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An emotional component analysis of chronic pain *

James B. Wade [a], Donald D. Price [b], Robert M. Hamer [a,c], Steven M. Schwartz [a] and Robert P. Hart [a]

Departments of [a] Psychiatry, [b] Anesthesia and [c] Biostatistics, Medical College of Virginia, Richmond, VA 23298 (U.S.A.)

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Summary The present study sought to determine the relative contribution of frustration, fear, anger and anxiety, to the unpleasantness and depression pain patients experience. Sixty-nine women and 74 men, with an average age of 47 years, were included. Patients underwent psychological evaluation which included use of the Minnesota Multiphasic Personality Inventory (MMPI), Beck Depression Inventory (BDI), and 7 visual analog scales (VAS) measuring degree of emotional unpleasantness, pain intensity, anxiety, frustration, fear, anger and depression. Test–retest reliability coefficients were significant for the negative feeling VAS yielding an average reliability coefficient of 0.82. Analyses relating the negative feeling state VAS to pain unpleasantness and depression indices from the MMPI (scale 2) and BDI (sum score) yielded significant canonical correlations. Multiple regression was used to clarify the relationships between negative feeling VAS, pain-related unpleasantness, and indices of depression. After statistically controlling for intensity of pain, anxiety and frustration predicted unpleasantness. Regression analyses indicate that anger is an important concomitant of the depression that pain patients experience. The results suggest that anger and frustration are critical concomitants of the pain experience. Treatment techniques specifically targeting anger and frustration in these patients may prove efficacious.

Key words: Emotional disturbance; Chronic pain

Introduction

Pain assessment methodology has recently given explicit recognition to the fact that the experience of pain is multidimensional, consisting of sensory, cognitive-evaluative, and affective-motivational dimensions [4,9,12]. Studies focusing on the affective component to pain suggest that it is predictive of pain intensity, pain behavior [8], levels of medication use at follow-up [3], work status at follow-up, post-treatment efficacy ratings for exercise and work [3], as well as response to relaxation and biofeedback treatment [2,7]. These studies suggest that an accurate assessment of emotional unpleasantness is useful for evaluating both treatment progress and potential long-term coping in chronic pain sufferers.

Several recent studies have demonstrated that visual analog scales (VAS) are capable of separately measuring pain sensation intensity and affective dimensions of both experimentally induced and clinical pain [11–13,15]. First, the sensory VAS and affective VAS ratings of experimental heat pain have been shown to be reliably different. Pain sensation intensity and emotional unpleasantness power function exponents were 2.1–2.2 for sensation and 2.7–3.5 for unpleasantness dimensions [13]. Second, psychological fac-

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Correspondence to: Dr. James Wade, Medical College of Virginia, MCV-C/L Psychiatry, P.O. Box 268, Richmond, VA 23298, U.S.A.

tors known to reduce affect have been shown to reduce affective VAS responses but not sensory VAS responses to experimental pain [13]. Finally, psychological factors inherent in different clinical pains (e.g., cancer pain and labor pain) were shown to powerfully and selectively influence VAS affective responses [10,12]. Thus, separate VAS measures of pain affect and pain sensation may be helpful in identifying specific psychological influences in individual patients.

Although it is clear that chronic pain is associated with significant emotional unpleasantness, such as depression, previous studies using the VAS paradigm have restricted their focus to a single area of emotional unpleasantness, such as severity of depression [8]. Just as multiple somatic therapies for chronic pain attempt to specifically identify and correct underlying pathology, a clarification of the multidimensional nature of emotional disturbance associated with pain is needed in order to optimally manage this dimension of pain experience.

The separate measurement of pain sensation intensity and pain affect, though very critical, is itself too simplistic because chronic pain can be accompanied by a variety of disturbing emotions. The experience of pain is not necessarily associated with one particular emotion, such as depression, but also may be accompanied by anxiety, frustration, anger or fear depending on a variety of circumstances. Therefore, in a recent extension of assessment of pain affect, 5 separate VAS were constructed for the emotions listed above [5]. Similar to the single VAS affect scale rating, ratings on these negative emotion VAS were augmented by the psychological factor of neuroticism. High neurotic score myofascial dysfunction (MPD) patients scored much higher on these negative emotion VAS than low neurotic score MPD subjects. However, examination of negative emotion VAS profiles of individual patients revealed considerable variability in the ratings of specific types of emotions. Thus, the possible differential assessment of specific pain-related emotions in chronic pain patients remains an intriguing possibility.

