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Affect and Low Back Pain: More to Consider than the Influence of Negative Affect Alone

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Abstract

Objectives—Affect balance style, a measure of trait positive and negative affect, is predictive of pain and functioning in fibromyalgia and healthy individuals. The purpose of this study was to evaluate the distribution of affect balance styles and the relationship between these styles and clinical factors in low back pain.

Methods—In this cross-sectional study, patients with low back pain (N=443) completed questionnaires and were categorized as having one of four distinct affect balance styles: Healthy (high levels of positive affect [PA] and low levels of negative affect [NA]), Low (low PA/low NA), Reactive (high PA/high NA) and Depressive (low PA/high NA). Comparisons between groups were made in regard to pain, functioning and psychiatric comorbidity.

Results—High NA was observed in 63% (n=281), while low positive affect was present in 81% (n=359). We found that having a Depressive style was associated with greater pain severity, increased odds for comorbid fibromyalgia, and worse functioning compared to having a Healthy or Low style. Yet, those with a Low style were at increased risk for depression compared to a Healthy style, while patients with a Reactive style had similar levels of pain, functioning and depression as those with a Healthy affective style

Conclusion—Our study revealed that there are important differences between trait affect balance styles in regard to pain, mood, and functioning in low back pain. Findings related to Reactive and Low affective styles suggest that relationships between affect, pain and disability in low back pain extend beyond considering negative affect alone.

Keywords

chronic pain; low back pain; fibromyalgia; temperament; affect; depression; anxiety

INTRODUCTION

The bidirectional relationship between pain and affect has been well established.^{1–4} Although dynamic in nature and influenced by experience, affect is neurobiologically-based with predisposing trait related patterns.^{5–7} Pain research has predominately focused on state affect experiences. However, trait affect is dispositional in nature and associated with temperament.^{8,9} Temperament is developmental but is recognized as a predominant and predisposing feature of adult personality patterns.^{6,10,11} Thus, positive and negative trait affect patterns reflect a person's predisposing affect response profile which is associated with personality traits.^{7,8} There is a plethora of evidence linking trait affect and psychiatric conditions;^{6,7,12} however, little is known regarding the relationship between trait affect and pain-related experiences in individuals with chronic low back pain.

Negative affect is associated with emotions such as anger, sadness, irritability, and fear, and has been found to be a risk factor for greater pain severity in chronic low back pain,¹³ increased disability,¹⁴ and worse outcomes after treatment including epidural steroid injections¹⁵ and lumbar surgery.¹⁶ Negative mood states such as depression and anxiety are commonly observed in chronic low back pain and, in turn, such emotional distress is linked to poor outcomes including higher healthcare utilization.^{17–20} In contrast, emotions associated with positive affect are also well-recognized (e.g., enthusiasm, optimism, vitality, engagement, alertness) and associated with benefits that have been repeatedly reported across numerous disciplines.^{21,22,23,24}

Affect balance style, a measure of the relative levels of positive and negative trait affect within an individual, has been predictive of clinical pain, functional impairment and psychiatric comorbidity in adults with fibromyalgia^{25,26} and associated with experimental pain sensitivity and pain-related psychological measures in healthy controls.²⁷ Growing evidence suggests that affect balance style may be a more informative way to understand the relationships between affect, pain, and physical and psychological functioning than considering positive and negative affect independently.^{25–27} Affect balance styles are defined by four distinct patterns.²⁵ Individuals with high positive affect and low negative affect are classified as having a “Healthy” affect balance style. Individuals with low positive affect and high negative affect are classified as having a “Depressive” style. A “Low” style is characterized by both low positive and low negative affect patterns while individuals with a “Reactive” affect balance style have a tendency toward heightened affective responses (high positive affect and high negative affect).

Though relatively stable overtime, affective traits (e.g., affect balance style) are modifiable by experience, learning, and exposure.^{21,28} Thus, the dynamic nature of affect is compelling as a target for pain treatment. Yet, studying positive and negative affect in isolation fails to capture the functional, trait-related aspects of relative positive and negative affect levels. Moreover, little is known about affect balance styles in individuals with chronic pain other than fibromyalgia. The trait-related qualities of positive and negative affect in individuals with low back pain and associations with physical and psychological functioning have not been explored. *Determining the applicability of a measure of affect balance style in individuals with chronic pain requires that we replicate findings across differing pain*

conditions. Second, since fibromyalgia is a widespread pain condition affecting more females than males and low back pain is a more focal condition with more equal sex distribution investigating affect balance styles in individuals with chronic low back pain is an important next step of investigation.

