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Differential association between affect and somatic symptoms at the between- and within-individual level

Hendrika M. Schenk¹*, Elisabeth H. Bos¹, Joris P. J. Slaets², Peter de Jonge¹ and Judith G. M. Rosmalen¹

¹Interdisciplinary Center Psychopathology and Emotion regulation (ICPE), University of Groningen, University Medical Center Groningen, The Netherlands
²Department of Internal Medicine, Clinical Geriatrics, University Medical Center Groningen, The Netherlands

Objectives. The established between-subjects associations between affect and somatic symptoms have often been interpreted as indicating a causal effect of affect on somatic symptoms, but it is doubtful whether this is valid. In this study, we evaluate the association between positive affect (PA), negative affect (NA), and somatic symptoms at both the between- and within-subject level.

Design and methods. Diary data were collected in the context of an online study called ‘HowNutsAreTheDutch’. Participants filled out an online questionnaire, three times a day for 30 consecutive days. A mixed linear model was used to test the contemporaneous and lagged associations between affect and somatic symptoms.

Results. Five hundred and eighty-six participants (481 females, median age 39.6 years [range 18.1–71.4]) were included with a total number of 28,264 completed questionnaires. At the between-subjects level, a positive association between NA and somatic symptoms was found ($B = .60, p < .001$), whereas the negative association between PA and somatic symptoms was much smaller ($B = -.14, p = .062$). At the within-subject level, PA ($B = -.33, p < .001$) was more strongly associated with somatic symptoms than NA ($B = .13, p < .001$). The lagged analyses showed a negative association between previous-day PA and somatic symptoms ($B = -.05, p = .001$).

Conclusions. The results suggest that NA is more important for differences in symptom levels between subjects, whereas PA is more important for variations in symptom levels within subjects. Moreover, our results suggest that an increase in PA is followed by a decrease in somatic symptoms after 24 hr, which suggests a causal effect.

Statement of contribution

What is already known on this subject?
• Affect and somatic processes are closely linked. Cross-sectional studies show, for example, that people with higher levels of negative affect tend to report more somatic symptoms. Findings between individuals, though, might camouflage processes at within-individual level, and it might not
always be possible to translate findings at the population level to the individual. However, diary studies are upcoming and show more about processes on individual level.

What does this study add?
- Highlights the difference between processes at the within-individual and the between-individual level.
- Shows the importance of positive affect at individual level in relation to somatic symptoms.
- Shows the benefits of the use of new techniques in diary studies.

A close relationship exists between mental and physical health (Brod, Rattazzi, Piras, & D’Acquisto, 2014; Prince et al., 2007). Mental disorders can function as precipitating and perpetuating factors in the development or presence of somatic symptoms (Haug, Mykletun, & Dahl, 2004; Simms, Prisciandaro, Krueger, & Goldberg, 2012; Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999). A positive association between negative affect (NA) and somatic symptoms has been found in healthy individuals. Individuals who report more stressful events, daily hassles, or more negative affect report more somatic symptoms (Clark & Watson, 1988; Watson & Pennebaker, 1989). Likewise, individuals who score high on personality traits associated with more NA, for example, neuroticism, report more somatic symptoms. This association is notably stronger for symptoms in the psychosomatic cluster (e.g., nausea, stomach ache, fatigue) than for symptoms associated with infectious disease (Rosmalen, Neeleman, Gans, & de Jonge, 2007). Also in patients with diseases with a clear organic origin, affect is associated with the level of somatic symptoms. Patients who report higher levels of NA report higher, and patients with higher positive affect (PA) report lower severity of somatic symptoms (Koller, Heitmann, Kussmann, & Lorenz, 1999; Kvaal & Patodia, 2000; Pressman & Cohen, 2005). Little is known about how PA and NA dynamically influence each other, and it is more or less assumed that a decrease in NA means that PA increases. However, studies show that this is not true for all individuals (Diener & Emmons, 1984; Wichers, Lothmann, Simons, Nicolson, & Peeters, 2012).