In the present study, we sought to evaluate the reliability and validity of negative feeling VAS as an instrument for differentially assessing specific pain-related emotions. In particular, we examined the extent to which these 5 emotion scales predict emotional unpleasantness and depression in a large sample of pain patients. An evaluation of the unique contribution of anger, frustration, anxiety, fear, and depression to pain-related unpleasantness and clinical indices of depression in these patients was made after statistically controlling for pain sensation intensity.

Method

Patients

Patients enrolled in this study were referred by anesthesiologists for psychological evaluation and were assessed between September of 1984 until June of 1987. Sixty-nine women and 74 men were included, with a mean age of 47.7 years. Eighty-nine (62.2%) were Caucasian, 52 (36.4%) were black, and 2 were Hispanic. The subjects completed an average of 10.8 years of education. Eighty-eight (61.5%) were married, 17 (11.9%) were single, 17 (11.9%) were divorced, 7 were separated (4.9%), and 14 (9.8%) were widowed. Pain was experienced for less than 6 months by only 9% of the sample. Sixty-three percent of the group suffered from pain for longer than 6 months but less than 5 years. Twenty-seven percent of the sample experienced pain for more than 5 years. About one-half of the patients suffered low back pain as their chief complaint (50.4%). Myofascial dysfunction (28.7%) and causalgia (8.4%) were the second and third most frequent diagnoses, with most subjects reporting multiple pain complaints.

Variables

Prior to beginning medical therapy, patients underwent a psychological pain battery conducted by a clinical psychologist. Subjects completed the Beck Depression Inventory (BDI) [1]; Minnesota Multiphasic Personality Inventory (MMPI) [6] and Pain Experience Visual Analog Scales (VAS) [5,13]. The Pain VAS consist of 15 cm lines with end points designated as 'the most severe imaginable' and as 'none.' The subject was asked to place a mark along each scale reflecting the intensity of feeling they experienced as a concomitant of their

pain. The 5 scales were labeled depression, anxiety, frustration, fear, and anger. A sixth scale labeled pain unpleasantness had anchor points labeled 'not bad at all' and as 'the most intense bad feeling imaginable.' A subject was required to indicate along the scale how disturbing their pain was when it was at its (1) maximum unpleasantness, (2) minimum unpleasantness, and (3) usual unpleasantness during the past week. In order to evaluate each individual's pain sensation intensity, a seventh VAS, labeled intensity of pain, was used. The scales anchor points were labeled, 'the most intense imaginable' and 'none at all.' Subjects placed a mark reflecting their pain sensation at its (1) usual, (2) maximum, and (3) minimum intensity during the past week.

Statistical methods

The primary purpose of this study was to identify which specific feelings contribute to the unpleasantness and depression pain patients suffer. To accomplish this goal we examined the relationships between the 5 negative feeling states associated with their pain (the emotion VAS) and the pain unpleasantness scale. In addition, analyses were conducted evaluating the relationship between the same negative feeling scales and measures of depression from the BDI and the depression scale (scale number 2) of the MMPI. Thus, the study involves 2 sets of dependent variables (pain unpleasantness scales and depression indices) and one set of independent variables (negative feeling VAS). To minimize chance findings (type 1 errors), we first chose to use canonical correlation analysis to examine simultaneously the relationships between the unpleasantness and the negative feeling scales, as well as between the depression indices from the BDI and MMPI with the negative feelings VAS.

Canonical correlation is a technique that assumes approximate multivariate normality. Using a Shapiro–Wilk W statistic as well as graphical techniques, we examined all negative feeling and unpleasantness variables for normal distribution. We failed to reject the null hypothesis of normality at the 0.01 level for anxiety, depression, fear, anger, and frustration, as well as for measures of unpleasantness and the depression indices of the MMPI and BDI. In each of the following analyses, evaluating the relationship between independent and dependent variables, we statistically controlled for an individual's pain sensation intensity by partialling the 3 pain sensation intensity VAS values from the set of independent variables. In the first canonical analysis we had 8 variables (3 unpleasantness values representing maximum, usual, and minimum pain levels and 5 negative feeling scores) and 143 subjects, and in the second analysis we had 7 variables (the BDI sum score, the depression scale from the MMPI, and the 5 negative feeling VAS scores) and 143 subjects.