The purpose of this study was to evaluate the distribution of affect balance styles and the relationship between these styles and clinical factors in patients with a primary diagnosis of low back pain. We hypothesized that having a Depressive, Reactive or Low affect balance style would be associated with greater pain severity, worse functional status, and/or higher levels of psychiatric comorbidity compared to those with a Healthy affect balance style. We also hypothesized that there would be differences between Depressive and Reactive styles; although both are characterized by high levels of negative affect, high levels of positive affect in the Reactive style are thought to buffer negative affect.²⁹ Further, we anticipated that based on our previous research, individuals with low back pain who have the Depressive or Reactive affective styles would be more likely to also meet criteria for fibromyalgia as a secondary diagnosis.³⁰

MATERIALS AND METHODS

All new patients undergoing evaluation at the University of Michigan Back & Pain Center (Department of Anesthesiology) complete an initial assessment packet as part of standard clinical care and our ongoing pain research. This initiative has been described elsewhere^{31,32} and has been used for previous cross-sectional studies.^{30,32–35} For the purposes of the current study, patients 18 years of age and older who were evaluated between November 2010 through February 2014 with a primary complaint of low back pain were included in our analysis (N= 624). Table 1 depicts the diagnostic categories of our study participants. Institutional Review Board (University of Michigan, Ann Arbor, MI) approval was obtained. Since these data were used in the context of clinical care, informed consent was not required. Instead, patients are given a document that explains the use of their data for both their care and research and provided the opportunity to opt out of research. To date, no patients have chosen to opt out.

Contained in the initial assessment packet that all new patients complete are validated questionnaires including the Positive and Negative Affect Schedule (PANAS). The PANAS can capture both trait and state responses. For this study, the trait version was implemented. The instructions request responses based on “the extent you **GENERALLY** feel this way.” The PANAS consists of two mood scales with 10-items each rated on a 5-point scale for assessing positive (e.g., enthusiastic, inspired, strong) and negative affect (e.g., guilty, scared, ashamed).³⁶ Each scale has a range of 10–50 with higher scores indicating greater positive or negative affect. Both scales are internally consistent, uncorrelated, and stable over a 2-month time period; good convergent and discriminant validity have also been demonstrated.^{36,37} Four affect balance style groups were created using established cut-off scores based on healthy norms and used in previous studies of affect balance.^{25,36} Thus, patients with positive affect > 35.0 and negative affect < 18.1 were assigned to the “Healthy” affect balance style group. Individuals with positive affect ≤ 35.0 and negative affect ≥ 18.1 were classified as having a “Depressive” style. Those with positive affect ≤ 35.0 and

negative affect <18.1 were assigned to the “Low” style group, while patients with positive affect > 35.0 and negative affect ≥ 18.1 were assigned to the “Reactive” affect balance style group.

Other measures contained in the packet and included in this study are described below. Pain severity was assessed using the mean of the four pain intensity items from the Brief Pain Inventory (BPI).³⁸ Patients report their average, worst, least and current pain on a scale where 0 represents “no pain” and 10 represents “pain as bad as you can imagine.”³⁹ Anxiety and depressive symptoms were assessed with the well-validated Hospital Anxiety and Depression Scale (HADS).⁴⁰ The HADS consists of two scales: seven items for symptoms of anxiety and another seven items to evaluate depressive symptoms. For each scale, scores range from 0–21 with higher scores indicating higher levels of depressive or anxiety symptoms. Scores greater than or equal to 11 are suggestive of a “definite case” of anxiety or depression and can be used for dichotomous analyses.⁴⁰ Functional status was assessed using the PROMIS Physical Function Short Form 1 (PROMIS SF1) which is a ten item self-report questionnaire developed as part of the PROMIS initiative.^{41,42}