In somatoform disorders and functional somatic symptoms (FSS), the association between mental and physical health is particularly evident. Cross-sectional, epidemiological studies show that individuals who suffer from FSS report more stress, stressful life events, and daily hassles (Christiansen, Copeland, & Stapert, 2008; Greene, Walker, Hickson, & Thompson, 1985; Kroenke, 2003; Tak, Kingma, van Ockenburg, Ormel, & Rosmalen, 2015). PA has been shown to be negatively associated with FSS (De Gucht, Fischler, & Heiser, 2004). Current treatments of somatoform disorders and FSS are often focused on reducing precipitating and perpetuating factors of somatic symptoms (Edwards, Stern, Clarke, Ivbijaro, & Kasney, 2010; Kroenke, 2007). Such factors include NA, stress, depression, and associated dysfunctional cognitions and behaviours (Edwards, Dworkin, Sullivan, Turk, & Wasan, 2016; Gupta, 2013; Henningsen, Zipfel, & Herzog, 2007). Although successful to a certain extent, effect sizes of treatments are generally small (van Dessel et al., 2014; Kleinstäuber et al., 2014; Kroenke, 2007). This might be due to an overestimation of the role of NA and an underestimation of the role of PA in the aetiology and persistence of somatoform disorders or FSS.

Reviews by Pressman and Cohen (2005) and Steptoe, Dockray, and Wardle (2009) discuss the findings with regard to the effect of PA on health. A limitation of most of the reported studies is that the effects of NA are not taken into account and most studies examine long-term health effects, for example, mortality or coronary heart disease. This makes it hard to identify the exact independent contribution of changes in PA on
short-term health-parameters. Therefore, we would like to explore the association between day-to-day fluctuations in NA, PA and somatic symptoms.

There are existing prospective longitudinal studies on PA, NA and somatic symptoms. However, most of them have long time windows between assessments, hampering the study of causality of such dynamic processes (de Jonge & Bos, 2013; Tennen & Affleck, 1996). Studies, who do have relatively short time windows between assessments (e.g., a day), have smaller samples sizes, comprise a certain subgroup, for example, college students (Watson, 1988), or a shorter study period (Charles & Almeida, 2006; Gartland, O’Connor, Lawton, & Ferguson, 2014). The goal of this study was to evaluate the associations between PA, NA, and levels of somatic symptoms at both the between-subjects and within-subject level in longitudinal diary data. As data at the between-subjects level are not directly translatable to the within-subject level, the within-subject association may be different in size or even sign from the association between subjects (Hamaker, 2012). For example, an earlier longitudinal study showed a direct link between stress and the increase in FSS in several patients (van Gils et al., 2014); however, the associations were inconsistent between individuals and not present, or even reversed in some. In addition, longitudinal diary data with shorter intervals allow lagged analyses (Bolger, Davis, & Rafaeli, 2003). Accordingly, the dynamic effects of affect on somatic symptoms can be examined within individuals.

In this study, our objective was to evaluate the contemporaneous and lagged associations between PA, NA, and somatic symptoms using diary data. First, we hypothesize a negative association between PA and somatic symptoms and a positive association between NA and somatic symptoms, at both the between- and within-subject level. Second, we hypothesize that the between-subjects associations between PA, NA, and somatic symptoms differ from the associations at the within-subject level. Third, we hypothesize that affect has a lagged association with somatic symptoms from one moment to the next. We used data from a diary study in which PA, NA, and somatic symptoms have been assessed. (van der Krieke, Jeronimus et al., 2016).

Materials and methods

Participants
This study was performed on diary data collected in the context of the study ‘HowNutsAreTheDutch’. ‘HowNutsAreTheDutch’ is an online platform and an ongoing study on the mental state of the Dutch population (Blaauw et al., 2014; van der Krieke, Jeronimus et al., 2016). Participants were recruited through the ‘HowNutsAreTheDutch’ website, www.hoegekis.nl (Dutch). The release of the study on the website was announced in magazines and newspapers. Participants received online information about the diary study. Informed consent was obtained online before entering the study. Eligible participants were age 18 or older and consented to their data being used for research. The protocol was approved by the local medical ethical committee. In total, 629 individuals enrolled in the diary study.

