state PA and NA were generally associated with stress, anxiety, depression, and three types of self-esteem (performance, academic, social). The coefficients describing these relationships differed somewhat, suggesting that trait and state measurement may have different predictive utility.

1. Introduction

Affect, or emotional response, is a key indicator of psychological functioning. Two valenced dimensions, termed *Positive Affect* (PA) and *Negative Affect* (NA), have been described as the general factors of emotional experience (Watson, Clark, & Tellegen, 1988). Individuals with high PA are characterized by "high energy, full concentration, and pleasurable engagement," whereas those with low PA are characterized by "sadness and lethargy" (Watson et al., 1988). Individuals with low NA are characterized as "being in a state of calmness and serenity", whereas those with high NA are characterized by "subjective distress and unpleasurable engagement" which includes apprehension, anger, irritation, shame, fear, sadness, guilt, and a negative view of the self (Watson et al., 1988).

Researchers generally agree that conceptually similar affective states (e.g., fear, anxiety) represent the same dimension (e.g., NA); although, there is disagreement regarding how these dimensions are organized. Proponents of the bipolar approach contend that the constructs of PA and NA are polar sides of a single dimension which are either activated or inhibited at a given moment (Barrett & Russell, 1998; Carroll, Yik, Russell, & Barrett, 1999; Green, Goldman, & Salovey, 1993; Russell & Carroll, 1999; van Schuur & Kiers, 1994). This suggests that emotion occurs on a continuum from unpleasant to pleasant, and that the experience of one denotes the absence of the other. Bipolar theorists suggest that the (co)activation of affect enables the simultaneous experience of seemingly opposite emotions, as if they were independent constructs (Barrett & Russell, 1998; Larsen, McGraw, & Cacioppo, 2001), whereas others suggest that there are two affective dimensions. There is a wide body of research supporting this dual (PA, NA) structure of affect, however the extent of the association between the affective factors is disputed. The factors have been described as "largely independent" because PA and NA can be experienced simultaneously, but the negative intercorrelation is too to weak suggest non-independence (Tellegen, Watson, & Clark, 1999; Watson & Clark, 1994; Watson et al., 1988). Many studies employ the two factor approach because the two-factor structure has been well-supported, although the "largely independent structure" has been difficult to reproduce. Thus, some researchers have suggested that PA and NA are distinct constructs that moderately co-occur (Brenner, 1975; Crawford & Henry, 2004; Diener & Emmons, 1984; Dyck, Jolly, & Kramer, 1994; Engelen, De Peuter, Victoir, Van Diest, & Van Den Bergh, 2006; Kammann, Christie, Irwin, & Dixon, 1979; Terracciano, McCrae, & Costa, 2003). For a full discussion of the history and conceptualization of affective structure, see Watson, Wiese, Vaida, and Tellegen (1999).

One widely used tool to assess PA and NA is the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). The PANAS is a 20-item self-report measure designed to evaluate the extent to which an individual is high or low on PA and NA. Items for the PANAS were empirically derived from a list of 27 adjectives from nine theoretically meaningful mood content categories (attentive, excited, proud, strong, distressed, guilty, angry, jittery, and fearful) established by Zevon and Tellegen (1982). Psychometric evidence suggests that the scores from the PANAS are reliable and valid

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0092-6566/$ - see front matter
doi:10.1016/j.jrp.2010.11.003

(Watson et al., 1988, Watson & Clark, 1994). Watson and colleagues (1988) maintain that the PANAS is a pure measure of the purportedly independent constructs of PA and NA. However, it has been argued that although PA and NA are distinct and separate, they are modestly and negatively associated (Crawford & Henry, 2004; Crocker, 1997; Engelen et al., 2006; Tellegen et al., 1999; Terracciano et al., 2003).

The psychometric properties of the PANAS have been further evaluated in a number of studies, most notably to reconcile the disagreement regarding the (non)independence of PA and NA. Exploratory factor analysis, a data-driven factoring technique wherein factors explain common variance between items has yielded evidence for two factors (e.g., Watson et al., 1988). However, theory-driven confirmatory factor analysis (CFA) which establishes the measurement model a priori and enables estimation of correlated uniqueness terms, factor variances, factor covariances, and comparison of competing models, has supported an oblique model (e.g., Crawford & Henry, 2004; Lonigan, Hooe, David, & Kistner, 1999; Terracciano et al., 2003).

In one sample of adolescents, the best fit using CFA yielded a model wherein PA and NA were associated; however, the authors suggested that misspecification might be further reduced by allowing for correlated uniqueness of redundant items (Crocker, 1997). Because there is conceptual overlap among Zevon and Tellegen's (1982) mood checklist items (e.g., *distressed* and *upset*), several PANAS items are redundant, which may evoke nonrandom correlated uniquenesses, leading to a flawed measurement model. Crawford and Henry (2004) tested this possibility using CFA and found that allowing for 13 correlated item-level uniqueness terms (chosen via content categories from Zevon and Tellegen's (1982) mood checklist) yielded the best model fit. Conversely, another study yielded support for an orthogonal PA/NA model if the correlated uniqueness terms of redundant items were permitted to correlate (Tuccitto, Giacobbi, & Leite, 2010). Thus, the best fitting structure of the PANAS remains a relatively unanswered question, particularly when accounting for overlapping item-level unique variance.