To assess the possibility that a subset of low back pain patients may also have widespread pain and other symptoms associated with fibromyalgia in addition to the low back pain for which they are presenting, the 2011 survey criteria for fibromyalgia were assessed.⁴³ The survey criteria consist of two measures. The first, the Widespread Pain Index (WPI) was calculated using the Michigan Body Map, which is a pen and paper body image checklist depicting 35 body areas where pain might exist. The 19 areas comprising the survey criteria for fibromyalgia are included (scores range 0 – 19).⁴³ To assess the second aspect of the criteria, the Symptom Severity (SS) scale was used to evaluate symptom presence and severity (scores range: 0 – 12). A dichotomous diagnosis of fibromyalgia was made based on the established cut points: WPI ≥ 7 and SS ≥ 5 or WPI = 3 – 6 and SS ≥ 9.^{43,44} This measure has been shown to differentiate patients phenotypically,^{30,45} as well as predict increased opioid consumption perioperatively, aberrant response to medial branch blocks, and poorer long-term surgical outcomes.^{46–48} The survey criteria have good reliability and validity with a concordance rate with the 1990 ACR criteria⁴⁹ of 72.7%.⁵⁰

Analysis

Data that are routinely collected for clinical care and research were entered into the Assessment of Pain Outcomes Longitudinal Electronic Data Capture (APOLO EDC) system.^{33,45,51} All missing data were treated in a manner consistent with that described by instrument authors. In this model, the Healthy affect balance group served as the reference group to which the three affect balance styles (Low, Reactive and Depressive) were compared. Additionally, a series of analysis of variance (ANOVA) tests was conducted to assess the relationships of affect balance style with pain, functioning, and psychiatric comorbidity. All post-hoc pairwise comparisons were conducted using the Tukey HSD method. Age and college education were included as covariates in each model as they differed significantly by affect balance style groups (Table 2). Further, to evaluate the possibility that affect balance styles provide unique information above and beyond depression and anxiety, additional models were conducted in which depression and anxiety

were included as separate covariates in ANOVA models predicting pain and functioning from affect balance style. Next, three logistic regression models predicting fibromyalgia status (meeting criteria or not meeting criteria) from affect balance style were conducted to assess whether the likelihood of meeting survey criteria for fibromyalgia differed by affective style. To correct for the three logistic regression models, a Bonferroni adjusted alpha level of 0.016 was used. Patients with missing PANAS scores were excluded from analysis ($n = 181$), leaving a final analysis sample of 443. Those with missing data did not differ from those with data in regard to pain severity ($p = 0.903$) or physical function ($p = 0.176$). Further, we found no differences between those with and without data on HADS depression score ($p = 0.788$), HADS anxiety score ($p = 0.360$), or fibromyalgia criteria survey score ($p = 0.289$). There were no differences in education ($p = 0.740$), but those with missing data on the PANAS were older ($p < 0.001$), less likely to be Caucasian ($p < 0.001$), and less likely to be married ($p = 0.028$). Patients with missing data were marginally significantly more likely to be male ($p = 0.052$).

RESULTS

As a group, mean negative affect scores were high (mean: 23.3 ± 9.2) in comparison to those from healthy individuals (mean: 18.1 ± 5.9)³⁶ and similar to levels reported by patients with fibromyalgia (23.2 ± 7.4).⁵² Likewise, positive affect was very low (26.6 ± 9.1) compared to healthy individuals (35.0 ± 6.4)⁵³ and close to responses endorsed by patients with fibromyalgia (29.1 ± 8.4).²⁵ High negative affect was observed in 63% ($n=281$) of our sample of low back pain patients, while low positive affect was present in 81% ($n=359$). The breakdown of demographics for the whole group and by affect balance style is presented in Table 2. There were overall differences in age ($p < 0.001$) and college education (0.012) by affect balance style such that individuals in the Depressive style group tended to be younger and better educated. A Depressive affect balance style was the most common (56.4%), followed by Low (24.6%), Healthy (12%) and Reactive (7%). Table 3 depicts outcomes for our sample by affect balance style.

In an ANOVA model predicting pain severity from affect balance style, a main effect of affect balance style was found ($F(3,432) = 8.27$, $p < 0.001$, partial $\eta^2 = .05$). Post hoc comparisons revealed that having a Depressive affect balance style was associated with significantly more pain compared to having a Healthy style ($t(363) = 3.13$, adjusted $p = 0.010$) or a Low affective style ($t(363) = 4.14$, adjusted $p < 0.001$). No other significant differences were found (Figure 1). In an ANOVA model predicting pain severity from affect balance style controlling for HADS depression scores, age, and education, the main effect of affect balance is still statistically significant ($F(3,422) = 2.90$, $p = 0.035$). Although there are no longer differences between the Depressed group and other groups, the Reactive affect group had significantly higher pain scores than the Low affect group ($t(422) = 2.86$, adjusted $p = 0.023$). When controlling for HADS Anxiety scores, the main effect of affect balance is not statistically significant ($F(3,421) = 1.41$, $p = 0.241$).