After the canonical correlation analyses indicated it was possible to predict unpleasantness and depression from the negative feeling state VAS, multiple regression was used to clarify further the relationships between negative feelings VAS, unpleasantness VAS, and depression indices from the BDI and MMPI. These multiple regression analyses also included pain sensation intensity so that all resulting estimates and hypothesis tests were adjusted for pain sensation intensity. Finally, test–retest reliability analyses were performed with the negative feeling VAS and the unpleasantness VAS in order to provide indication of the scales' reliability.

Results

Test–retest reliability

In order to evaluate the reliability of the negative feeling state VAS, 35 patients were assessed twice on these scales at an interval of 8–11 days prior to their first therapy session. Correlations between these scores at intake and at pre-treatment provide a rough estimate of these scores stability without treatment intervention. Significant correlations were noted for the fear ($r = 0.67$, $P < 0.001$), depression ($r = 0.86$, $P < 0.001$), anxiety ($r = 0.93$, $P < 0.001$), anger ($r = 0.94$, $P < 0.001$), and frustration ($r = 0.74$, $P < 0.001$) VAS. The group mean VAS values for pain-related unpleasantness and negative emotion scales are presented in Fig. 1. Pain patients reported higher levels of frustration than any other negative emotion.

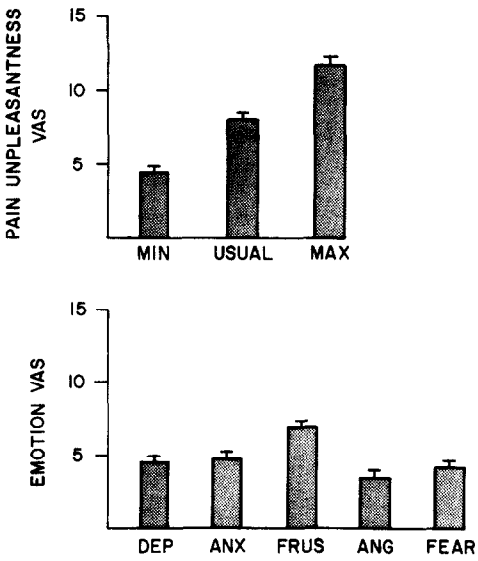

Fig. 1. Top: mean visual analog scale (VAS) ratings of pain unpleasantness by 143 pain patients. Vertical bars are standard errors of the mean. Ratings were of minimum (MIN), visual, and maximum (MAX) intensities of the previous week. Bottom: mean visual analog scale (VAS) ratings of pain-related emotions by these same patients. Vertical bars are standard errors. DEP = depression; ANX = anxiety; FRUS = frustration; ANG = anger.

Canonical correlation results

The first canonical correlation analysis related the 5 negative feeling VAS to the 3 pain unpleasantness VAS (at maximum, usual, and minimum levels) after partialling out (or statistically adjusting for) the 3 pain sensation intensity variables (at maximum, usual, and minimum levels). Since the smallest group of variables (the pain unpleasantness VAS) had 3 variables, the analysis extracted 3 orthogonal canonical variates. The usual step-down significant tests indicated that only the first canonical variate directed a significant amount of the relation between the two sets of data (F (15, 384) = 2.78, $P < 0.0004$). Table I contains the canonical structure matrix, which are the correlations between the first canonical variate (the only significant canonical variate) and the variables involved in the analysis. Redundancy statistics indicate that via the first canonical variate the negative feeling VAS explained approximately 11% of the standardized variance in the pain unpleasantness variables.