Historically, assessments of affect have relied on general, rather than idiographic approaches, potentially overestimating the role of traits in evaluating psychological phenomena (Shiffman, Stone, & Hufford, 2008). Researchers assert that affect is both a trait (dispositional) and a state (situational) and can be measured accordingly (Watson & Clark, 1984; Watson et al., 1988). To accommodate measurement of trait or state affect, survey instructions are often modified to reflect trait (e.g., how do you usually feel) or state (e.g., how do you feel today) language (Watson et al., 1988). That is, respondents are typically asked to recall their affect in general, or at a specific time (Hufford, 2007). For example, Kashdan and Roberts (2004) administered the PANAS twice, first asking participants to report general feelings (trait), then asking them to report their feelings in that moment (state). This method neglects the moment-to-moment variability of psychological phenomena associated with the situational fluctuations of daily life. To help clarify the trait/state distinction by tapping a greater range of affective states over time, Watson and Clark's (1994) PANAS-X uses 8 time instructions: *right now*, *today*, *past few days*, *past week*, *past few weeks*, *past month*, *past year*, *general*. Although tailored language seems that it should be sensitive to capturing both dispositional and dynamic emotion, global, retrospective reports are still subject to recency and saliency heuristic biases (Hedges, Jandorf, & Stone, 1985; Stone, Shiffman, Atienza, & Nebeling, 2007), rendering single time-point assessments of state constructs in doubt. To overcome this limitation, Diener and Emmons (1984) suggest that the best way to capture the variation of trait and state affect is by making multiple assessments of momentary or daily (state) affect, and using the average or deviation of those scores to assess trait affect. Although trait and state values assessed in this manner are correlated to the extent that they share some variability and can be used to make predictions about the other, traits do not fully explain all momentary affective experiences, thus these fluctuations are of substantive interest (Eid & Diener, 1999; Vaidya, Gray, Haig, & Watson, 2002; Watson & Clark, 1994). For example, there have been several reports of reliably measured state affect, wherein a large proportion of variability in trait affect is accounted for by state variability (Eid & Diener, 1999; Yasuda, Lawrenz, Van Whitlock, Lubin, & Lei, 2004).

Trait and state PA and NA have been linked to other psychological constructs such as stress, anxiety, depression, and self-esteem, providing evidence for the discriminant validity of the dual structure of affect, and also offering support for distinction between traits and states. For example, high stress and high trait NA co-occur (e.g., Dua, 1993; Watson, 1988); however high trait PA has also been associated in instances of severe stress (for a discussion see Folkman & Moskowitz, 2000). Trait and state PA and NA have also been linked to concentrations of the stress hormone cortisol, although NA was more reliably predictive than PA (Polk, Cohen, Doyle, Skoner, & Kirschbaum, 2005). Notably, trait affect was associated with cortisol more strongly, but the state affect variables did contribute unique variance, suggesting that state PA and NA are distinct predictors of stress and should not be disregarded (Polk et al., 2005). Anxiety and depression are both characterized by high trait NA; however, depressed individuals also tend to report low trait PA, whereas individuals with anxiety do not (e.g., Clark & Watson, 1991; Clark, Watson, & Mineka, 1994; Joiner & Lonigan, 2000; Lonigan, Carey, & Finch, 1994; Watson & Walker, 1996). Clark, Vittengl, Kraft, and Jarrett (2003) found that although depression is associated with trait and concurrent state PA and NA among patients receiving cognitive therapy, changes in depression status were associated with changes in state, but not trait, PA and NA. Watson and Clark (1984) suggested that high trait PA and low trait NA are associated with higher self-esteem, and those with low self-esteem report the converse. Other researchers suggest that link between negative emotionality and self-esteem is stronger than that of positive emotionality (e.g., Brown & Marshall, 2001; Cheng & Furnham, 2003; Dua, 1993; Huang & Zhang, 2010; Juth, Smyth, & Santuzzi, 2008; Lorr & Wunderlich, 1988; Richardson, Ratner, & Zumbo, 2009). Taken together, these findings suggest that PA and NA are distinct structures. Thus, how one generally feels and how one feels on a given day may predict psychological phenomena differently.

One technique for assessing trait and state affect is Ecological Momentary Assessment/Daily Diary (EMA/DD) methodology. In EMA/DD, individuals are assessed multiple times over small time-frames, which enables modeling both trait and state affect. EMA/DD data allow researchers to capture trait and state variability through multilevel modeling. Multilevel modeling in the context of an EMA/DD design has several advantages. It allows researchers to capture moment-to-moment affect and model this within-person (co)variability (akin to a state) while simultaneously estimating reliable between-person variability (akin to a trait). Between-person variability is determined by aggregating within-person data over multiple assessments, yielding a reliable, powerful assessment of trait PA and NA with reduced error, relative to a single assessment. Additionally, EMA/DD methodology enables researchers to evaluate associations between trait and state affect and other constructs.

To establish whether greater variability exists at the trait or state levels, the intraclass correlation coefficient (ICC) can be used. Within the context of an EMA/DD study, the ICC reflects the amount of between-individual variability for a target variable, relative to total variability (the sum of between- and within-individual variability). A large ICC value indicates more trait variability, or