Study design

Diary study
During the study, participants received a text message on their smart phone three times a day during awakening time, every 6 hrs, for 30 consecutive days. This text message
contained a link to an online questionnaire, which was available for 1 hr. The questionnaire contained 43 items about emotions, activities, sleep, et cetera. Omitting questions in the questionnaire was not possible, as the questionnaire could not be submitted if a question was skipped or unanswered. The questionnaire also contained twelve items about affect, based on the circumplex model of affect (Feldman Barrett & Russell, 1998; van der Krieke, Jeronimus et al., 2016). The following items were included to assess PA: ‘I feel relaxed, I feel energetic, I feel enthusiastic, I feel content, I feel calm, I feel cheerful’ (Cronbach’s $\alpha = .89$ for $t = 1$). The items used to assess NA were ‘I feel gloomy, I feel anxious, I feel nervous, I feel irritable, I feel dull’ (Cronbach’s $\alpha = .79$ for $t = 1$) (Russell, 1980; Yik, Russell, & Barrett, 1999). For this study, the item ‘I feel tired’ was excluded, as it can be somatic as well as psychological. Participants had to report how they felt at that particular moment. Responding to the items was carried out by moving a slider on a visual analogue scale ranging from ‘not at all’ (0) to ‘very much’ (100). The PA and NA scores were calculated by taking the mean of the six and five items, respectively.

**Validation outcome measure**

The item ‘I experience somatic symptoms (e.g., headache, diarrhoea, heavy legs, etc.)’ was used to determine the level of somatic symptoms. This item was validated using data from the cross-sectional part of HowNutsAreTheDutch. HowNutsAreTheDutch included questions on the occurrence of 28 somatic symptoms over the preceding 24 hrs (van der Krieke, Jeronimus et al., 2016), which was assessed in a subgroup of participants. The means of the single diary item and the sum score of this cross-sectional symptom questionnaire correlated significantly ($N = 63$, Spearman’s rho = .46; $p < .001$).

**Statistical analyses**

**Contemporaneous associations**

To test the between- and within-subject association between affect and somatic symptoms, a mixed linear model was constructed. The PA and NA scores were used as predictors in the model. The advantage of the hierarchical multilevel model is that the technique deals with missing values automatically. Therefore, it was not necessary to impute the data. All participants with at least one completed questionnaire are thus included in the analyses. Although participants who filled out only one questionnaire do no contribute to the within-individual associations, they do contribute to the between-individual associations.

To remove long-term time trends, the data were detrended, for each individual separately (Chatfield, 1996; Curran & Bauer, 2011). To disaggregate the between- and within-subject effects in the analyses, the predictor variables were person-mean centred (Curran & Bauer, 2011). Both the person-mean centred values and the person means were entered as predictors in the models, to assess the within- and the between-subjects association, respectively. Models with random intercepts and random slopes were used for the within-subjects effects, to provide insight into the heterogeneity of these effects. An autoregressive covariance structure at level 1 was found to be optimal according to the Bayesian Information Criterion (BIC).

**Logged associations**

The appropriate time lag to analyse the effect of PA and NA on somatic symptoms has not been described. In addition, the optimal lag length can differ between individuals (van Gils
et al., 2014). Analyses about the optimal lag length exceeds the scope of the study; therefore, we studied the effects of affect up to three previous time points (t-1, t-2, t-3), which reflects a period of 24 hrs, which seemed a suitable time frame. To test the lagged within-subject association between affect and somatic symptoms, the three lagged values of PA and NA were used as predictors in a second mixed linear model, to correct for the influence of each of them. To correct for auto-correlation, the lagged (t-1) variable of somatic symptoms was entered as a predictor too. A scaled identity structure at level 1 was found to be optimal according to the BIC.

