The association between positive and negative affect at the inter- and intra-individual level

Nazia P. Gill a, Elisabeth H. Bos b,⁎, Ernst C. Wit a, Peter de Jonge b

a University of Groningen, Johann Bernoulli Institute of Mathematics and Computer Science, Groningen, The Netherlands
b University of Groningen, University Medical Center Groningen, Interdisciplinary Center Psychopathology and Emotion regulation, The Netherlands

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Background: It is unclear to what extent positive affect (PA) and negative affect (NA) may co-occur across and within people. The present study aimed to find unbiased estimates of the between- and within-subjects association between PA and NA.

Methods: 85 participants recorded their PA and NA daily by means of an electronic diary (mean 38 observations, range 2 to 56). A linear mixed-effects model was applied. The covariances between the random effects at the person- and measurement level were used to simultaneously estimate the between- and within-subjects correlation between PA and NA.

Results: The within- and between-subjects correlation between PA and NA were large: \( r = -0.56 \) (95% CI \( -0.58 \) to \( -0.54 \)) and \( r = -0.52 \) (95% CI \( -0.69 \) to \( -0.40 \)), respectively. The difference between the correlations was not significant (Fisher Z = \( -0.56; P = 0.58 \)). In participants who completed ≥80% of the measurements (\( n = 46 \)), the within- and between-subjects correlation were \( r = -0.59 \) (95% CI \( -0.61 \) to \( -0.57 \)) and \( r = -0.50 \) (95% CI \( -0.67 \) to \( -0.28 \)), respectively (Z = \( -0.98; P = 0.33 \)).

Conclusion: Our study suggests that the correlation between PA and NA is large, both at the within- and between-subjects level. The discrepancy between the two correlations as estimated by mixed-effects models may be larger if more repeated assessments are available.

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1. Introduction

Most affective states in humans can be characterized as either positive or negative (Watson, 1988). Positive affect (PA) reflects an individual’s level of pleasant engagement with the environment. Persons high on PA may feel enthusiastic, energetic, and alert (Watson & Tellegen, 1985). Conversely, negative affect (NA) has been conceptualized as a dimension of subjective distress and unpleasant engagement. It consists of a variety of mood states including fear, anger, guilt, and distress (Watson & Tellegen, 1985). Negative affect is strongly correlated with stress and mental health complaints (Watson & Pennebaker, 1989) and plays a role in several DSM-defined psychiatric disorders, depression in particular (American Psychiatric Association, 2000). It is not clear to what extent positive and negative affect can co-occur. Studies on the association between positive and negative affect have yielded inconsistent results: several studies have reported strong correlations between the two affect states whereas others found weak or even no correlations (Larsen, McGraw, & Cacioppo, 2001; Scott, Sliwinski, Mogle, & Almeida, 2014).

A reason for the inconsistency in findings may lie in the fact that PA and NA differ not only between individuals but also within individuals over time (Watson & Clark, 1997; Brose, Voelkle, Lovden, Lindenberger, & Schmiedek, 2013). Affect is clearly not a constant but may fluctuate, and in fact these temporal affect dynamics have been considered important in understanding why some persons develop psychiatric disorders and others do not (Bradley, 2003). It is therefore important to disaggregate these two sources of variation, because results at the inter-individual level are not necessarily translatable to the intra-individual level. Between-subjects and within-subjects correlations may be of different magnitudes and even of different directions (Hamaker, 2012; Wilson & Butler, 2007; Brose et al., 2015). In other areas of research important differences have been reported when correlations are investigated at the individual versus the group-aggregate level, leading to quite different conclusions (Hoffman & Stawski, 2009; Kanning, Ebner-Priemer, & Schlicht, 2013; Tennen & Affleck, 1996).

Theoretically, it may be hypothesized that within a given individual, a change in positive affect will often be accompanied by a change in the opposite direction in negative affect, and vice versa. This does not mean, however, that all individuals scoring high on positive affect generally will have low scores on negative affect as well: some individuals can...
be characterized as having little feelings in general whereas others may have many positive as well as many negative feelings. From this perspective, a difference in correlation between PA and NA at the two different levels of investigation seems plausible, with stronger (negative) coupling within individuals than between individuals. Only with repeated assessments of PA and NA in a sample of multiple individuals, i.e. with both a sufficient sample size and a sufficient number of assessment points, are we able to disentangle these two effects. Unfortunately, the vast majority of studies on the association between PA and NA have only examined the between-subjects correlation (Crawford & Henry, 2004). Although a number of authors have pointed out that focusing only on inter-individual variance will lead to false conclusions (e.g., Danziger, 1994; Molenaar, 2004), this practice remains extremely dominant. To date, only a few studies investigated the PA and NA association at both the between- and within-subjects level (Diener & Emmons, 1984; Watson, 1988; Goldstein & Strube, 1994; Brose et al., 2015). In these studies, estimates for the correlation between PA and NA were reported of −0.54 to −0.15 within subjects and −0.23 to 0.26 between subjects, in daily diary studies of varying sample sizes and assessment points. Unfortunately, in most of these studies (with Brose et al., 2015 as an exception), the correlations were estimated in two separate analyses using product-moment correlations, and potential serial dependency was not accounted for. As a result the reported correlations may be biased. Also, the sample sizes and/or number of assessment points in most of these studies were rather small. Recent statistical advances have made it possible to disentangle within- and between-subjects variance in three-dimensional data in a single model (Hoffman & Stawski, 2009; Wardenaar & de Jonge, 2013; Curran & Bauer, 2011). Three-dimensional data are characterized by containing persons, variables, and data points in a single matrix. Mixed-effect models have become popular to analyze data in which the data points are nested in higher-order variables (Cheng, Edwards, Maldonado-Molina, Komro, & Muller, 2010). In a longitudinal setting, repeated measurements are nested in individuals (Bolger & Laurenceau, 2013). In the present study, we have analyzed the association between individuals’ PA and NA in a three-dimensional data set, using a linear mixed-effect model. Our aim was to disaggregate within- and between-subjects variance in PA and NA in order to derive unbiased estimates of the within- and between-subjects correlation between the two affect measures, and to evaluate whether these two estimates are different. Specifically, we hypothesized that correlations between PA and NA are stronger at the within-subjects level than at the between-subjects level.