We also anticipated that more affectively distressed low back pain patients would be more likely to have a fibromyalgia-like presentation. In a logistic regression model with 3 dummy coded affect balance styles with Healthy as the reference group and controlling for age and

education, we found that compared to having a Healthy affect balance style, those with a Depressive style had significantly higher odds of meeting criteria for fibromyalgia (OR = 8.03, $p < 0.001$). Those with a Reactive style trended toward increased odds of meeting criteria for fibromyalgia compared to those with Healthy affect balance style (OR = 3.00, $p = 0.056$). A Low affect balance style was not significantly different from having a Healthy affect balance specific to predicting whether or not criteria for fibromyalgia were met (OR = 0.90, $p = 0.833$). In a logistic regression model with 3 dummy coded affect balance styles with Low as the reference group and controlling for age and education, we found that compared to have a Low affect balance style, those with a Depressive affect style had higher odds of meeting criteria for fibromyalgia (OR = 8.9, $p < 0.001$). Further, those with a Reactive style had significantly higher odds of fibromyalgia criteria than those with a Low style (OR = 3.35, $p = 0.018$). In a logistic regression model with 3 dummy coded affect balance styles with Reactive style as the reference group, we found that compared to the Reactive style group, those with a Depressive style had marginally significantly higher odds of meeting fibromyalgia criteria (OR = 2.67, $p = 0.024$).

In an ANOVA model predicting functional status from affect balance style, a main effect for affect balance style was found ($F(3, 410) = 17.97$, $p < 0.001$, partial $\eta^2 = .12$). Those with a Depressive style had scores consistent with a significantly lower level of functioning than those with a Healthy style ($t(410) = -5.77$, adjusted $p < 0.001$) and a Low style ($t(410) = 5.84$, adjusted $p < 0.001$). Similarly, patients with a Reactive affect balance style reported only marginally lower functioning in contrast with low back pain patients with a Healthy affect balance style ($t(410) = -2.42$, adjusted $p = 0.076$). Significant differences between the Low and Healthy affect balance styles were not found (Figure 1). In an ANOVA model predicting functional status from affect balance style controlling for HADS depression scores, age, and education, the main effect of affect balance is still significant ($F(3, 403) = 3.22$, $p = 0.023$). Those with Low affect balance style had significantly higher functioning scores than those with a Reactive style ($t(403) = 3.01$, $p = 0.015$). In a model predicting physical function from affect balance style controlling for HADS anxiety scores, age, and education there was a significant main effect of affect balance style ($F(3, 400) = 6.07$, $p = 0.001$). The Depressed group had significantly lower functioning scores than the Healthy group ($t(403) = -3.88$, $p = 0.001$) and the Low group ($t(403) = 3.24$, $p = 0.007$).

Scores from the HADS were used to assess the relationships between psychiatric comorbidity and affect balance style. In an ANOVA model predicting depressive symptoms from affect balance style, a main effect of affect balance style was found ($F(3, 423) = 73.29$, $p < 0.001$, partial $\eta^2 = .34$). Planned comparisons revealed that those with Depressive style had a significantly higher mean on the HADS depression subscale than those with a Healthy style ($t(423) = 12.07$, adjusted $p < 0.001$) and those with a Reactive style ($t(423) = 7.31$, adjusted $p < 0.001$) and higher than those with a Low style ($t(423) = -10.21$, $p < 0.001$). Further, those with Low affect balance style had a significantly higher mean than those with a Healthy affect style ($t(423) = 4.00$, adjusted $p = 0.001$). Individuals with a Reactive affect balance style were not significantly different from those with a Healthy style in terms of the presence of depressive symptoms (Figure 1).