A p-value of .05 was used to determine statistical significance. All statistical analyses were carried out using SPSS 22.0 (IBM Corp, Armonk, NY, USA). The assumption of homoscedasticity of the residuals was checked by plotting the standardized predictor values against the standardized residuals. Normality of the residuals was checked by a Q-Q plot, and both assumptions were met. In addition, to ensure the robustness of our results, we bootstrapped our models (k = 1000), which did not lead to an alteration of our conclusions, and the normal, non-bootstrapped results were presented. As the association of PA and physical symptoms can depend on the level of NA, or vice versa, the interaction PA × NA was explored at both the between-individual (B = .002, SE = .003, p = .612) and the within-individual level (B = .001, SE = .001, p = .077) in the contemporaneous model. However, none of the interaction terms was significant, and therefore, we excluded them from the final models.

Results
Sample characteristics
In total, 629 participants (517 females) enrolled in the diary study. 586 participants (481 females) filled out at least one questionnaire and were included in the analyses. In this subgroup, the median of the age of the participants was 39.6 years (range 18.1–71.4) and participants were highly educated (high 84%, middle 12%, and low 4%). The total number of completed questionnaires was 28,264; the median number of completed questionnaires per participant was 59 (range 1–90). The median response time was within 11.6 min (range 1–60) after receiving the text message. Median time to fill out the questionnaire was 3 min. Reporting the same score on a certain item did occur, but only in a small number of participants and on specific items. However, in those cases, participants usually reported not having any physical complaints and did show variability on other items. Overall, the median score for PA was 57.4 (range 0–100), the median score for NA was 20.2 (range 0–100), and the median score for somatic symptoms was 16.1 (range 0–100). More details about the diary study can be found elsewhere (van der Krieke, Blaauw et al., 2016).

Association between affect and somatic symptoms
Contemporaneous associations
At the between-subjects level, the mixed linear model showed a significant positive association between NA and somatic symptoms (B = .60, p < .001). The negative association between PA and somatic symptoms approached significance (B = −.14, p = .062) (Table 1).

At the within-subject level, the analysis showed a significant positive association between NA and somatic symptoms (B = .13, p < .001) (Table 1). In addition, a
significant negative association was found between PA and somatic symptoms within individuals ($B = 0.33$, $p < .001$).

The random-effects variances, presented in the lower panel of Table 2, showed substantial between-subjects variability in the contemporaneous associations between affect and somatic symptoms. The variation around the NA slope was 0.08, corresponding with an SD of $\sqrt{0.08} = .28$. On the basis of this SD and an estimate of 0.13, it can be estimated that 95% of the population has coefficients between $-.42$ and $.68$ for negative affect. The variation around the PA slope, with an estimate of $0.33$, was 0.07, corresponding with an SD of .26, and slopes ranging between $-.85$ and $.19$ for positive affect in approximately 95% of the population.

**Lagged associations**

The lagged associations at the within-subject level with lags up to one day during awakening time ($t-1$, $t-2$, $t-3$) showed the following results. At the within-subjects level, the analysis showed a significant effect of PA at $t-3$ ($B = -.05$, $p = .001$). For NA at $t-1$, $t-2$, and $t-3$ and PA at $t-1$ and $t-2$, no significant effects were found (Table 2). The random effects in the model on the lagged associations also showed large variability between subjects in the effect of affect on somatic symptoms, with slopes ranging between $-0.20$ and 0.20 for lag 1 of NA, between $-0.31$ and 0.25 for lag 3 of NA, and between $-0.22$ and 0.18 for lag 1 of PA in approximately 95% of the population. The random slopes of lag 2 of NA, and 2 and 3 of PA were non-significant, indicating there was no significant variability in the effect.