TABLE I

CORRELATIONS BETWEEN PAIN UNPLEASANTNESS, THE NEGATIVE FEELING ANALOG SCALES, AND THEIR CANONICAL VARIABLES

	Unpleasantness VAS
Maximum unpleasantness	0.87
Lowest unpleasantness	0.69
Usual unpleasantness	0.77
	Negative feeling VAS
Depression	0.35
Anxiety	0.83
Frustration	0.70
Anger	0.11
Fear	0.48

The next canonical correlation analysis related the 5 negative feeling VAS to the 2 depression indices (the Beck Depression Inventory, and the depression subscale of the MMPI), after partialling out the pain sensation intensity variables, as before. In this analysis, step-down tests indicated that only the first of the 2 possible canonical variates directed a significant amount of the relation between the 2 sets of data (F (10, 272) = 10.18, $P < 0.0001$). Table II contains the canonical structure matrix, which are the correlations between the first canonical variate (the only significant canonical variate) and the variables involved in the analysis. Redundancy statistics indicate that via the first canonical variate (the only significant one), the negative feeling VAS explained ap-

TABLE II

CORRELATIONS BETWEEN NEGATIVE FEELING ANALOG SCALES, THE DEPRESSION INDICES, AND THEIR CANONICAL VARIABLES

	Negative feeling VAS
Depression	0.85
Anxiety	0.58
Frustration	0.74
Anger	0.78
Fear	0.57
	Depression indices
Beck	0.99
MMPI	0.69

proximately 33% of the standardized variance in the depression variables. Therefore, these data indicate that a significant proportion of the pain-related unpleasantness and depression that chronic pain patients experience can be explained by the negative feeling VAS measures of anxiety, anger, fear, frustration and depression. In other words, the depression and unpleasantness associated with pain can be predicted from these negative feeling VAS. One way to think of a canonical correlation analysis is that it is a means of protecting against rejecting the null hypothesis unduly because of the multiple comparisons problem inherent in regression analyses involving a set of dependent variables and a set of predictor variables.

Multiple regression analyses

Having established a relationship between the depression indices, VAS index of unpleasantness and the negative feeling VAS, we used multiple regression to further clarify the specific contribution of each negative feeling VAS to unpleasantness and depression. To partial pain sensation intensity out of the regression analysis, we used pain sensation intensity as a covariate in all analyses, which produced the results seen in Fig. 2. For the prediction of pain unpleasantness at its maximum intensity from the negative feeling state VAS (Table III), anxiety was the single most important predictor (partial r^2 change = 0.05, F (1, 141) = 11.72, $P < 0.0008$), followed by frustration (partial r^2 change = 0.02, F (1, 141) = 6.13, $P < 0.02$). For the prediction of unpleasantness at its usual intensity (Table IV), the term frustration was the only significant variable (partial r^2 change = 0.01, F (1, 141) = 5.37, $P < 0.03$). With regard to unpleasantness at its minimum intensity (Table V), anxiety (partial r^2 change = 0.02, F (1, 141) = 5.08, $P < 0.03$), anger (partial r^2 change = 0.01, F (1, 141) = 4.42, $P < 0.04$) and frustration (partial r^2 change = 0.01, F (1, 141) = 4.92, $P < 0.03$) contributed significant variance in the prediction.

For the prediction of the Beck Depression sum score from the negative feeling state VAS (Table VI), the regression model accounts for 46% of the variation (Fig. 3). The depression (partial r^2 change = 0.32, F (1, 141) = 14.38, $P < 0.0002$) and anger VAS (partial r^2 change = 0.05, F (1, 141) =

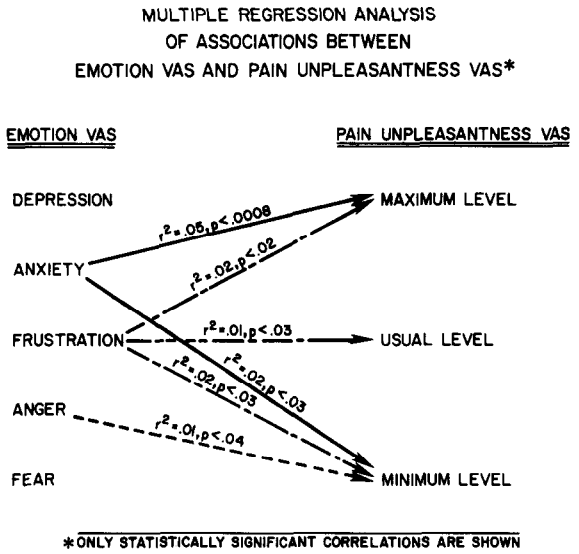

Fig. 2. Multiple regression analysis of r^2 values for associations between emotion VAS and pain unpleasantness VAS. Arrows indicate statistically significant correlations. Arrows for anxiety, frustration, and anger are solid, broken, and dashed lines respectively.