To investigate further, odds ratios were calculated to assess the magnitude of the effect for a dichotomous case categorization of depression. We found that compared to having a Healthy affect balance style, those with a Low style had marginally significantly higher odds of meeting likely case criteria for depression ($OR = 10.53$, $p < 0.024$). This is not akin to the more robust and anticipated effect we found for having a Depressive affect balance style ($OR = 81.79$; $p < 0.001$), but certainly noteworthy. Further, we found that those with a Depressive style had significantly higher odds of meeting criteria for depression than those with a Low style ($OR = 7.77$, $p < 0.001$) and those with a Reactive style ($OR = 12.81$, $p < 0.001$). In an ANOVA model predicting anxiety symptoms from affect balance style, a main effect of affect balance was found ($F(3, 422) = 68.91$, $p < .001$, partial $\eta^2 = .33$). Planned comparisons revealed that those with a Depressive style had a significantly higher mean on the HADS anxiety subscale than those with a Healthy affective style ($t(422) = 10.25$, adjusted $p < 0.001$), higher than those with a Reactive style ($t(422) = 3.43$, adjusted $p = 0.004$), and higher than those with a Low style ($t(423) = -12.31$, adjusted $p < 0.001$). Low back pain patients with a Reactive affect balance style had a significantly higher mean than those with a Healthy affect style ($t(422) = 3.99$, adjusted $p < 0.001$) and higher mean than those with a Low affect balance style ($t(422) = -3.83$, adjusted $p = 0.001$). There was not a significant difference between the Low and Healthy affect balance style on anxiety. In an analysis of dichotomous categorization of the likely presence of an anxiety disorder, we found that compared to having a Healthy affect balance style, those with a Depressive or Reactive style had significantly higher odds of meeting criteria for a dichotomous categorization of anxiety ($OR = 22.59$; $p < 0.001$ and $OR = 10.22$, $p = 0.005$, respectively). Having a Low affect balance style was not significantly different from having a Healthy style; however, compared to a Low style, those with a Depressive style had higher odds of meeting criteria for anxiety ($OR = 17.52$, $p < 0.001$). Those with a Reactive style also had higher odds of meeting criteria for anxiety than those with a Low style ($OR = 7.93$, $p = 0.001$).

DISCUSSION

The purpose of this study was to evaluate affect balance styles in patients with a primary diagnosis of low back pain. Prior publications related to affect balance style in individuals with chronic pain have been limited to those diagnosed with fibromyalgia. Our findings extend the predictive applicability of a measure of affect balance style to individuals with chronic low back pain as results replicated those described in individuals with fibromyalgia and provide additional insights.^{25,26} As anticipated, the Depressive style was strongly associated with greater pain severity and worse functional status compared to those with a Healthy affective style who had a much more favorable symptom and functioning profile. We also observed that those with a Depressive affective style had greater pain severity and worse functioning than those with a Low affect balance style. Additionally, those with a Depressive style were much more likely to meet survey criteria for fibromyalgia (eight times the odds compared to having a Healthy style). Conversely, the Reactive group, with high levels of trait NA similar to the Depressive affect balance style group appear to be benefited by higher levels of trait PA, who reported similar levels of pain and functioning as those with a Healthy affect balance style. Moreover, those with a Reactive affect balance style had

lower odds of meeting fibromyalgia criteria compared to those with a Depressive affective style. Also noteworthy was that consistent with previous findings, the Low style is associated with lower levels of clinical pain symptoms and functional limitations - significant differences between the Low and Healthy styles were not found except in the case of depressive symptoms.

In regard to psychiatric comorbidity, current findings align with those previously described for patients with fibromyalgia.^{25,26} Specifically, Hassett and colleagues reported that having a Depressive affect balance style was highly related to mood and anxiety disorders, while a Reactive affect balance style was associated with generalized anxiety disorder compared to a Healthy affect balance style. Patients with a Low affect balance style had better outcomes than Reactive or Depressive styles; however, here, too, it was reported that these patients had more symptoms and worse functioning compared to those with a Healthy affective style. Interestingly, back pain patients with a Low affect balance style had over ten times the odds of having depression compared to those with a Healthy affective style. Patients with a Low style have low levels of negative affect and low levels of positive affect. Consistent with the temperament and affect regulation literature^{7,8,28,54,55} during chronic periods of stress, i.e., increased negative affect activation, without the counterbalancing effects of adequate positive affect these individuals become at risk for apathy and disengagement, which are anhedonic qualities of depression. Additionally, those with a Reactive style were less likely to have high levels of depressive symptoms than both those with a Low or Depressive affective style. Similarly, compared to having a Depressive style, those with a Reactive style were less likely to have high levels of anxiety, yet again suggesting the higher level of positive affect may provide a buffer to the high level of negative affect.