2. Method

2.1. Participants and procedure

The data were collected during a Mindfulness-Based Stress Reduction (MBSR) program in the period January 2010 until June 2012, in Tilburg, The Netherlands (see Snippe, Nyklíček, Schroeters, & Bos, 2015). Participants were recruited by means of a website and advertisements in local newspapers. The MBSR program was advertised as a group training program aimed at reducing mental distress and increasing well-being through cultivation of mindfulness. Participants of the MBSR program were offered a 10% discount if they were willing to participate in the diary study. Exclusion criteria were severe psychiatric disorders (e.g., current severe depressive episode, acute burnout, psychotic tendencies) and insufficient reading and writing skills. An online screening tool was used to check exclusion criteria for the study. This tool consisted of 3 questions regarding 1) the presence of psychological problems in the past; 2) current psychological problems; 3) any treatment of these problems. If necessary, the online screening was supplemented by a telephone interview. This telephone interview was unstructured. The exclusion criteria were assessed by an experienced psychologist/researcher. None of the individuals interested in the MBSR program had to be excluded because of these criteria. A total of 187 individuals participated in the MBSR program, of whom 85 (45%) agreed to fill out the daily diary. These 85 participants were used in the present analysis. All participants provided written informed consent.

The MBSR program followed the manual of the group program developed by Jon Kabat-Zinn (Kabat-Zinn, 1990). It consisted of 8 sessions of 2.5 h, over a period of 8 to 9 weeks, a silent retreat of 6 h, and daily homework practice. Participants filled out an online daily questionnaire during the entire MBSR program, each day after 5 pm. They were permitted to miss only one entry per week. Before the start of the intervention participants filled out an online pre-treatment questionnaire.

Not all participants filled out the diary over the entire period of the MBSR program; the series of observations ranged from 3 to 62 days, with an average of 46.1 days (SD = 12.4). The participants completed on average 38.2 measurements (SD = 12.9, range 2–56). A total of 3240 observations for PA and NA was included in the present study; 17.1% of the observations was missing. These observations were missing either because the participants did not fill out the diary or filled it out before 5 pm or after 4 am the next day. A listwise deletion approach was used in the analysis to handle missing observations.

Because the diary series of some participants were either very short period or had a lot of missing values, we also estimated the correlations in a sample of the most compliant patients. For this compliant sample we selected those individuals whose series covered at least 45 days and had filled out at least 80% of the measurements (n = 46, total number of observations = 2160). These 46 participants did not differ significantly from the non-compliant participants in demographic characteristics, positive affect, negative affect, and mindfulness at baseline.

2.2. Measures

The pre-treatment questionnaire consisted of questions on demographic and disease-related information, as well as psychological well-being and mindfulness. The daily diary questionnaire consisted of 30 items on momentary affect, mindfulness, and stress. For the daily assessment of positive and negative affect the Dutch version of the Profile of Mood States short form (POMS-SF) was used (Wald & Mellenbergh, 1990). We selected 13 items from this questionnaire, to keep the diary short (Thiele, Laireiter, & Baumann, 2002). We selected items with high factor loadings on the corresponding subscale (Baker, Denniston, Zabara, Polland, & Dudley, 2002) and applicability in daily life. Negative affect was measured with eight items, two for each of the Negative Affect subscales of the POMS-SF: blue and miserable (Depression), nervous and tense (Tension), tired and fatigued (Fatigue), peevish and angry (Anger). Positive affect was measured with five items, three from the Vigor subscale of the POMS-SF (energetic, lively, cheerful), and two extra items (relaxed and happy). The items were rated on a scale ranging from 1 to 5, where 1 represents not at all and 5 extremely. NA and PA affect scores were calculated as the average score for the eight NA items and five PA items, respectively. The NA and PA scores can range from 1 to 5 and describe how the participants feel at the time of reporting. The selected NA and PA items correlated highly with the total NA scale (r = 0.95) and PA scale (r = 0.96) of the POMS-SF as assessed at baseline. We calculated the reliability of the NA and PA scale at both the within- and between-subjects level following the procedure as suggested by Crawford et al. (2006). The reliability of the scales at the within-subjects level was 0.82 for NA and 0.87 for PA. The reliability at the between-subjects level can be calculated in three different ways (Crawford et al., 2006). The between-subject reliability for an average (fixed) day was 0.84 for NA and 0.91 for PA in our study. The between-subjects reliability for a random day was 0.49 for NA and 0.56 for PA. The between-subjects reliability across all days was 0.995 for NA and 0.997 for PA.
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