As the median level of the somatic symptoms was low, we performed additional sensitivity analyses, with subgroups using (1) only the values of somatic symptoms above the 50th percentile, increasing this threshold each time with 10%. In addition, we repeated the analysis in (2) individuals who reported on average higher levels of somatic symptoms, starting from the median, increasing this threshold each time with 10%. Overall, the results remained approximately the same in size and sign. In both subgroups 1 and 2, the association between PA and somatic symptoms at the individual level remained inversely significant in each severity class. The association between NA and somatic

### Table 1. Mixed linear model of somatic symptoms as a function of positive affect and negative affect

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>CI$_{95}$ Lower</th>
<th>CI$_{95}$ Upper</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between-subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>19.30</td>
<td>8.66</td>
<td>29.94</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>NA</td>
<td>0.60</td>
<td>0.47</td>
<td>0.72</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>PA</td>
<td>$-0.14$</td>
<td>$-0.29$</td>
<td>0.01</td>
<td>.62</td>
</tr>
<tr>
<td><strong>Within-subject</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>0.13</td>
<td>0.09</td>
<td>0.16</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>PA</td>
<td>$-0.33$</td>
<td>$-0.36$</td>
<td>$-0.29$</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td><strong>Random-effects variances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>242.77</td>
<td>213.93</td>
<td>275.51</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>NA</td>
<td>0.08</td>
<td>0.06</td>
<td>0.10</td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>PA</td>
<td>0.07</td>
<td>0.05</td>
<td>0.09</td>
<td>$&lt;.001$</td>
</tr>
</tbody>
</table>

**Note.** $N = 586$; duration of the study = 30 days, 3 measurements per day. Total number of completed questionnaires = 28,264. PA = positive affect; NA = negative affect. Dependent variable: somatic symptoms (scale 0–100), CI$_{95}$ = 95% confidence interval; Significant $p$ values are in bold.
symptoms at the individual level did not remain significant in subgroup 1. Neither did the association between PA, NA, and somatic symptoms at the group level in both subgroups, due to a decrease in power (data not shown).

Discussion

In this study, a striking difference was found in the between- and within-subject associations between affect and somatic symptoms. The results showed that NA was more strongly associated with somatic symptoms at the between-subject level, in contrast to the within-subjects level, where PA was more strongly associated. Moreover, we showed that within subjects, an increase in PA is followed by a small but significant decrease in somatic symptoms the following day, whereas no significant lagged association was found for NA.

This study suggests that NA is more important for differences in symptom levels between subjects, whereas PA is more important for variations in symptom levels within subjects. Our findings imply that between-individual results might camouflage individual processes. Therefore, the consequences of translating between-individual results to an individual should be considered, as results derived at between-person level do not always apply to the individual (Hamaker, 2012). Another interesting finding, which emphasizes the importance of acknowledging the difference between within-individual and between-individual level results, is the considerable heterogeneity observed in the effects. This shows the diversity across individuals in the degree to which affect is related to somatic symptoms. The fixed effect of the mixed linear model showed the average

<table>
<thead>
<tr>
<th>Table 2. Mixed linear model of somatic symptoms as a function of lagged values of positive affect and negative affect</th>
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<tbody>
<tr>
<td>Fixed effects</td>
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<td>----------------</td>
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<tr>
<td>Within-subject</td>
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<tr>
<td>Intercept</td>
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<tr>
<td>Somatic symptoms (t-1)</td>
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<tr>
<td>NA (t-1)</td>
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<tr>
<td>PA (t-1)</td>
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<td>NA (t-2)</td>
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<td>PA (t-2)</td>
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<td>Random-effects variances</td>
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<td>Somatic Symptoms (t-1)</td>
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<td>NA (t-1)</td>
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<td>PA (t-1)</td>
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<td>PA (t-2)</td>
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<tr>
<td>NA (t-3)</td>
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<tr>
<td>PA (t-3)</td>
</tr>
</tbody>
</table>

Note. N = 525; Total number of completed questionnaires = 28,146; PA = positive affect; NA = negative affect. Dependent variable: somatic symptoms (scale 0–100). CI<sub>95</sub> = 95% confidence interval; t-1, t-2, t-3 = three preceding measuring points; Significant p values are in bold.
within-subject effect, but the significant random effects imply that the within-individual associations differed in size and even sign between individuals.