The relationships between pain, functioning, and psychiatric comorbidity are complex. In a set of secondary analyses the possibility that affect balance styles provided the same information as depression and anxiety was explored. We found that while adding depression and anxiety into the models dampened the effect in some cases, for the most part our data suggested that affect balance styles provided unique information. Nonetheless, the consistency in the pattern of findings across four studies in three different groups of individuals: patients with chronic back pain, patients with fibromyalgia, and individuals without chronic pain or other chronic health conditions, warrants thoughtful consideration. Taken together, these studies suggest that trait affect balance style has the potential to help us move beyond a focus on emotion related affect state and cognitive process (e.g., catastrophizing) and identify dispositional characteristics that are associated with greater or lesser pain severity, physical and psychosocial functioning, and psychiatric comorbidity. Summarizing across studies, not surprisingly, trait patterns of high negative affect and low positive affect, as seen in the Depressive style group, are associated with reports the greatest level of discomfort, dysfunction and distress. Also, not surprisingly, trait patterns of high positive and low negative affect, the Healthy style group, consistently reports the least discomfort, dysfunction and distress. The importance of the considering both positive and negative trait affect are further indicated in the Low and Reactive groups. Specifically, both groups demonstrated lower levels of clinical pain and distress, as well as better functioning compared to the Depressive group. Further, high levels of positive affect observed in the Reactive group appear to be protective in terms of having a pain and functioning similar to

those with a Healthy style. Findings indicate that varying pathophysiological and psychosocial outcomes are associated with dispositional affect traits are well recognized and established in the developmental and psychiatric literature.^{6,7,11}

Psychological interventions have traditionally focused on ameliorating negative affect; however, the merits of targeting positive affect have been repeatedly communicated across various disciplines.^{24,56,57} Our data also support the notion that promoting positive affect activation in addition to decreasing negative affect in those with chronic pain might be an efficacious target. Frederickson's Broaden and Build theory proposes that experiencing positive emotions *broadens* one's moment-by-moment thought and action repertoires and this broadening of perspective, in turn, results in *building* enduring personal resources in the physical, intellectual, social and psychological spheres.²⁹ In contrast, negative emotions have direct and adaptive benefits when survival is threatened, but they tend to narrow one's perspective and alienate others. Positive emotions are associated with a broadened mindset and draw others in thus promoting social support and enhanced quality of life. In fact, numerous studies demonstrate the benefits of activating positive affect behaviorally, biologically, and neurobiologically.^{21,22,58–60} Additionally, there is developing evidence that training and enhancing state related positive affect can have lasting benefits resulting in a shift of trait affect patterns.⁵ Moreover, interventions that enhance positive affect have been found to be more appealing than many standard therapies including drug therapy and cognitive-behavioral therapy,^{61,62} are effective treatment options in many populations,⁵⁷ and do not necessarily require a mental health professional for provision. Based on affect balance style, a clinician could potentially focus on increasing positive affect, while also reducing negative affect (treating depression or anxiety) for individuals with a Depressive affective style. Similarly, for patients with a Low style, boosting positive affect would be an important element of treatment. Positive affect enhancing activities could include keeping a gratitude diary, recording daily positive occurrences or trying mindfulness meditation.^{61,63,64} Further, new studies that suggest more comprehensive positive activity programs could be beneficial for patients with pain.^{65–67}

There are a number of limitations to this study to consider. First, the direction of the relationship between affect balance style and symptom severity and functional limitations cannot be inferred. Future studies with a prospective design could shed light on the temporal relationships. Second, results from our study may not be generalizable to all other patients with low back pain. Patients seen in our academic tertiary care center likely have greater pain severity, higher levels of disability and/or are more prone to psychiatric comorbidity than those evaluated in other settings. Third, these data are limited by our use of self-report measures to assess trait affect balance style as well as symptoms and functioning. Using momentary time sampling could provide a more accurate assessment of all of these factors, as well as provide information about temporal relationships. Fourth, the cutoff scores used to calculate affect balance are based on healthy samples thus may tend to pathologize. Future studies could consider validating condition specific cutoff scores. Fifth, there is potential for contamination between predictor (affective balance) and outcomes (i.e., HADS scores) since there is likely significant overlap. In addition, there were only 31 patients with a Reactive style in our sample thus the power to detect an effect may have been insufficient although the trend was observable. The lower representation may indicate that as a consequence of

chronic pain, fewer experiences of positive affect occurred resulting in a transition to a more depressive style - prospective analyses are needed to confirm this hypothesis. Finally, only those with data on the PANAS, and thus those for whom an affect balance style could be assigned, were included in the study. Although there were no differences between those with and without PANAS data on our outcomes, our results could nonetheless be biased due to this missing data.