12.61, $P < 0.0005$) significantly predicted the BDI sum score. For the prediction of the MMPI's depression scale from the negative feeling state VAS (Table VII), the regression model accounted for 26% of the variation. Depression (partial r^2 change = 0.15, F (1, 137) = 28.67, $P < 0.005$), anxiety (partial r^2 change = 0.03, F (1, 137) = 5.17, $P < 0.02$), and anger (partial r^2 change = 0.03, F (1, 137) = 5.81, $P < 0.01$) were the only emotion VAS which significantly predicted the

TABLE III

MULTIPLE REGRESSION ANALYSIS PREDICTING PAIN UNPLEASANTNESS AT ITS MAXIMUM INTENSITY FROM THE NEGATIVE FEELING VAS

Source	*df*	Sum of squares	Mean square	*F* value	Probability
Model	8	518	64.7	14.811	$P < 0.0001$
Error	141	616	4.3		
Corrected total	149	1134			

r^2	Adjusted r^2
0.45	0.42

TABLE IV

MULTIPLE REGRESSION ANALYSIS PREDICTING PAIN UNPLEASANTNESS AT ITS LOWEST INTENSITY FROM THE NEGATIVE FEELING VAS

Source	*df*	Sum of squares	Mean square	*F* value	Probability
Model	8	1442	180.2	32.5	$P < 0.0001$
Error	141	780	5.5		
Corrected total	149	2222			

r^2	Adjusted r^2
0.64	0.62

TABLE V

MULTIPLE REGRESSION ANALYSIS PREDICTING PAIN UNPLEASANTNESS AT ITS USUAL INTENSITY FROM THE NEGATIVE FEELING VAS

Source	*df*	Sum of squares	Mean square	*F* value	Probability
Model	8	1012	126.5	19.66	$P < 0.0001$
Error	141	907	6.4		
Corrected total	149	1919			

r^2	Adjusted r^2
0.52	0.50

MMPI's depression scale. Although the frustration VAS accounted for a significant amount of variance in the prediction of pain-related unpleasantness (at all intensity levels), it did not significantly contribute to depression indices from the BDI or MMPI. In addition to VAS depression, anger accounted for a significant amount of variance in the prediction of clinical depression. Interestingly, the depression VAS was not a significant predictor of pain-related emotional unpleasantness at any intensity level (Fig. 2).

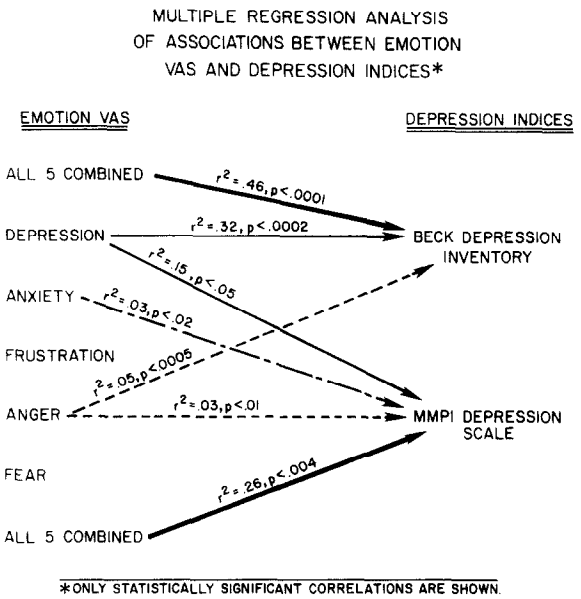

Fig. 3. Multiple regression analysis of r^2 values for associations between emotion VAS and depression indices. Arrows indicate statistically significant correlations. Thick lines indicate composite correlations between all 5 emotion VAS and depression indices. Arrows for depression, anxiety, and anger are solid, broken, and dashed lines respectively.