The small, but significant association between PA and somatic symptoms the next day implies that higher levels of PA are followed by lower levels of somatic symptoms the next day. Moreover, the between-person variability in this effect was non-significant, which indicates that this association was in general present in the participants. It is remarkable that our results show an effect of PA only after 24 hrs. It is possible that physiological effects need some time to become apparent. In addition, a lagged association has already been found between daily hassles and somatic symptoms, up to 4 days (Dancey, Taghavi, & Fox, 1998).

Our results suggest that current treatments aimed at reducing somatic symptoms might benefit from a shift to a stronger focus on increasing PA. Höhn et al. (2013) showed already that individuals with depressive symptoms who had greater PA persistence showed better prevention and recovery. Positive psychology interventions are expanding already, and more and more attention is given to the idea that positive psychology interventions can be a useful supplement to traditional treatments (Linley, Joseph, Maltby, Harrington & Wood, 2009), and in our opinion also in the treatment of FSS. Furthermore, the heterogeneity between individuals suggests that interventions may profit from an approach which is based on a within-subject model. We restricted our analyses to the role of affect on somatic symptoms, but it is without doubt that the effect of somatic symptoms on PA and NA is interesting as well. A vicious circle may exist between NA and somatic symptoms, and PA may be a target to break this.

The strengths of this study include the large sample size, the large number of assessments within individuals, the duration of 30 days, and the age diversity of the participants. A handful of studies have examined the association between stress or affect and somatic symptoms in a longitudinal setting. However, these studies have a smaller, less diverse population (DeLongis, Folkman, & Lazarus, 1988; Larsen & Kasimatis, 1991), and/or a less intense study protocol (Charles & Almeida, 2006; Watson, 1988). The duration of this study and the relatively small interval between the measurements allowed us to examine dynamic processes within individuals while taking into account individual variance. Moreover, the relatively small time windows between the assessments limit recall bias, often present when using self-reports (Houtveen & Oei, 2007).

This study has also limitations. The biased sample with an overrepresentation of higher educated women, and thus the perhaps limited generalizability of the study, should be taken into account. However, the findings at the individual level are not influenced by this selection bias, as participants serve as their own controls. It should be taken into account that the data are based on self-report measures, which may have introduced differential measurement error (an error with different magnitude or direction across groups or subjects) at the between- and within-individual level. The momentary assessments do not eliminate the error and bias associated with retrospection, but do reduce this problem considerably. In addition, there was only one item about somatic symptoms in the diary study. However, we showed that there is a significant correlation between the daily average of this item and the scores on a more elaborate questionnaire, assessed at a single day, which expands the validity of this single item. The generally low level of symptoms reported by participants could be regarded as a limitation of this study. However, sensitivity analysis revealed that in subgroups with higher levels of somatic symptoms, the associations between affect and somatic symptoms remain roughly the same. Another limitation is that the protocol did not include an assessment in the night. This was because we did not want to interfere with participants’ sleep, which would reduce ecological validity. Because of this gap in the night, the intervals between assessments were not entirely evenly spaced.
However, it can be argued that affect is not present during sleep and cannot be measured. Therefore, we evenly spaced the measurements during awakening time.

This study provided insights into the associations between affect and somatic symptoms, demonstrating the strong concurrent and prospective association of PA and somatic symptoms at the within-subject level. Future studies should reveal whether in psychopathological conditions PA and NA contribute to the presence of somatic symptoms.

Conflict of interest
All authors declare no conflict of interest.

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References


Brod, S., Rattazzi, L., Piras, G., & D’Acquisto, F. (2014). “As above, so below” examining the interplay between emotion and the immune system. Immunology, 143, 311–318. doi:10.1111/imm.12341


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