In conclusion, our study revealed that the evaluation of relative levels of trait positive and negative affect is predictive of clinical pain, functional limitations, and psychiatric comorbidity in individuals with low back pain. Importantly, the group representation patterns and associated physical and psychological relationships indicated from the current study replicate previous findings in clinical and healthy populations and provide evidence for the utility of evaluating trait affect balance style. Importantly, findings convey that when high NA occurs in combination with high PA (Reactive style), lower physical and psychological suffering is reported compared to those with high NA and low PA (Depressive style). Additionally, although individuals low NA may report less clinical pain (Low and Healthy style) when low NA occurs in conjunction with low PA (Low style), there is an increased risk for depressive disorders. Hence, by identifying a patient's affect balance style, clinicians can potentially identify a) symptoms and conditions for which their patient will be at risk and b) the affective state(s) to target: positive, negative, and/or both.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Marginal means of pain severity, function, depression symptoms, and anxiety symptoms by affect balance style

Note. * Horizontal bars denote that differences between groups exist following post-hoc pairwise comparisons using Tukey's HSD method. Marginal means presented are adjusted for college education and age, included as covariates due to statistically significant differences among affect balance style groups on these two demographic variables.

Table 1

Diagnostic categories for the study population.

Diagnosis (ICD9 Code)	No. (%)
Lumbosacral spondylosis without myelopathy (721.3)	36 (5.77)
Degeneration of lumbar or lumbosacral intervertebral disc (722.52)	26 (4.17)
Spinal stenosis, lumbar region, without neurogenic claudication (724.02)	64 (10.26)
Lumbar spinal stenosis (724.2)	498 (79.81)

Table 2

Demographic differences for all participants and by affect balance style.

	All	Healthy	Reactive	Depressive	Low	p-value
Age	49.7(15.6)	50.5 (14.8)	54.7 (17.7)	47.1 (14.1)	53.6 (17.5)	< 0.001
Male	186 (42.0%)	14 (26.4%)	12 (38.7%)	113 (45.2%)	47 (43.1%)	0.088
Caucasian	392 (91.2%)	47 (88.7%)	26 (83.9%)	225 (90.0%)	94 (86.2%)	0.172
College graduate	146 (33.3%)	12 (22.6%)	5 (16.1%)	100 (40%)	29 (26.6%)	0.012
Lives with Spouse	242 (55.5%)	26 (49.1%)	21 (67.7%)	130 (52.0%)	65 (59.6%)	0.376

Note. Analysis of variance was used to test for differences in age among groups. Chi-square difference tests were used to test for differences in all other demographic variables among affect balance style groups.

Table 3

Unadjusted means and standard deviations of outcomes by affect balance style.

	Depressive (n = 250)	Reactive (n = 31)	Low (n = 109)	Healthy (n = 53)	Partial η^2
Pain Severity	6.91 (1.54)	6.54 (1.63)	5.94 (1.93)	5.96 (1.99)	0.05
Depression	11.6 (3.98)	5.72 (3.46)	6.82 (3.86)	4.20 (3.04)	0.10
Anxiety	10.81 (4.19)	7.94 (3.68)	5.20 (2.71)	4.88 (2.63)	0.33
PROMIS-Function	27.31 (6.59)	29.38 (7.00)	31.66 (7.45)	33.61 (7.76)	0.34
Fibromyalgia ^a	126 (50.4%)	9 (29.0%)	14 (12.8%)	7 (13.2%)	--

^aCounts and percentages are presented for meeting survey criteria for fibromyalgia.

These means and standard deviations are unadjusted for age and college education, the two covariates included in the models due to statistically significant differences found among affect balance style groups. Partial η^2 is provided for the effect of affect balance on each continuous outcome