TABLE VI

REGRESSION ANALYSIS PREDICTING BECK DEPRESSION INVENTORY FROM THE NEGATIVE FEELING VAS

Source	*df*	Sum of squares	Mean square	*F* value	Probability
Model	8	4696	587.0	15.0	$P < 0.0001$
Error	137	5327	38.8		
Corrected total	145	10023			

r^2	Adjusted r^2
0.46	0.43

TABLE VII

REGRESSION ANALYSIS PREDICTING MMPI DEPRESSION SCALE FROM THE NEGATIVE FEELING VAS

Source	*df*	Sum of squares	Mean square	*F* value	Probability
Model	8	7782	972	6.3	$P < 0.0001$
Error	137	21053	153		
Corrected total	145				

r^2	Adjusted r^2
0.26	0.22

Discussion

Overall, this analysis demonstrated the 5 negative feeling VAS to be reliable and valid instruments for assessing specific pain-related emotions. In addition, the test–retest reliability for the negative feeling VAS clearly represents an acceptable measure of reliability. Given that these scales accounted for only a modest amount of overall variance in predicting indices of clinical depression and emotional unpleasantness, they should not be used in lieu of more established measures of depression, such as the BDI. Nevertheless, the speed and simplicity in administering these scales and their demonstrated association with measures, such as the BDI, suggest that they may be helpful additions to a psychological pain battery, particularly when time constraints preclude extensive psychological testing.

Multiple regression showed that anger and anxiety, along with depressed mood itself, are important concomitants of clinical depression associated with clinical pain (Fig. 3). Similarly, anxiety and frustration were the most important predictors of emotional unpleasantness (Fig. 2). These findings remained after controlling for pain sensation intensity. Although this study demonstrates an association between various negative feelings and emotional unpleasantness and depression resulting from clinical pain, it does not specify a causal relationship between these variables. Several possible explanations should be considered. It may be the case that prolonged or intense anger and anxiety exacerbate the overall emotional unpleasantness associated with pain, making pain less tolerable. Over time this exacerbation of emotional unpleasantness may result in an intensification of depression. Alternatively, as the severity of depression intensifies, greater life disruption occurs due to the impact of these depressive symptoms on an individual's lifestyle (e.g., sleep disturbance, increasing fatigue, and social withdrawal). A concomitant of this disrupted lifestyle may be an intensification of anxiety and anger.

The composite of the 5 emotion VAS can be construed as a general measure of pain-related emotional unpleasantness, whereas each individual VAS separately assesses the contribution of specific emotional feelings to pain-related emotional unpleasantness. That the specific emotion VAS are not redundant measures of the same dimension is indicated by a statistical examination of the partial correlations, as well as by several other lines of evidence. First, the VAS measure of depression, as would be expected, is the one most highly correlated with Beck and MMPI depression indices (Fig. 3). Second, although the frustration VAS is not significantly correlated with either the Beck Depression Inventory or MMPI depression scale, frustration VAS ratings appear to make a powerful overall contribution to pain-related emotional unpleasantness (Fig. 2). Thus, the frustration VAS is significantly correlated with the pain unpleasantness VAS at minimum, usual, and maximum intensities, whereas the other 4 VAS are correlated only with one (anger VAS) or two (anxiety VAS) pain levels or none at all (depression and fear VAS). Finally, the frustration VAS is rated higher than any of the other emotion VAS (Fig. 1), not only in the present patient sample, but in several types of chronic pain patients previously studied [5,10–12]. By contrast, and as might be expected, women with labor pain gave high VAS ratings only to anxiety and fear [10]. All of these observations combined indicate that each emotion VAS makes a unique contribution to the overall magnitude of pain-related emotional unpleasantness. In general, patients appear to be responding to these VAS in a manner consistent with the meanings directly implied by the verbal descriptors (i.e., depression, anxiety, frustration, anger, fear).

The finding that anger, frustration, and anxiety, in addition to depression, are significant contributors to the overall emotional unpleasantness produced by chronic pain has practical implications. Psychological approaches to pain treatment frequently focus on reducing symptoms of depression, body tension and anxiety, through approaches such as antidepressant medication, biofeedback and the use of relaxation techniques. Our findings suggest that anger and frustration are important components of the emotional unpleasantness associated with chronic pain. Changes in these symptoms during treatment may have

important implications for the potential long-term coping of pain sufferers. The use of treatment approaches specifically targeting these symptoms may prove efficacious. We hope to explore this hypothesis in a second study repeating these measures in patients prospectively, as their symptoms change with treatment.

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